UNIVERSITY OF SOUTHERN QUEENSLAND

Disaggregating the influences on IPO underpricing in the Australian fixed-price setting

A dissertation submitted by
Michelle Goyen, BFinAdmin (Hons) UNE, MCom USQ

For the award of

Doctor of Philosophy

2009

ABSTRACT

This research examines the relationship of initial public offer (IPO) underpricing and intrinsic value in the Australian fixed-price setting. The first stage of the research contains a review of major underpricing theories (asymmetric information, institutional explanations and theories of ownership and control) and relates these theories to the Australian institutional setting. A baseline model of underpricing is developed from analysis of Australian empirical IPO literature. The second stage of the research is the disaggregation of underpricing into mispricing (*MP*) and misvaluation (*MV*) components. *MP* captures the extent of the issuer's influence on underpricing and is measured as the difference between the intrinsic value of an IPO share and its offer price. *MV* captures the extent of investors' influence on underpricing and is measured as the difference between the intrinsic value of an IPO share and its market price at listing.

Mispricing is modelled with issuer-related variables that have hypothesised associations with offer price. Results show a proxy for IPO market sentiment and the size of the IPO relative to industry median market capitalisation make significant contributions to the explanation of mispricing. Misvaluation is modelled with investor characteristics that have hypothesised associations with market price. A proxy for general market sentiment and the level of mispricing make significant contributions to the explanation of misvaluation. The third stage of the research integrates results from the disaggregation of underpricing with the baseline model.

Several conclusions can be drawn from the results. First, with respect to mispricing, issuers incorporate their knowledge of current IPO market conditions when establishing offer price, with more positive mispricing observed during hot IPO markets. Further, issuers taking relatively larger companies public tend to overprice their issues. This result persists even after controlling for potential scale effects. Second, with respect to misvaluation, overpriced issues (i.e. positive mispricing) are also overvalued by the market. This result provides an indication that price is not a suitable proxy for value. Third, prior Australian research [Cotter, Goyen & Hegarty (2005) and How, Lam & Yeo (2007)] reports a negative association for mispricing and underpricing. Consistent with US results (Zheng, 2007), no relationship is

observed for this sample. Overall, the results from this research indicate that investor-related factors are the primary drivers of underpricing.

This research makes eight major contributions to the body of knowledge. The first is the novel approach of disaggregating underpricing into mispricing and misvaluation components. Second, mispricing is modelled and it is demonstrated that previously hypothesised issuer-related factors do not explain mispricing. Third, misvaluation is modelled, providing some interesting insights into the role of market sentiment in the underpricing context. Fourth, the relationships of mispricing, misvaluation and underpricing are investigated. Fifth, the Australian institutional setting is compared to that of the US and implications for future research are identified. Sixth, the baseline model of underpricing consolidates variables developed from prior Australian literature, providing a yardstick for comparison in future underpricing research. Seventh, evidence shows issuers exploit high market sentiment with positive mispricing in the fixed-price setting. The final major contribution relates to the role of institutional investors in the fixed-price setting. Contributions to the IPO literature on ownership and control, signalling, asymmetric information theories of ex ante uncertainty and agency theory are also made with tests of key variables in the mispricing and misvaluation models. Finally, evidence on the role of institutional investors in the fixed-price setting and on the role of demand (informed and total) sheds light on the underpricing puzzle.

CERTIFICATION OF DISSERTATION

I certify that the ideas, results, analyses and conclusions reported in this dissertation are entirely my own effort, except where otherwise acknowledged. I also certify that the work is original and has not been previously submitted for any other award.

__________________________ ______________

Signature of Candidate Date

ENDORSEMENT

__________________________ ______________

Signature of Supervisor/s Date

__________________________ ______________

ACKNOWLEDGEMENTS

First and foremost, my heartfelt thanks belong to my principal supervisor, Julie Cotter and my associate supervisor, Diana Beal. They have provided excellent guidance both prior to and during my period of candidature and have managed to remain cheerful and supportive over the journey. Julie and Diana have gone beyond my expectations for supervisors, providing careful mentoring and an impressive enthusiasm for this research. My knowledge of research processes is much richer for their efforts.

My gratitude also goes to the University of Southern Queensland (USQ) for providing funding support for the research, a period of leave and a scholarship. I am also thankful for the PhD scholarships awarded by the Accounting and Finance Association of Australia (AFAANZ). The completion date for this research would still be on some distant horizon without these generous sources of funding.

My PhD has benefited from the comments of student participants and academics at the 2006 AFAANZ Doctoral Colloquium and from participants in the Faculty of Business (USQ) confirmation seminar. Other helpful comments have been made by USQ staff members and special thanks are due to Sarath Delpachitra who has patiently listened to the trials and tribulations associated with modelling the data.

Finally, and not solely because they insist on seeing their names in print, thanks belong to Victoria Rose and William Robert who have endured a very part-time mother over the last three years. They have displayed empathy and understanding beyond their years and have appreciated that a PhD requires a very co-operative family. This research is dedicated to Rosie and Will.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

APPENDICES

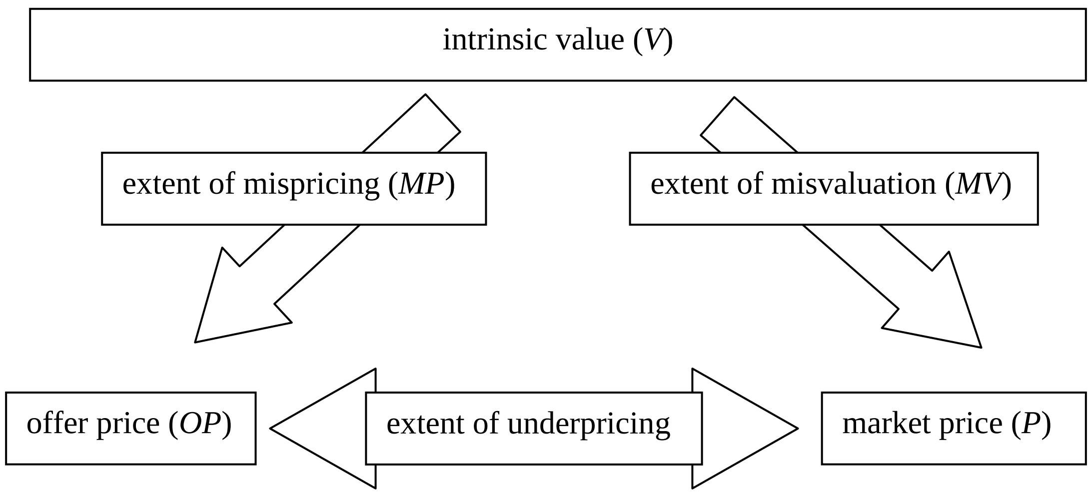
CHAPTER 1
INTRODUCTION

1.1 Purpose

The purpose of this dissertation is to investigate issuer- and investor-related factors associated with the underpricing[1] of Australian fixed-price[2] initial public offers (IPOs). This involves the disaggregation of underpricing into mispricing (*MP*) and misvaluation (*MV*) factors. *MP* captures the extent of the issuer's influence on underpricing and is measured as the difference between the intrinsic value[3] of an IPO share and its offer price. *MV* captures the extent of investors' influence on underpricing and is measured as the difference between the intrinsic value of an IPO share and its market price at listing.

Figure 1.1 shows the potential relationships of intrinsic value (*V*), offer price (*OP*) and market price (*P*) for fixed-price IPOs.

Figure 1.1 The relationship of intrinsic value, mispricing and misvaluation



This dissertation asks:

[1] Underpricing refers to the phenomenon of offering an IPO at a lower offer price than the price that the shares trade for at the end of one day's trading (i.e. post listing on the stock exchange).
[2] Fixed-price issues are those where the offer price is established prior to publication of the prospectus. This and the alternate bookbuild approach to setting the offer price are discussed in chapter 2.
[3] The intrinsic value of a security is normally defined as the present value of the security's expected future cash flows, or the 'fair' value of the security. Intrinsic value cannot be measured by observation.

Is underpricing due to mispricing (i.e. issuer-related factors), misvaluation (i.e. investor-related factors) or a combination of these?

To answer this fundamental question, the following sub-questions are examined:

1. *Which factors identified in the extant literature explain underpricing in Australia?*
2. *Which issuer-related factors determine the level of IPO mispricing?*
3. *Which investor-related factors determine the level of IPO misvaluation?*
4. *To what extent do issuer-related mispricing and investor-related misvaluation factors contribute to the explanation of underpricing?*

1.2 Motivation

In addition to facilitating the transfer of ownership, markets exist to allocate resources where they will be used most efficiently. The efficient allocation of resources is critical to sound performance of an economy. The underpricing phenomenon is inconsistent with the efficient allocation of resources as

a) issuers sell their companies too cheaply, or
b) investors purchasing shares at listing pay too much, or
c) some combination of a) and b).

Therefore, the motivation for this research is to gain greater understanding of the gap between offer price and day one market price (the underpricing puzzle). Extant underpricing research tends to focus on specific factors that are either demand- or supply-side-driven (Brailsford, Heaney & Shi, 2004). Rather than focussing on ‘a model’ of underpricing, this research disaggregates underpricing with models of mispricing and misvaluation to gain a clearer picture of the potential sources of underpricing. By contributing to the understanding of how market price is determined (relative to the proxies for intrinsic value) for earnings forecasting IPOs this research will assist share vendors and their advisors (investigating accountants, auditors, underwriters and brokers) when setting the selling price for the firm. By contributing to the understanding of the setting of offer prices (relative to the proxies for intrinsic value), this research will assist investors and their advisors (accountants and brokers) in their IPO investment decisions.

Australian institutional features provide a natural setting for the separate investigation of issuer and investor valuations. Differences in the contractual selling mechanisms used by floating companies, the characteristics of companies and institutional constraints were identified by Loughran, Ritter and Rydqvist (1994) as having the potential to contribute to the underpricing puzzle. Major underpricing theories [c.f. Rock (1986); Titman & Trueman (1986); Benveniste & Spindt (1989); Tinic (1988); Shultz (1993)] tend to be developed to explain underpricing in markets where the bookbuild pricing mechanism dominates and underwriters provide price support. Bookbuilt offer prices do not provide clear indicators of the issuer's valuation of the firm as they are set with reference to the market's assessment of the IPO's value.

In contrast, offer prices established via the Australian fixed-price mechanism reflect the valuation of the issuer and underwriter or sponsoring broker and these valuations are determined without the explicit canvassing of demand. Price support results in the contamination of market price by creating a price floor. As underwriters cannot provide price support in the Australian fixed-price setting[4], market prices that are equal to offer price reflect the aggregate of investors' assessments of IPO value rather than the trading activities of underwriters. Thus, Australian data facilitate tests of issuer-related and investor-related influences on underpricing.

Further, 58% of Australian industrial IPOs provide management earnings forecasts during the sample period. This institutional feature facilitates earnings-based proxies for intrinsic value which can be used to estimate mispricing and misvaluation. While Kim and Ritter (1999) report measures of IPO value based on analysts' earnings forecasts, US research is typically constrained by the use of pre-floatation earnings and capital structure data [Purnanandam & Swaminathan (2004); Zheng (2007)].

1.3 Contribution to the literature

On average, IPOs have mean and median prices at the end of the first day's trades that are significantly higher than the offer prices of the issues. Persistent average

[4] ASIC is responsible for the administration of the *Corporations Act 2001* and they consider that market stabilisation activities by underwriters could result in contraventions of one or more of the following sections of the Act - s1041A (market manipulation), s1041B–1041C (false trading and market rigging), s1041H (misleading and deceptive conduct) or s1043A (insider trading) (ASIC, 2005).

underpricing of new equity issues is documented for the major world markets and for many smaller equity markets since the 1970s [c.f. Loughran, Ritter & Rydqvist (1994); Jenkinson & Ljungqvist (2001)]. Ibbotson, Sindelar and Ritter noted in 1988 that

> … a number of hypotheses have been offered to explain … underpricing, but to date there is still no persuasive, widely accepted, and test-supported explanation of IPO underpricing (p. 37).

In the two decades since they made this statement, the number of hypotheses has increased and considerable academic effort has been directed toward resolving the underpricing puzzle. An underpricing theory that is widely accepted and is capable of explaining underpricing in different institutional settings is yet to emerge. A fundamental question that has yet to be answered is if underpricing is due to offer prices being too low (the decision of the issuer and advisors) or market prices being too high (the aggregate of investor decisions). The novel approach of modelling mispricing and misvaluation as two separate components of underpricing is adopted here to address this question.

This research builds on the current IPO mispricing (*MP*) literature by modelling *MP*. It extends the extant misvaluation (*MV*) literature by examining *MV* in the IPO setting. To date, there is no available research that attempts to ascertain how much underpricing can be attributed to issuer-related factors (evidenced by *MP*) and how much is due to investor behaviour (evidenced by *MV*). This question is examined by incorporating insights from the disaggregation of underpricing into a baseline model of underpricing developed from the literature. Further, results in this dissertation provide the first evidence on the relationships between mispricing and misvaluation and between misvaluation and underpricing.

In their review of recent IPO literature, Ritter and Welch (2002) state that investigation of share allocation procedures and non-rational explanations will increase understanding of underpricing. In this dissertation, the share allocation process is investigated as a potential mispricing factor while the disaggregation process allows for the non-rational influence of sentiment on market price to create misvaluation. Chowdhry and Sherman (1996) call for research that documents regulations and issuing procedures for IPOs. They identify features such as the advance payment for shares, allocation methods, how offer price is set and how long the process takes as areas of specific interest. Further, Ritter (2003) identifies limits to arbitrage as one of the building blocks of behavioural research. This dissertation documents these features for the Australian IPO institutional setting. The implications arising from differences in institutional settings for theories of underpricing are discussed. Further, documentation of the Australian institutional setting will assist international researchers in the identification of other markets suitable for exploring underpricing with the disaggregation approach.

Behavioural theory allows for investor emotions in decision-making processes and, hence, a role for investor sentiment in asset pricing. Market valuation errors are positively related to proxies for market sentiment (Brown & Cliff, 2005). In the IPO context, underpricing has been related to the level of investor sentiment via its influence on day one market price (Derrien, 2005); setting offer price (Ljungqvist & Wilhelm, 2002); and on the timing of issues (Loughran, Ritter & Rydqvist, 1994). This dissertation contributes to the literature via the inclusion market sentiment variables in the mispricing and misvaluation models to determine how sentiment affects underpricing.

The investigation of the role of institutional investors in the underpricing phenomenon [c.f. Derrien (2005); Ljungqvist, Nanda & Singh (2006); Ellul & Pagano (2006)] is a recent theme in the literature. This research contributes to that literature with the investigation of role of institutional investor participation in mispricing and underpricing in the fixed-price setting. Finally, contributions to the IPO literature on ownership and control, signalling, asymmetric information theories of ex ante uncertainty and agency theory are made with tests of key variables in the mispricing and misvaluation models. Further contributions are made with the investigation of demand proxies and the participation of institutional investors.

1.4 Scope of the research

There are three main delimitations of scope placed on this research. First, only ‘industrial’ companies are included in the sample. Given their particular characteristics, the results of this research may not be generalisable to mining companies and entities with non-corporate structures.

Second, the sample period commences in 1997 as electronic data required for the measurement of some variables is scant for earlier periods. Therefore, to avoid any bias that could potentially arise from systematic factors associated with data availability, the approach has been to constrain the sample period rather than omit many observations from a longer sample period.

Third, only fixed-price IPOs are examined in this research. This delimitation is essential for the identification of issuer-related factors in the disaggregation of underpricing. The results may not, therefore, be generalisable to IPOs where offer price is established using other pricing mechanisms such as bookbuilding or auctions.

1.5 Organisation of the dissertation

Chapter 2 reviews the three broad groups of underpricing theories (asymmetric information, institutional explanations and theories of ownership and control) and discusses their relevance in the Australian institutional setting. Extant Australian tests of these theories are then discussed. The baseline model of underpricing is developed from this literature via the identification of factors which consistently contribute to the explanation of underpricing in the Australian context.

Chapter 3 presents the rationale for selecting the test sample. A number of different screens are applied in the selection of the sample and these are justified and described. This chapter also provides some preliminary description of the sample data used to test the baseline model. Chapter 4 addresses the first research sub-question by presenting the empirical tests of the baseline model.

Chapter 5 explores alternative proxies for the unobservable construct of intrinsic value. The comparable firms PE is selected as the primary proxy for *V* and the EBO model is identified as an appropriate proxy for robustness tests. Chapter 6 identifies the factors that determine IPO mispricing while chapter 7 identifies factors that determine IPO misvaluation.

The final research sub-question is addressed in chapter 8. Here, the baseline model is re-estimated with the constrained sample of earnings forecasters employed for testing the misvaluation model. These results are compared to those for the full sample presented in chapter 4. To explore the incremental explanatory power of mispricing and misvaluation, models that include each of these variables are then tested. Extended models of underpricing are then identified and tested to determine if issuer- and investor-related factors contribute to the explanation of underpricing. Chapter 9 then concludes by answering the question: is underpricing due to issuer- or investor-related factors or to a combination of these?

CHAPTER 2

THEORY, LITERATURE AND THE BASELINE UNDERPRICING MODEL

2.1 Introduction

To determine if additional insights to the underpricing puzzle can be gleaned by analysis of mispricing (*MP*) and misvaluation (*MV*), it is first necessary to identify from the literature those factors that contribute to the understanding of underpricing. The underpricing model developed in this chapter is based on the extant Australian literature which, in turn, has considered international literature. This model will then form the baseline for assessing the contribution of variables identified from the mispricing and misvaluation models developed in later chapters.

The main theories of underpricing are briefly discussed in the next section. Section 2.3 outlines the differences in the Australian institutional setting that have the potential to impact on theories developed in other institutional settings. Section 2.4 then discusses the expected impact of institutional differences on each of the main underpricing theories. Section 2.5 analyses the Australian underpricing literature and develops the baseline underpricing model by including those factors which consistently contribute to underpricing in this market. Section 2.6 concludes the chapter.

2.2 Theoretical frameworks

The majority of underpricing theories are based on the concept of market efficiency – that the market reflects the intrinsic value of a share without bias. This traditional approach results in the conclusion that '… IPOs are underpriced relative to their fair value' (Zheng, 2007 p 287) and the implication that issuers misprice issues by setting the offer price too low. Hence, under the assumption of market efficiency, mispricing is viewed as the only cause of underpricing.

Theories of underpricing can be broadly categorised into three groups: asymmetric information, institutional explanations and ownership and control (Jenkinson & Ljungqvist, 2001). Each of these groups is discussed in the following sections.

2.2.1 Asymmetric information

Asymmetric information theories are the most prevalent in the literature. They can be grouped as theories of adverse selection, signalling, information revelation and principal-agent models (Jenkinson & Ljungqvist, 2001).

Adverse selection theories of underpricing are based on the concept of a discounted offer price as compensation for investors. Rock (1986) posits that the issuer and the underwriter are uninformed about the true value of the firm. Some investors are fully informed and only bid for underpriced IPOs. Uninformed investors bid for all IPOs but the application of discretionary share allocation procedures ensures the uninformed receive more allocations in overpriced (and correctly priced) offerings where informed investors do not compete – hence this is an example of the winner's curse[5]. Valuation becomes more difficult as ex ante uncertainty increases, providing an incentive for more investors to become informed and, thus, increases the winner's curse (Beatty & Ritter, 1986). Greater ex ante uncertainty causes investors to demand an estimation risk premium (Wolfe & Cooperman, 1990), with underpricing as compensation for this additional risk. Proxies for ex ante uncertainty in the literature include gross proceeds, trading volume and volatility and the number of risk factors disclosed in the prospectus (Jenkinson and Ljungqvist, 2001).

In contrast to adverse selection, signalling theory relies on the concept that the firm, rather than potential investors, has more knowledge about its true value. To maximise vendors' wealth in subsequent share issues, high-quality firms use costly signals that are difficult for lower-quality firms to replicate (Jenkinson & Ljungqvist, 2001). Leyland and Pyle (1977) view the level of retained ownership as a signal of firm value. Grinblatt and Hwang (1989) posit that issuers use underpricing and the level of retained ownership as costly signals to convey the value of the firm to investors. Quality firms with relatively higher levels of risk will choose to issue options with shares at the IPO rather than rely on the more expensive signal of retained earnings (Chemmanur & Fulghieri, 1997).

---

[5] In the IPO context, Rock (1986) identifies underpricing as a necessary compensation to encourage the participation of uninformed investors in issues. He argues that uninformed investors subscribe to all IPOs indiscriminately so receive larger allocations in overpriced issues than they do in underpriced issues. Uninformed investors receive only small allocations in underpriced IPOs where issues are oversubscribed due to the participation of informed investors and allocations are rationed.

Welch (1989) and Allen and Faulhaber (1989) view underpricing as a signal of firm quality. These authors argue that issuers consider future capital raisings in their pricing decisions. Thus, quality firms use underpricing to convince the market they have good prospects that will allow them to recoup the cost of this signal. Issuers with superior future cash flow prospects signal these to the market by disclosing earnings forecasts in the prospectus (Clarkson et al., 1992). Titman and Trueman (1986) argue that issuers use underwriter and auditor reputation as certification of the quality of the IPO to reduce information asymmetry and, therefore, the required level of underpricing. Signalling via certification is supported in the US setting for underwriters (Carter & Manaster, 1990) and auditors (Datar, Feltham & Hughes, 1991).

Compared to issuers, investment bankers or underwriters are better informed about the state of the capital market in the principal-agent model of asymmetric information. Jenkinson and Ljungqvist (2001) consider that underwriters have conflicting incentives with respect to underpricing – more underpricing increases the demand for the issue while less underpricing increases the underwriting fee received. Investment bankers can provide three services to the issuer: underwriting, advising and distribution (Baron, 1982). The more uncertain the issuer is about the value of the firm the more valuable the underwriter's advice. Hence, the issuer will delegate the pricing decision to the underwriter with the result of higher underpricing (Baron, 1982). Muscarella and Vetsuypens (1989) tested Baron's theory on a sample of investment banks that were self-underwritten. They found significant underpricing even when the underwriter would not have an information advantage over the issuer.

Information revelation theory argues that while issuers know more about the true value of the firm, institutional investors know more about the demand for the issue, the industry and market factors that affect that demand. Benveniste and Spindt (1989) argue that the investment bankers and underwriters handling the issue become most informed as they have access to information from issuers and investors during the bookbuild process. The pricing mechanism is an important institutional difference between the Australian and US IPO markets and is discussed below in section 2.3. While an issuer only participates in the IPO market once, investment bankers and underwriters have the capacity to 'bundle' issues for their clients, giving them favourable allocations of the more underpriced issues in return for information and for taking shares in some less underpriced issues (Benveniste & Spindt, 1989).

2.2.2 Institutional explanations

Institutional explanations of underpricing include the legal insurance hypothesis and the provision of price support by the underwriter (Jenkinson & Ljungqvist, 2001). Tinic (1988) argues that underpricing provides an insurance to issuers and investment bankers against legal liability and subsequent damages claims. Loughran, Ritter and Rydqvist (1994) do not find any evidence to suggest higher underpricing in the more litigious US market than in other markets. Tinic (1988) himself acknowledges that his results in support of the legal insurance hypothesis are also consistent with asymmetric information explanations of underpricing.

Explanations of underpricing associated with the theories of asymmetric information, ownership and control (see next section) and Tinic's legal hypothesis are predicated on deliberate underpricing by issuers and their advisors (Ljungqvist, 2004). Ruud (1993), in her institutional explanation of underpricing, argues that issuers and their advisors do not deliberately underprice issues. Rather, she posits that the right skew of the distribution of initial returns is attributable to the reduction of negative returns associated with underwriter price support activities.

2.2.3 Ownership and control theories

Theories of ownership and control view underpricing as either a means of minimising or encouraging monitoring by shareholders. Brennan and Franks (1997) argue that issuers choose to underprice to ensure oversubscription. Share allocations are rationed in this scenario to constrain the size of outside shareholder blocks. The cost of underpricing is offset by the benefits to original owners from maintaining control. This concept has evolved into the more encompassing Habib and Ljungqvist (2001) measure of underpricing as 'wealth loss to owners' rather than 'money left on the table'. Conversely, the rationale in Stoughton and Zechner (1998) is that firms with higher agency costs will, ceteris paribus, require more underpricing to make a successful float. Here, large blockholders are encouraged by lower offer prices relative to those paid by small investors (Stoughton & Zechner, 1998). Pham, Kalev and Steen (2003) extend this stream of the literature by suggesting a trade-off exists between post-listing liquidity and control, where liquidity is a requirement of small investors.

When tested empirically, none of these theories provides an unequivocal explanation of underpricing for Australian industrial IPOs. Lee, Taylor and Walter (1996), for example, test Rock's (1986) information asymmetry theory and find that it explains 11.28% of the variation in underpricing. How, Izan and Monroe (1995) extend Rock's (1986) theory with the inclusion of a proxy for underwriter quality and report an adjusted R-squared of 20% (the highest explanatory power for an Australian sample of industrial IPOs). The explanatory power of Australian underpricing models cannot logically be compared to those developed in markets such as the US where bookbuilding is the dominant issue mechanism. The specific Australian institutional factors that limit the applicability of the foregoing theories of underpricing are discussed in the next section.

2.3 Institutional setting

As mentioned in chapter 1, the Australian institutional setting for IPOs has some important differences from other IPO markets. The results for Australian empirical IPO research indicate that theories of underpricing developed in the US institutional framework do not easily transfer to the Australian institutional setting. In this section, four fundamental institutional differences between the Australian and US IPO markets are investigated. The implications for theories developed in the US setting are then considered in section 2.4. The institutional differences that are of relevance to the baseline model of underpricing are the capacity to incorporate demand into the offer price via the pricing mechanism, differences in underwriting contracts, the capacity of underwriters to provide price support and discretion in the allocation method. Other institutional differences are discussed in chapters 5, 6 and 7.

2.3.1 Pricing mechanisms

Offer prices are established with differing input data determined by the choice of selling mechanism. Bookbuilding, fixed-pricing and auctions are the three main contractual selling mechanisms used by IPOs internationally (Sherman, 2005). The choice of pricing mechanism has a major implication for determining the offer price for the issue – the issuer has much more information available when offer price is set from a bookbuild issue compared to other pricing mechanisms.

Bookbuilding is used by US IPOs [Jenkinson & Ljungqvist (2001); Busaba (2006)]. The final price is set after bids from institutional investors are received and price-setting usually occurs the night before selling starts [Ellis, Michaely & O'Hara (2000); Busaba (2006)]. Thus, the bookbuilt offer price includes investors' valuations and the results of the formal canvassing of demand (Benveniste & Busaba, 1997).

2.3.1.1 Bookbuilding in Australia

In 2005, the ASX reviewed current practices in Australian bookbuild issues via industry consultation (ASX, 2006a). They report that the aims of the bookbuild include obtaining an optimal final price with a covered book, the desired spread between retail and institutional shareholders and to provide 'a sound basis for the secondary market' (ASX, 2006a, p. 9). As in the US institutional setting, the bookbuild price is set after considering the valuations of and demand from institutional investors. Thus, the final offer price reflects '… aggregate investors' beliefs that would otherwise be manifest in the post-offering trading price' (Busaba, 2006). General marketing of the offer occurs while the book is being built (ASX 2006a).

Australian bookbuild offers normally involve a book of institutional investors and an offer to retail investors with a reduced retail offer price determined in relation to the final price established by the institutional book. A second variation is the addition of a 'broker firm offer' where specified brokers bid on behalf of their retail clients. These brokers receive an amount of shares which they then allocate to their clients (ASX, 2006a).

The ASX (2006a) reports that some brokers have difficulties receiving pricing instructions from each of their retail clients during the bookbuilding process while other brokers can incorporate the bids of their retail clients. While institutional investors have the opportunity to change or withdraw their bids, those of the brokers' offer retail clients are normally binding (ASX, 2006a). The final institutional and retail prices are announced by pre-quotation disclosures to the ASX (ASX, 2006a).

2.3.1.2 Fixed-price offers in Australia

The dominant pricing mechanism in Australia is fixed-pricing. Data presented in the next chapter show that 95% (by number) of Australian issues during the sample period used the fixed-pricing mechanism. In contrast to a bookbuild prospectus that contains a 'price range', the fixed-price prospectus states the price at which the shares are offered. Thus, while the bookbuild price is set close to the listing date, the fixed-price offer sets the price, on average, about 54 days before the share is traded on the exchange (see chapter 4). The offer price is published in the prospectus and potential investors are invited to subscribe for the number of shares they would like to receive at the offer price. While indications of demand for an issue are non-binding when the bookbuild pricing mechanism is used, applications from the prospectus of a fixed-price offer must be accompanied by payment for the desired subscription. Advance payment increases the costs of ordering, especially when investors receive fewer shares than they applied for (Chowdhry & Sherman, 1996).

Australian issuers (and their underwriters or sponsoring brokers) set the fixed-price with reference to the price-earnings (PE) multiple of comparable firms, making adjustments for the additional risks associated with an IPO, differences in retained ownership, firm size, growth prospects and leverage (Cotter, Goyen & Hegarty, 2005). Thus, the procedure involves setting the offer price without receiving formal indications of demand from potential investors (Lee, Taylor & Walter, 1996).

2.3.2 Underwriting contracts

Differences in the nature of underwriting contracts offered to US and Australian issuers are discussed in this section. While Australian underwriters contract for a 'stand-by' arrangement to purchase any unsold shares (Finn & Higham, 1988), investment banks offer US issuers the choice between 'firm commitment' underwriting contracts and 'best efforts' contracts to market the issue (Ogden, Jen & O'Connor, 2003). The vast majority of contracts in the US are on a firm commitment basis [Chalk & Peavy (1987); Jenkinson & Ljungqvist (2001); Busaba (2006)] where all of the IPO shares are sold to the underwriter at a fixed price and then on-sold to the underwriters' clients (Ogden, Jen & O'Connor, 2003). The 'spread' is the difference between the price paid for the IPO shares by the underwriter and the price at which the underwriter on-sells the shares (Smart, Megginson & Gitman, 2004).

Best efforts contracts set the offer price early in the IPO process and the price cannot be adjusted to incorporate investor demand (Booth & Chua, 1996). These contracts are much less popular than firm commitment contracts in the US (Smart, Megginson & Gitman, 2004) and they are generally not included in US underpricing studies (Fama & French, 2004). Under a best efforts contract, the investment bank acts more like a sponsoring broker in the Australian setting. The logistics of the issue are handled by the bank but there is no underwriting agreement to ensure the full subscription of the issue. US IPOs using best efforts contracts tend to be more underpriced than firm commitment offers (Smart, Megginson & Gitman, 2004). As best efforts contracts are effectively fixed-price issues that are not underwritten, we could expect Australian IPOs without underwriters similarly to have higher underpricing.

In contrast to the US firm commitment contracts (where the underwriter purchases all issue shares) and best efforts contracts (that are not underwritten), Australian underwriters use a standby arrangement. Australian underwriters only purchase shares when the issue is not fully subscribed [Finn & Higham (1988); How & Yeo (2000)]. Unlike their US counterparts, Australian underwriters face the risk of capital loss when they are required to take up shares (How & Yeo, 2000).

2.3.3 Price support in the aftermarket

Participants in US bookbuilds may choose to purchase in the aftermarket rather than act on their non-binding indications of interest made during the process or sometimes renege on firm orders (Shultz & Zaman, 1994). To minimise these activities, underwriters provide an implicit put option to investors (Shultz & Zaman, 1994). Shultz and Zaman (1994) argue this put option provides the rationale for high underwriting fees, some level of underpricing and for underwriters to trade in the aftermarket to ensure that the share price does not fall below the IPO offer price.

Investors do not make indications of interest in the Australian fixed-price setting, nor can they renege on orders after they have applied for shares as all share applications must be accompanied by payment for the full price of the shares. Further, the underwriter of an IPO listing on NASDAQ will normally take the role of market maker for the share when trading commences (Jenkinson & Ljungqvist, 2001). In contrast to the US system where the market maker provides a bid and offer for the share, the trading system adopted by the ASX matches bids and offers directly.

Almost all US IPOs include an over-allotment (or 'green shoe') option that allows the underwriter to increase the sale of shares by up to 15 percent over the amount being offered by the issuer (Aggarwal, 2000). The underwriter takes a naked short position when demand for the issue is expected to be weak, repurchasing the excess shares on market and maintaining the share price. Where demand for the issue is strong, the underwriter exercises the over-allotment option that requires the listing company to issue additional shares. Over-allotment options, combined with the US underwriters' ability to trade as market makers, allow US underwriters to provide price support to their IPO clients when the company lists.

The Australian Securities and Investments Commission (ASIC) define price support (or market stabilisation) as the

> … purchase of, or the offer to purchase, securities for the purpose of preventing, or slowing, any fall in the market price of those securities following an offer of those securities. (ASIC, 2005)

ASIC describes the benefit of market stabilisation as the provision of a more-orderly secondary market that in turn results in increased investor confidence and the facilitation of company fundraising (ASIC, 2005). However, the capacity for underwriters to offer market stabilisation services is severely constrained by Australian legislation. ASIC is responsible for the administration of the *Corporations Act 2001* and they consider that market stabilisation activities by underwriters could result in contraventions of one or more of the following sections of the Act - s1041A (market manipulation), s1041B–1041C (false trading and market rigging), s1041H (misleading and deceptive conduct) or s1043A (insider trading) (ASIC, 2005). Underwriters can apply to ASIC to obtain a 'no-action letter' that is, in effect, conditional permission to conduct market stabilisation activities (ASIC, 2005). No-action letters were issued on a case by case basis during the sample period for this dissertation (ASIC, 2000).

ASIC’s *Interim Guidance on Market Stabilisation* (IROO-031) outlines the necessary conditions for obtaining a no-action letter for price support activities. These include disclosure of the ‘nature and effect’ of the stabilisation arrangement in the prospectus, advance notification to the ASX of the arrangement and continuous disclosure to the ASX of the stabilisation trades (all of which must be conducted through the ASX’s electronic trading system (SEATS) (ASIC, 2000)). Stabilisation bids must be no higher than the offer price of the shares (ASIC, 2000). Aggarwal (2000) notes that the price stabilisation activities of US underwriters lack transparency. As Australian underwriters disclose details of their stabilising trades to the ASX but not to market participants at large, the same can be said of stabilisation in Australia.

ASIC (2000) identifies underwriter negotiation of an over-allotment option as the first step in the market stabilisation process. Over-allotment options are largely confined to privatisations in the Australian IPO market (Aitken et al., 2005). Further, ASIC (2000, p. 2) identifies ‘imperfections in the pricing and allocation of shares derived from the book build process’ as a rationale for allowing price support. No over-allotment options were granted to the underwriters of the fixed-price offers in the sample for this research.

2.3.4 Allocation methods

Many investors are excluded from the bidding process in US bookbuilds and only bidding investors receive allocations (Sherman & Titman, 2002). In addition to this exclusivity, a benefit of choosing the bookbuild method in the US is that it allows the investment banker discretion in allocating shares (Jenkinson & Ljungqvist, 2001). The underwriter’s capacity to allocate shares to bidders is critical for eliciting accurate information (Sherman, 2000).

There are no legal requirements that specify how shares are to be allocated in Australia (Centre for Corporate Law and Securities Regulation, 1998). Therefore, Australian issuers have the capacity for preferential share allocation without using bookbuilding. The capacity to use discretionary allocation for fixed-price offers is unusual – other countries specify how shares are to be allocated and frequently favour allocations to small investors (Sherman & Titman, 2002). Discretion in allocation procedures in the fixed-price setting is normally allowed only on the basis of order size (Sherman, 2000).

Section 711(1) of the *Corporations Act 2001* contains the requirement for disclosure of the terms and conditions of the offer. Thus, the share allocation policy is disclosed in Australian prospectuses. Most Australian fixed-price issuers indicate that shares are allocated at their (or the underwriter's) discretion (see chapter 6). Specific groups receiving priority allocations (broker firm offers, customers or employees, for example) and the maximum size of these are also identified in the prospectus. The allocation policy choices available to Australian issuers may, in part, explain why bookbuilding has not become the dominant issue mechanism in Australia[6].

As shown in the foregoing discussion, the Australian institutional setting exhibits major differences from the US market with respect to the dominant pricing mechanism (and related allocation methods), the nature of underwriting contracts and the provision of market stabilisation services by underwriters. The following section discusses the implications of these institutional features for the main underpricing theories identified in section 2.2.

2.4 Implications of the Australian institutional setting for underpricing theories

Potential impacts arising from institutional differences in the Australian IPO market compared to the US are discussed in this section. Each of the main theory groups - asymmetric information, institutional explanations and ownership and control - are discussed with reference to the Australian institutional setting. The results of Australian tests of these theories are also analysed. Table 2.1 relates the Australian

[6] Busaba (2006) investigates the value of the option for the issuer to withdraw from a US bookbuild offer. He considers that the value of this option can exceed the cost of underpricing required to elicit truthful responses from investors in the bookbuild process. Australian fixed-price offers can be withdrawn prior to the allocation of shares, granting the withdrawal option to all issuers, not only those using bookbuilding. This option to withdraw negates another benefit for US bookbuilds in the Australian institutional setting.

research to each of the main theories and identifies which of the theories enjoy empirical support in this market.

As discussed in section 2.2, the asymmetric information theories can be categorised as theories of adverse selection, signalling, the principal-agent model and information revelation. Each of these is discussed with reference to the Australian institutional setting in the following four subsections.

2.4.1 Adverse selection theories and the Australian institutional setting

Rock's (1986) winner's curse relies, in part, on the issuer having the capacity to allocate more shares to uninformed investors when issues are overpriced. As mentioned earlier, one reason US IPOs choose the bookbuild pricing mechanism is to gain discretion in the allocation method for shares. Australian issuers have the capacity to choose their allocation method with a fixed-pricing mechanism as there are no legal restrictions on this choice in Australia. While the pricing mechanisms chosen in Australia and the US differ, issuers in both markets can effectively structure their issues to achieve the objective of discretionary allocation. There is no specific role for the underwriter or investment banker in adverse selection theory, so institutional differences in underwriting contracts and the provision of price support have no apparent capacity for influence here. Therefore, institutional differences will not negate the potential for adverse selection to explain underpricing in Australia.

Lee, Taylor and Walter (1996) consider that the Australian institutional setting will create market conditions that are consistent with Rock (1986). Using Australian data, Finn and Higham (1988) do not find support for the winner's curse. Lee, Taylor and Walter (1996) attribute this finding to the winner's curse phenomenon being 'overwhelmed' by institutional factors specific to the sample period of that study. They find support for the winner's curse using a later Australian sample period. How, Izan and Monroe (1995) also find support for the winner's curse using a sample of industrial IPOs and How (2000) finds support for the theory with resource IPOs. No evidence of the winner's curse was found in a sample of trust IPOs (James, How & Izan, 1995).

The winner's curse theory relies on the existence of a group of investors willing to engage in the costly process of information production. Beatty and Ritter (1986) posit that more investors will engage in information production when valuation uncertainty is higher. Support for a positive association between the level of ex ante uncertainty and underpricing is found in the Australian context [James, How & Izan (1995); How, Izan & Monroe (1995); Lee, Taylor & Walter (1996)]. These studies typically use a number of proxies for this unobservable variable. As discussed in section 2.5 below, the different proxies exhibit uneven performance.

2.4.2 Signalling theories and the Australian institutional setting

Signalling models are based on the notion that information asymmetry is reduced by using costly signals that cannot be replicated by lower quality firms. The signals discussed in the literature are independent of the pricing mechanism, the nature of the underwriting contract and the provision of price support. With the exception of signalling firm quality by issuing options with shares in the IPO (How & Howe, 2001), persuasive support for signalling is not found in Australian data (see table 2.1). The capacity for an issuer to choose the share allocation method (independently of the pricing mechanism) is an issue that has yet to be addressed in the signalling literature. Given the role played by discretionary allocation in the winner's curse, the requirement for issuers to disclose their allocation method in the prospectus affords an opportunity to examine the issuer's selection of allocation method as a signal of firm value. This issue will be investigated in chapter 6.

2.4.3 Principal-agent models and the Australian institutional setting

Institutional differences in underwriting, price support and allocation methods are not expected to have an impact in the principal-agent model. Baron's (1982) model is developed in a fixed-price environment, so differences in the price-setting mechanism do not affect this theory. Most likely attributable to the fact that this theory did not perform well when tested in the US context where it was developed, principal-agent models have not been tested in Australia.

Table 2.1 Summary of Australian empirical tests of underpricing theories

	Theory source	Predicted relationship	Australian test	Empirical support
Theories of information asymmetry				
Adverse selection	Rock (1986)	Underpricing compensates uninformed investors for the winner's curse	Finn & Higham (1988) How, Izan & Monroe (1995) James, How & Izan (1995) Lee, Taylor & Walter (1996)	No Yes No – trust IPOs Yes
	Beatty & Ritter (1986)	Underpricing compensates investors for the greater ex ante uncertainty about market price	James, How & Izan (1995) How, Izan & Monroe (1995) Lee, Taylor & Walter (1996)	Yes – trust IPOs Yes Yes
	Wolfe & Cooperman (1990)	Higher underpricing for small startups to compensate for greater ex ante uncertainty	How, Izan & Monroe (1995) Lee, Taylor & Walter (1996)	No – issue size (p = 10%) No – issue size, total assets
Signalling	Leyland & Pyle (1977) Grinblatt & Hwang (1989)	Higher retained ownership signals value – lower underpricing	Lee, Taylor & Walter (1996) Dimovski & Brooks (2004)	No No
	Welch (1989) Allen & Faulhaber (1989)	Higher underpricing for quality firms – they can afford to underprice	How & Low (1993)	Mixed – result depends on measure of firm value
	Chemmanur & Fulghieri (1997)	High risk quality firms signal with options rather than the using more expensive retained earnings	How & Howe (2001)	Yes – industrials and mining
	Titman & Trueman (1986)	Lower underpricing for high reputation auditors and underwriters.	James, How & Izan (1995) How, Izan & Monroe (1995) Dimovski & Brooks (2004) Chang et al. (2008)	No (auditor, trustee) – trust IPOs Yes (underwriter) – trust IPOs Yes (underwriter reputation) No (investigating accountant, experts) No (investigating accountant) No (auditor quality) - positive

	Theory source	Predicted relationship	Australian test	Empirical support
Signalling (continued)	Clarkson et al (1992)	Higher market valuations for firms providing earnings forecasts	How (1996) – less underpricing for earnings forecasters	No
Principal-agent model	Baron (1982)	Higher underpricing results from information asymmetry between the underwriter and the issuer	Not tested	
Information revelation	Benveniste & Spindt (1989)	Higher underpricing by underwriters to compensate for information revelation	No discrete testing of Australian bookbuild issues	
Differential information	How, Izan & Monroe (1995)	Low retained ownership firms have higher agency costs so disclose more information. This results in lower ex ante uncertainty and lower underpricing	How, Izan & Monroe (1995)	Yes
Institutional explanations				
Litigation hypothesis	Tinic (1988)	Underpricing is ex ante compensation to reduce the probability of a law suit	No testing – see institutional setting	
Price support	Ruud (1993)	The distribution of UP returns has right skew because price support reduces negative returns	No testing – see institutional setting	
Ownership and control				
Monitoring	Brennan & Franks (1997)	Underpricing is used to achieve a broad ownership base	Pham, Kalev & Steen (2003)	Yes
Agency costs	Shultz (1993)	Higher underpricing for firms making share issues packaged with options	How & Howe (2001) Dimovski & Brooks (2004)	No – industrials and mining Yes – for the total combined sample, but not in any sample subdivisions

2.4.4 Information revelation and the Australian institutional setting

Information revelation theories that predict preferential allocations to large investors [Benveniste & Busaba (1997); Benveniste & Spindt (1989)] for revealing information could well apply to Australian bookbuild offers, but they do not easily translate to the Australian fixed-price setting. Booth and Chua (1996) argue that fixed pricing results in higher information costs for investors because the issuer cannot adjust the offer price to compensate for their information purchases.

Lee, Taylor and Walter (1996) argue that the Australian institutional feature of fixed pricing with no formal pre-selling negates Benveniste and Spindt's (1989) rationale. While discretionary allocation is permitted in the Australian fixed-price setting, the revelation of costly information theory relies on the collection of information from the bookbuild process. Only five percent of Australian IPOs by number during the 1997-2006 period were bookbuilds. Given the low proportion of Australian IPOs that choose this pricing mechanism, it is unsurprising that no published Australian test of the information revelation theory could be found.

Neither of the institutional explanations of underpricing is relevant in the Australian setting. The low risk of an issuer being sued in Australia [Lee, Taylor & Walter (1996); Lee et al. (2003)] removes the imperative for 'legal insurance'. As discussed in section 2.3.3, price support is not a factor in Australian fixed-price offers, so it cannot explain underpricing in this setting. There are no published Australian studies that test these institutional explanations of underpricing.

The availability of alternatives for allocating shares is important for control-based theories. The Brennan and Franks (1997) model remains valid with the fixed-price mechanism with discretionary allocation. Stoughton and Zechner's (1998) model, on the other hand, requires a two-stage selling process that allows the investment banker to price shares for blockholders lower than shares for small investors. While Australian fixed-price prospectuses sometimes indicate that some investor groups (employees, for example) will receive a discounted offer price, none disclose a reduced offer price for investors who have the potential to become large blockholders. Corporate control has a significant economic influence on the choice between a public float and a private placement in the Australian institutional setting (Sharpe & Woo, 2005). Private placements are a more appropriate mechanism for firms seeking monitoring shareholders in the Australian context. In Australia, underpriced IPOs have greater breadth of ownership and higher liquidity (Pham, Kalev & Steen, 2003). Differences in the nature of underwriting contracts and the provision of price support are not relevant to theories of ownership and control.

In addition to the implications for the application of US theories to the Australian context, the Australian institutional setting creates an interesting opportunity to investigate of the roles of supply and demand in the underpricing puzzle. Demand is not incorporated in the offer price as is the case for bookbuild pricing so the offer price is expected to provide a relatively unbiased assessment of the issuer's (and underwriter's or sponsoring broker's) assessment of value. The absence of market stabilisation activities by underwriters in the Australian fixed-price setting has an important implication for the market price of IPO shares at the end of the first day of trading. The market price is set by supply and demand without trades by underwriters that effectively put a floor at the offer price. In this sample, IPOs with zero underpricing indicate an offer price that corresponds with the market's assessment of the value of the firm. Conversely, IPOs with negative underpricing indicate that the issuer's valuation is higher than the market's valuation of the firm. Thus, market price is expected to provide a relatively unbiased assessment of investors' assessments of value.

In conclusion, the institutional differences between Australia and the US discussed in this section have an important implication - the Australian IPO market affords a 'cleaner' setting for identifying the core factors that contribute to underpricing. Information revelation theories are invalid in the Australian fixed-price IPO setting. Conditions necessary to support the institutional explanations of the legal hypothesis and price support do not exist in the Australian fixed-price market. Further, the Australian institutional setting provides natural controls to test theories of adverse selection, signalling and ownership and control, all of which were developed in a different institutional setting.

2.5 The baseline underpricing model

The underpricing model developed here is based on the extant Australian literature which has, in turn, been based on the theoretical and institutional aspects discussed above. While small compared to the number of IPO studies conducted in the US, there has been considerable research into underpricing in Australia. However, as shown in table 2.2 and discussed below, the results of these studies are frequently inconsistent. In addition to the discussion about these prior Australian IPO studies presented in this chapter, they are referred to and discussed further in several of the other chapters in this dissertation. For example, chapter 4 presents a comparative analysis of the reported underpricing from these studies.

The first hypothesis in this dissertation relates to the first research sub-question and investigates the factors that explain underpricing in Australia. The variables included in the model are selected because they are usually found to have a significant association with underpricing in the Australian institutional setting.

$H0_1$ *Underpricing in Australia is unrelated to time from prospectus issue to listing, the level of retained ownership, ex ante uncertainty, the participation of an underwriter and the inclusion of options at floatation.*

$UP = \beta_0 + \beta_1 DELAY + \beta_2 OWN + \beta_3 SIGMA + \beta_4 UW + \beta_5 OPT + \varepsilon$ **baseline model**

For ease of exposition, this first model will be referred to as the 'baseline model'. Table 2.3 contains a summary of independent variable measurement for the baseline model. Justification for the inclusion of each independent variable is discussed in the following sub-sections.

Table 2.2 Summary of explanatory variables for Australian underpricing

Study	Sample	Significant variables	Relationship to underpricing	AR^2	Other variables
Finn & Higham (1988)	1966-78			n.a.	*logDELAY* *SIGMA* log issue size log firm size
How, Izan & Monroe (1995)	1980-90	*Model 1*		0.1789	
		Underwriting fee %	negative	*(n = 214)*	Investigating accountant dummy
		log issue size	negative		No. of years of financial statements
		log *DELAY*	negative		Growth options
					Leverage
					Market conditions dummies
		Model 2		0.2000	log issue size
		Underwriting fee %	negative	*(n = 202)*	Investigating accountant dummy
		log *DELAY*	negative		No. of years of financial statements
		SIGMA	positive		Growth options
					Leverage
					Market conditions dummies
How (1996)	1979-90	*Model 1*		0.1295	Earnings forecast dummy
		log *DELAY*	negative	*(n = 220)*	*OPT*
		SIGMA	positive		Underwriter reputation
		Model 2		0.2003	
		log *DELAY*	negative	*(n = 200)*	Underwriter reputation
		SIGMA	positive		log post listing equity (size)
		Packaged options	positive		1 market state dummy
		Auditor reputation	negative		
		Leverage	positive		
		OWN	positive		
		Years of financial statements	negative		
		1 market state dummy	positive		

Study	Sample	Significant variables	Relationship to underpricing	AR^2	Other variables
Lee, Taylor & Walter (1996)	1976-89	Operating history log *DELAY* *OWN*	negative negative positive	0.1224 *(n=266)*	log issue size log total assets σ monthly returns Growth options
Lee, Lee & Taylor (2003)	1976-94	*DELAY* σ of monthly returns	negative positive	0.085 *(n = 394)*	*OPT* *OWN* Operating history in years log issue size Growth options log total assets
How & Howe (2001)	1979-90	log *DELAY* 2 market state dummies mining dummy	negative positive positive	0.303 *(n = 396)*	log issue size *SIGMA* log days from incorporation to listing Auditor reputation Underwriter reputation Dummy for second board listing Proceeds from exercise of options *OWN*
Dimovski & Brooks (2004)	1994-99	Market sentiment Packaged options *UW* DPS yield Underwriter options	positive negative positive negative positive	0.098 *(n = 358)*	Offer price log issue size EPS yield Investigating accountant's reputation *OWN* Dividend reinvestment dummy Franking credit forecast dummy Limited liability dummy
Cotter, Goyen & Hegarty (2005)	1995-98	Offer price / PE value Issue size Firm size Operating history	negative positive negative positive	0.205 (n=60)	*DELAY* Growth *OWN*

Study	Sample	Significant variables	Relationship to underpricing	AR^2	Other variables
How, Lam & Yeo (2007)	1993-2000	*Model 1 - raw UP* Offer price / PE value	 negative	0.0959 (n=98)	Underwriter reputation log *DELAY* Packaged options *SIGMA* Age Auditor reputation
		Model 2 - raw UP log *DELAY* *SIGMA*	 negative positive	0.1649 (n=170)	Underwriter reputation *OPT* Age Auditor reputation
Chang et al. (2008)	1996-2003	Big 4 auditor log pre-IPO assets σ monthly returns going concern audit opinion underwriter prestige VC backing	positive negative negative negative positive negative	0.260 (n = 371)	log Age log Issue size reciprocal of offer price log number of risk factors in prospectus current assets return on assets loss in year prior to listing retained ownership

DELAY = number of days from prospectus to listing date. *OWN* = retained ownership. *SIGMA* = standard deviation of daily returns. *UW* = indicator variable for underwritten issues. *OPT* = indicator variable for attaching options

Table 2.3 Variable measurement and predicted relationships for baseline model

Independent variable	Variable measurement	Predicted relationship
DELAY	proxies for the level of informed demand. *DELAY* is captured by the number of days from prospectus date to listing date.	negative
OWN	is the level of retained ownership. *OWN* is measured by (shares retained by pre-IPO owners / number of shares at listing) x 100.	indeterminate
SIGMA	proxies for the level of ex ante uncertainty. *SIGMA* is defined as the standard deviation of daily returns for days 2 to 20 from listing date.	positive
UW	indicates the participation of an underwriter in the issue. *UW* is defined as a dichotomous variable equal to one if the issue is underwritten.	indeterminate
OPT	indicates IPOs that include attaching options. *OPT* is defined as a dichotomous variable equal to one if the issue includes attaching options.	indeterminate

2.5.1 Level of informed demand (DELAY)

Based on Rock's (1986) theory of information asymmetry, the number of days from prospectus date to listing (*DELAY*) is used as a proxy for the level of informed demand [Finn & Higham (1988); How, Izan & Monroe (1995); How (1996); Lee, Taylor & Walter (1996); How & Howe (2001); Lee, Lee & Taylor (2003); Cotter, Goyen & Hegarty (2005); How, Lam and Yeo (2007)]. The negative relationship between *DELAY* and underpricing is often interpreted as evidence of the winner's curse. With two exceptions [Finn & Higham (1988); Cotter, Goyen & Hegarty (2005], *DELAY* is significant for explaining underpricing in published Australian models that include this variable. The relationship between underpricing and *DELAY* is expected to be negative in the baseline model.

2.5.2 Retained ownership (OWN)

Australian empirical studies do not consistently support signalling theory's predicted relationship between retained ownership (*OWN*) and underpricing. Lee, Taylor and Walter (1996) and How (1996) both find a positive relationship between retained ownership and underpricing for industrial IPOs. No significant relationship between retained ownership and underpricing is reported by How and Howe (2001), Lee, Lee and Taylor (2003), Dimovski and Brooks (2004), Cotter, Goyen and Hegarty (2005) or Chang et al. (2008). In their investigation of the role of venture capitalists in Australian underpricing, da Silva Rosa, Velayuthen and Walter (2003) find IPOs with the about the same level of retained ownership experience about the same level of underpricing.

The conflicting results for the role of retained ownership justify testing the *OWN* variable in the more recent data set used in this dissertation. Given the results of prior studies, a directional relationship between underpricing and *OWN* is not specified a priori.

2.5.3 Ex ante uncertainty (SIGMA)

There is some support for adverse selection theory where return volatility (*SIGMA*) is used as a proxy for the speed of resolution of ex ante uncertainty. First used in the US context by Ritter (1984a), some Australian studies show this variable provides significant explanatory power for underpricing [How, Izan & Monroe (1995); How (1996); Lee, Lee & Taylor (2003); How, Lam & Yeo (2007); Chang et al. (2008)][7]. Other Australian studies do not find a relationship [Finn & Higham (1988); Lee, Taylor & Walter (1996); How & Howe (2001)].

Another proxy for ex ante uncertainty tested on Australian samples is issue size [Finn & Higham (1988); How, Izan & Monroe (1995); How (1996); Lee, Taylor & Walter (1996); How & Howe (2001); Lee, Lee & Taylor (2003); Dimovski & Brooks (2004); Cotter, Goyen & Hegarty (2005); Chang et al. (2008)]. Fewer than half of these [How, Izan & Monroe (1995); How & Howe (2001); Cotter, Goyen & Hegarty (2005)] found a significant relationship for issue size and underpricing. Other proxies for ex ante uncertainty are the inclusion of earnings forecasts in the prospectus [How (1996); Dimovski & Brooks (2004)] and offer price (Dimovski & Brooks, 2004). Neither of these proxies makes a significant contribution to the explanation of underpricing. There is some mixed evidence for firm age with Lee, Taylor and Walter (1996) and Cotter, Goyen and Hegarty (2005) reporting a significant relationship between firm age and underpricing while most do not find any

[7] The standard deviation of post-listing share prices from days 2 to 10 is highly significant in the Italian fixed-price IPO context (Cassia et al, 2004).

relationship [How, Izan & Monroe (1995); Lee, Lee & Taylor (2003); How & Howe (2001); How, Lam and Yeo (2007); Chang et al. (2008)].

Overall, prior Australian research using different proxies indicates that *SIGMA* is the most consistent proxy for the unobservable level of ex ante uncertainty. Therefore, *SIGMA* is included in this model. A positive relationship between underpricing and *SIGMA* is predicted.

2.5.4 Underwriter participation (UW)

As discussed below, underwriter reputation has received considerable attention in the literature. In light of mixed results for underwriter reputation measures, this research uses a dummy variable (*UW*) to assess the association between underwriter participation and underpricing.

Citing the underwriter reputation literature as a justification, Dimovski and Brooks (2004) use a dummy variable to indicate underwriter participation and find underwritten issues are more underpriced. This positive relationship between underpricing and underwriter participation would be expected if underwriter participation is perceived by the market as a signal the issue will be underpriced.

Brokers play an active role in determining the offer prices for Australian fixed-price IPOs (Cotter, Goyen & Hegarty, 2005) and underwriters negotiate with the issuer to price underwritten issues (How & Yeo, 2000). If underwriters are demonstrating superior skills in pricing offers and are acting in the best interest of issuers, one would expect a negative association between the participation of an underwriter and the level of underpricing. A positive association is consistent with agency conflict with issuers [Loughran & Ritter (2002); Reuter (2006)] or with underwriter activities to increase the market value of the IPO (Chemmanur & Krishnan, 2008). Cotter, Goyen and Hegarty (2005) do not find a statistically significant difference in offer prices of underwritten issues and those that are not underwritten. As this model was estimated on four years of data their result may be a function of the specific time period investigated. They do not include an underwriter variable in their model of underpricing.

In contrast to underwriter participation, underwriter reputation is posited to have a negative association with underpricing attributable to the reduction of ex ante uncertainty [Carter & Manaster (1990); How, Izan & Monroe (1995)]. Unexpected positive relationships for underwriter reputation and underpricing are reported for Australian trust IPOs (James, How & Izan, 1995) and for an Australian sample of mining and industrial IPOs (Chang et al., 2008). How, Izan and Monroe (1995) find the expected negative relationship for industrial IPOs when reputation is measured as the percentage of IPO proceeds represented by underwriter fees. Underwriter reputation measured as the number of IPOs in sample using the same underwriter [How (1996); How & Howe (2001)] or the proportion of proceeds underwritten (How, Lam & Yeo, 2007) does not contribute to the explanation of underpricing.

Australian studies investigating the relationship between underpricing and underwriter reputation group issues that are not underwritten with non-prestigious underwriter issues. This classification system may contribute to the lack of consistent results across studies using an underwriter reputation variable. While the dichotomous variable (*UW*) alleviates the problem of grouping issues that are not underwritten with non-prestigious underwriter issues, it is not possible to make an a priori specification of a directional relationship between underpricing and *UW*.

2.5.5 Attaching options (OPT)

The inclusion of options with the IPO share issue is explained by the agency cost hypothesis (Shultz, 1993) where 'packaged' issues of shares and options are expected to experience more underpricing than share only IPOs (How & Howe, 2001). Alternately, options packaged with the IPO shares can be viewed as a signalling mechanism (Chemmanur & Fulghieri, 1997) resulting in no expected difference in underpricing for packaged and share only issues (Lee, Lee & Taylor, 2003). Again, the Australian evidence is inconsistent. Several studies find no significant difference in underpricing [Howe & Howe (2001); Lee, Lee & Taylor (2003); How, Lam & Yeo (2007)], another finds no difference in underpricing in two models but a positive relationship in a third model (How, 1996) while another reports a significant negative relationship (Dimovski & Brooks, 2004). These inconsistent results justify the investigation of the role of packaging options with shares in this later data set. Again, given the reported results in the literature, no directional relationship between underpricing and *OPT* is specified a priori.

2.6 Conclusion

Before this research attempts to improve the explanatory power of underpricing models in the Australian context, it is first necessary to examine the theoretical underpinnings of this research. Thus, the broad categories of underpricing theory have been reviewed in this chapter. Following Jenkinson and Ljungqvist (2001), underpricing theories are categorised as asymmetric information, institutional explanations and theory of ownership and control. The large information asymmetry literature is divided into subcategories of adverse selection, signalling, principal-agent models and information revelation.

These theories have been developed in different institutional settings and do not provide unequivocal explanations of underpricing in Australia. There are four key areas of difference in the Australian institutional context compared to the US setting where the majority of underpricing theory has been developed. Differences in the pricing mechanism, the nature of underwriting contracts, the provision of price support by underwriters and the capacity to choose discretionary share allocation methods were discussed in section 2.3. Each of the main underpricing theories was discussed with reference to the Australian institutional setting in section 2.4.

Australian empirical underpricing research was reviewed and the baseline model of underpricing developed in section 2.5. The model includes variables that are usually found to have a significant relationship to underpricing in Australia. This model provides the baseline for assessing the relative performance of the underpricing models developed in chapter 8. The sample used for testing this model is described and sample descriptives are presented in the next chapter. Testing and results for the model are discussed in chapter 4.

CHAPTER 3
SAMPLE SELECTION AND DATA DESCRIPTION

3.1 Introduction

The baseline model of underpricing was developed in the previous chapter and will be tested in the next chapter. This chapter presents the rationale used for selecting the test sample and provides preliminary description of the sample data that will be used to test the baseline model.

The first section of this chapter includes the identification and justification for the sample period. Next, the rationale for exclusions from the sample is presented. Descriptive statistics (mean, median, standard deviation, minimum and maximum) for five size measures and leverage are given in section 3.3 to contextualise the sample.

3.2 Sample selection

In this section, the sample period is identified and the annual numbers of IPOs are compared to the mean number of annual IPOs for a prior period. The sample selection process is constrained to include IPOs for corporations offering ordinary shares only or ordinary shares and attaching options. Grounds for exclusion from the sample are then discussed.

3.2.1 Sampling period

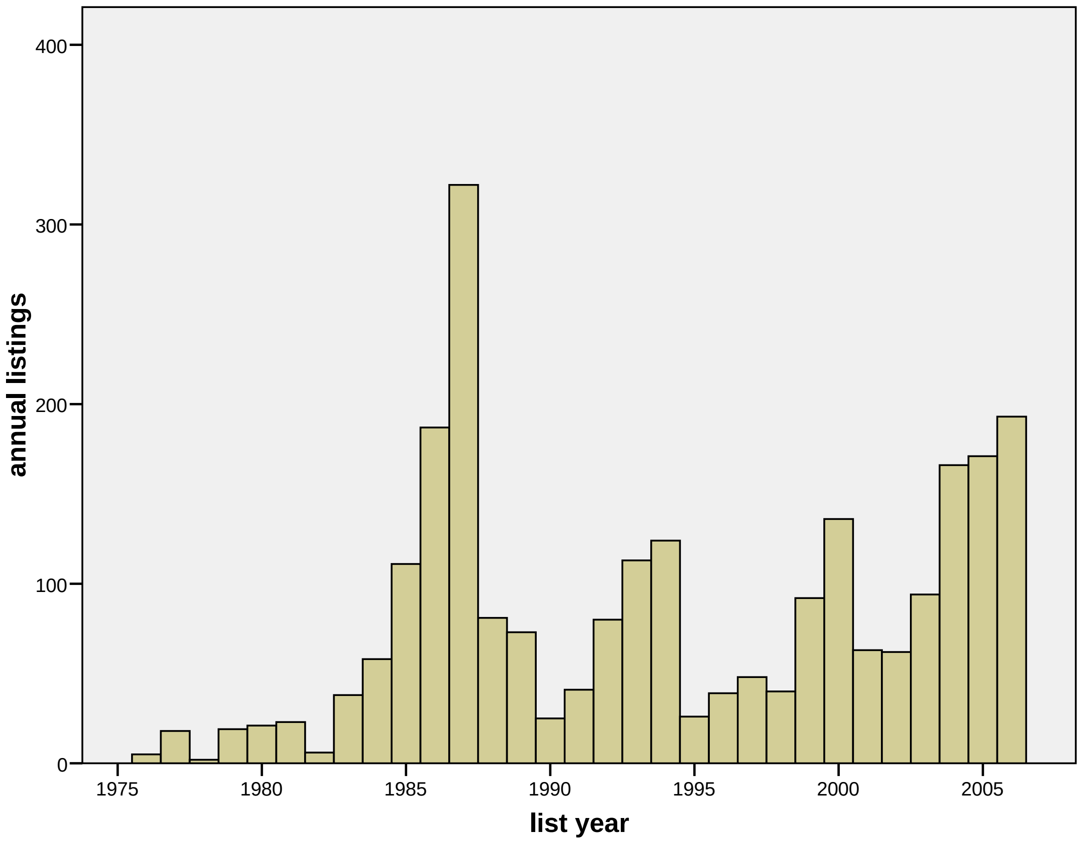
The sample period is 1 January 1997 to 31 December 2006. The choice of sample period is largely a matter of data availability[8]. Whilst the sampling timeframe is not constrained by the data requirements of the model developed in chapter 2, the models developed in later chapters require data sourced from the financial press and from announcements made by companies to the ASX. Electronic coverage of the financial press in the ten-year sample period has greater depth compared to that in years prior to the sample period. Further, data for the exact number of shares issued are only available electronically from February 1998.

---

[8] A summary of data sources and variable measurements for all models in this dissertation is presented in appendix A.

Figure 3.1 shows the number of corporate listings on the ASX for 31 years from 1976 to 2006. The data for figure 3.1 were sourced from the DatAnalysis database. The mean (median) number of annual corporate listings is for the 21 years prior to the sample period is 67 (39). The mean (median) for the sample period is 104 (93).

Figure 3.1 Number of listings on the ASX, 1976-2006



Comparison of the number of IPOs in the sample period to a prior period is important for determining if the sample period is dominated by hot issue market years. Prior research characterises hot markets as those with high underpricing at the start of the period followed by high IPO volume (Ritter, 1984a). In their investigation of the underpricing of Australian resource IPOs, Suchard and Woo (2003) find a systematic relationship between hot market periods and the explanatory power of risk factors for underpricing.

The data in figure 3.1 show that annual listing activity during the sample period is, on average, greater than in the previous two decades raising the possibility that the sample includes one or more hot market periods. In six of the ten sample years, the annual mean number of listings is higher than that of the 21 years prior to the sample. The remaining four sample years (1997, 1998, 2001 and 2002) have fewer listings than the mean for the prior period.

A brief discussion of the overall growth in the Australian equities market during the sample period helps to contextualise the data in figure 3.1. Market capitalisation grew from approximately $A420 billion in June 1997 (ASX, 2008a) to $A1 390 billion in December 2006 (ASX, 2008b) representing a nominal increase of 230%. The RBA's Consumer Price Index (CPI) data shows a 30% rate of inflation for the same period, so real growth in market capitalisation is around 200%. This real growth rate in market capitalisation casts doubt on the validity of categorising the sample period as a hot issue market based solely on comparison with the numbers of IPOs in the previous two decades. The determination of hot markets is discussed further in chapter 6.

Table 3.1 shows the number of new corporate listings (IPOs) on the ASX for each of the sample years. The number of exclusions for each category is shown for each of the sample years. Total exclusions from the sample for each exclusion reason are shown in the final column. The final row of the table shows the number of issues for each year that will be used to test the baseline model in the next chapter. The following sections contain the rationale for each category of exclusion from the sample.

3.2.2 Exclusions from the sample

A diverse array of entities seek listing on the ASX each year. This research, however, draws its sample from the 1 165 corporate equity listings over the period from 1997 to 2006. Consistent with prior research [Brailsford, Heaney & Shi (2001); Shi (2003); Dimovski & Brooks (2004)], debt and hybrid security issues are not included in the sample as these securities are fundamentally different from ordinary shares. CHESS Units of Foreign Securities (CUFS) are electronic depository receipts that represent beneficial ownership of foreign securities (ASX, 2007a). CUFS are not ordinary shares per se and are also excluded.

Table 3.1 Sample selection

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Total
Corporate listings	60	52	117	174	66	72	96	168	170	186	1 161
Exclusions											
Stapled securities and other multiple security type offers	5	3	3	4	1	5	4	6	20	8	59
Bookbuilds and privatisations	2	3	9	9	5	1	8	5	9	4	55
Extractive industry IPOs	11	7	2	16	16	34	42	67	74	109	378
Listed managed funds	1	3	5	8	3	2	10	11	4	3	50
Demutualisations and listing co-operatives	1	3	1	1	2	1	0	0	0	1	10
Cross listing or foreign currency financial reports	3	0	7	12	3	2	3	6	3	11	50
Previously listed on regional exchange	0	0	0	0	0	0	0	2	4	2	8
Relisting in same industry	2	3	4	2	1	2	0	2	4	3	23
Restructuring	2	1	0	1	1	2	1	1	0	1	10
Listing without public share sale	0	3	1	2	4	1	4	4	2	1	22
Total exclusions	27	26	32	55	36	50	72	104	120	143	665
Final sample	33	26	85	119	30	22	24	64	50	43	496

Listed trusts hold a portfolio of investments on behalf of the trust security holders (ASX, 2007b). The trust structure is quite different from the corporate structure and there are different legal issues for trusts. Given that trusts are systematically different from corporates in their nature and in their observed pattern of underpricing, they are excluded from this sample[9].

To meet the research objective outlined in chapter 1, it is necessary to exclude categories of corporate equity issues with specific characteristics that have the potential to confound the results of the model developed in chapter 2. With this objective in mind, these listings are excluded: stapled securities and other types of multiple security offers; bookbuild issues and privatisations; companies operating in the extractive industries; listed managed funds; demutualised entities; listed co-operatives; cross-listings where trading has already occurred on a foreign exchange; listings on the ASX after having been listed on an Australian regional exchange; companies relisting on the ASX in the same industry; corporate restructurings without a capital raising for new entity and listing without an offer of shares.

3.2.2.1 Stapled securities and other multiple security offers

In total, 59 issues of stapled securities and multiple security offers are excluded from the sample. Stapled securities involve the concurrent purchase of a trust unit or debt security with a related equity interest in a company. The Residential Land Partners Group IPO, for example, sold one share of Residential Land Partners Ltd stapled to one unit of the Residential Land Partners Trust. Valuation of stapled securities is complex as the unit or debt securities cannot be traded separately from the share. The non-equity securities have different cash flow patterns and rights in the event of liquidation compared to equities. Even when the value of the debt security is partially determined by the value of the firm's equity as is the case with convertible notes, these securities are debt rather than equity until it is highly probable that notes will be converted (Brailsford, Heaney & Shi, 2001). The complexities associated with

[9] In contrast to the majority of corporate IPO research, James, How & Izan (1995) find no significant relationship between *DELAY* and underpricing for a sample of Australian unit trust IPOs. They also find trusts are less subject to underpricing when compared with ordinary equity issues. Investment trusts and real estate investment trusts are excluded from prior Australian underpricing research [How & Low (1993); How & Yeo (2000); Brailsford, Heaney & Shi (2001)].

valuing two instruments together could potentially mask the underlying determinants of underpricing, so stapled securities are excluded from this sample.

In addition to the exclusion of stapled securities, Brailsford, Heaney and Shi (2001) remove firms issuing packages of shares and options (termed ‘unit offerings’ in the US) from their sample due to the inherent difficulty of valuing the package components individually. How and Howe (2001) use the term ‘PIPOs’ to refer to packages of shares and options offered in the prospectus. The three approaches to offering options in the prospectus are to sell options independently of the issue of shares, to allow investors to purchase options in proportion to the number of shares they apply for and to allot options with shares without charging a discrete price for the options.

Some issuers offer shares and options separately in the same prospectus although this is rare during the sample period. The 2001 offer of Safe Effect Technologies Ltd, for example, offers options at $0.005 and does not require a share application for participation in the option offer. More common but still infrequently, issuers include a discrete offer price and allow applicants to make an application for options in addition to the purchase of shares. Here, the number of options the applicant can apply for depends on the pre-specified ratio of shares needed to purchase one option. The 2001 prospectus of Heartlink Ltd, for example, allows investors to subscribe for an option priced at $0.01 with each share. Investors subscribing for shares do not have to purchase the offered options.

The third and most common approach is for the issuer to allocate a pre-specified number of options with each share. These issues are described as having ‘attaching’ options in the prospectuses. In these cases, issuers do not raise any funds by the issue of options per se, but appear to be using the options as a signalling or marketing tool to attract investors. The options are described as ‘free’ to investors and phrases such as ‘options for no further consideration’ are used to create the impression that investors are receiving extra value from the issuer. The 2006 prospectus of Oz Brewing Ltd, for example, offers ‘one free attaching option for every two shares subscribed for’. While attaching options can only be acquired by the purchase of shares from the prospectus, the options trade separately from the shares on listing with a discrete ASX security code.

Two separate investment decisions are made by investors when the prospectus offers options for sale either with or without the requirement to purchase shares. The first is the decision to purchase the IPO shares and the second relates to the choice to purchase options. Only one investment decision is made by applicants for offers of attaching options – the decision to apply for shares or not. For IPOs offering 'sold' options, the initial return for an investor depends on their investment decision with respect to the option purchase. All investors participating in the offer generate the same initial return for IPOs with attaching options. IPOs offering options for sale are excluded from this sample to avoid potentially confounding influences on initial returns that could arise from the choice investors have to participate in the option offer. IPOs offering attaching options will be included in this study as all investors receive an allocation of options when they participate in the issue. This definition of package issues is consistent with that of Chemmanur and Fulghieri (1997) in their signalling theory of IPO option issuance.

3.2.2.2 Bookbuild issues and privatisations

The fundamental differences in the bookbuild and fixed-pricing mechanisms were discussed in chapter 2. Sharpe and Woo (2005) exclude bookbuilds when investigating factors affecting the choice of a private or public issue immediately prior to listing. Cotter, Goyen and Hegarty (2005) exclude bookbuilds from their study of offer price. Only fixed-price offers are included in the sample in order to avoid any potentially confounding impact of incorporating market demand into the offer price.

In addition to the fundamental differences between the bookbuild and fixed-pricing methods, bookbuild issues present a practical difficulty for measuring underpricing in the Australian context. As discussed in chapter 2, Australian bookbuild issues consist of an institutional component and a retail component, each of which attract a different offer price. Calculation of the initial return requires one offer price and one market price and the level of underpricing for the same issue will be different for institutional and retail investors. A total of 55 bookbuild issues that occurred during 1997-2006 are excluded from the sample.

A privatisation is the transfer of publicly-owned assets by sale of a business to the private sector (RBA, 1997). Privatisations typically experience much higher underpricing than other types of IPOs [Paudyal, Saadouni & Briston (1998); Ariff, Prasad & Vozikis (2007)]. Jones et al. (1999) find a relationship between the underpricing of privatised IPOs and the level of income inequality in a country and the political objectives of the privatising government. These factors will not explain the underpricing of non-privatisation IPOs. Further, asymmetric information will play little or no role in explaining the underpricing of privatised IPOs (Jones et al., 1999). How and Yeo (2000) and Sharpe and Woo (2005) exclude privatised public entities from their Australian IPO samples. As is typical of Australian privatisations, the three that occurred during the sample period used a bookbuild process to establish the offer price.

3.2.2.3 Extractive industries

The valuation of resource firms is fundamentally different from the valuation methods used for non-resource firms. The prospective nature of many resource firms means their valuations are heavily dependent on geological reports rather than current or forecast earnings. Ritter (1984a) argues that the valuation issues associated with resource stocks, relatively higher levels of information asymmetry and relatively higher levels of business risk mean resource stocks have inherently higher risk. Resource stocks exhibit significantly higher average underpricing than industrials and display different behaviours from industrials in the market post-listing (How, 2000). Eight of the ten most underpriced issues from a sample of Australian IPOs over the period 1976 to 1997 were resource stocks (Brailsford, Heaney & Shi, 2001).

Resource firms are systematically smaller with lower average offer prices compared to industrials (Brailsford, Heaney & Shi, 2001). Australian mining firms, however, have relatively higher firm values than their non-extractive counterparts (How & Low, 1993). These differences between extractive and non-extractive IPOs have the potential to confound results if both types of firm are included in the same model of underpricing. Further, earnings forecasts are the critical component in the estimation of intrinsic value in chapter 5 and very few extractive companies provide earnings forecasts. The focus in this research is thus on non-extractive or ‘industrial’ IPOs and 378 resource IPOs are excluded from the sample.

3.2.2.4 Listed managed funds

Listed managed investments, like listed trusts, manage a portfolio of assets on behalf of security holders (ASX, 2007b). Index funds aim to mirror the performance of some particular share market index to provide diversification benefits to equity investors. While index funds take a passive investment approach, hedge funds adopt an aggressive strategy by selecting securities that provide some absolute level of return to equity investors (ASX, 2007b). Licensed investment companies (LICs) also purchase the equities of other companies (ASX, 2007a). Pooled development funds (PDFs) combine funds from equity participants for investments in a portfolio of listed and unlisted shares (ASX, 2007a).

Index funds, hedge funds, LICs and PDFs all derive their values from the net value of the securities in which they invest and the investment style of the fund manager given the current market conditions. As such, these investments are fundamentally different from typical corporate IPOs and 50 such issues are excluded from the sample.

3.2.2.5 Demutualisations and co-operatives

Ownership of mutuals and co-operatives is obtained by membership rather than an equity investment and the ownership interest cannot be traded (RBA, 1999). Demutualised insurance IPOs provide benefits to policyholders upon listing as they experience significantly higher underpricing than their non-mutual counterparts in the US market (Krupa, 2006). Demutualised building society IPOs in the UK are underpriced in an institutional setting where underpricing theories based on management incentives, relative risk, relative size and a requirement to raise sufficient funds are negated (Shiwakoti, Hudson & Short, 2005). Given these differences in the nature of demutualisations, such IPOs are excluded from the sample. As the nature of co-operatives is similar to that of mutuals, these are also excluded. Although it had a corporate structure prior to listing, AWB Ltd is also excluded as it was effectively operating as a growers' co-operative. AWB Ltd 'privatised' in 1999 when the Wheat Industry Fund was transferred to the newly established company and shares were issued to grain grower 'members' who held units in the fund. In total, ten issues are excluded in this category.

3.2.2.6 Cross-listings

Cross listing occurs when a company establishes a second listing on a foreign exchange (Bedi & Tennant, 2002). How and Low (1993), How and Yeo (2000), and Brailsford, Heaney and Shi (2001) exclude any foreign-based company from their studies as these are normally listed on foreign exchanges prior to seeking listing in Australia. Companies that are already listed are not IPOs, even if the company is making its first offer of shares to the Australian investing public. A company listed overseas has an observable market price available, albeit in a foreign currency, that should influence both the offer price and the market price upon listing in Australia.

In this dissertation, cross-listed issuers (rather than foreign-based issuers) are excluded from the sample based on the foregoing discussion. The Australian company Cash Converters International, for example, listed in the UK a year prior to applying for listing in Australia, so is excluded on the basis of that prior listing rather than included because it is an Australian company. Companies disclosing their intention to list on a foreign exchange concurrently or after the Australian listing are included in the sample. One concurrent listing in the sample period was excluded on the basis of the potential leakage of market information given the earlier opening of the New Zealand Stock Exchange than the Australian market.

Irrespective of any cross-listing status, foreign companies that use a reporting currency other than Australian dollars in the prospectus are excluded as their financial statements are not comparable to other firms in the sample. In total, 50 IPOs are excluded from the sample as cross lists or for foreign-currency reporting.

3.2.2.7 Listed on regional exchanges

Brailsford, Heaney & Shi (2001) exclude companies transferring from the Second Board to the Main Board of the ASX as these are not unseasoned issues. The market has access to trading price histories for seasoned issues. This price information affects the establishment of both the offer price and the market price on the first day of trading on the ASX. The Second Board did not exist at the commencement of the sample period for this dissertation. However, the re-emergence of regional exchanges in the Australian market creates a setting similar to the operation of the Second Board.

Eight companies were excluded from the sample as they had been listed on the Newcastle Stock Exchange prior to seeking listing on the ASX.

3.2.2.8 Relistings

Some companies raise new capital after they are removed from the ASX lists and seek to relist. Amlink Ltd, for example, was delisted in 1992 after a five-year suspension of trading of its shares. A rights issue was made to Amlink shareholders in 1997 to provide sufficient capital to acquire assets and proceed to a public issue. The company relisted at the end of 1998 after the successful public issue. Relisting can also occur on the same day as delisting. The shareholders of Telecasters North Queensland Ltd, for example, exchanged their shares for shares in a new entity, Ten Network Holdings Ltd. Telecasters North Queensland Ltd was removed from the ASX lists on the same day Ten Network Holdings listed after raising additional capital. Such issues are seasoned as a history of trading prices is available for these firms. Twenty three relistings are excluded from the sample as these companies continue operations in the same industry.

3.2.2.9 Restructuring

Capital restructurings of existing listed companies are not unseasoned issues and are typically excluded from Australian underpricing studies [How & Low (1993); How & Yeo (2000); Brailsford, Heaney & Shi (2001)]. The restructured company may be identified as a new listing by the ASX but no prospectus is available unless the restructure is accompanied by a new capital raising. Westfield Group Ltd's 2004 listing was the result a merger of three associated listed entities: Westfield Holdings Ltd, Westfield Trust and Westfield America Trust. As an observable market price is available for the company immediately prior to restructuring, ten such companies are excluded from the sample.

A spin-off is a form of corporate restructuring that involves the divestiture of a line of business to create a new listed entity. Shareholders of the original company receive a pro-rata allocation of shares in the new company (Durand, Woodliff & Richards, 2003). Sonic Health Ltd, for example, listed its subsidiary Scigen Ltd without raising any new capital. Spin-offs without any public capital raisings are excluded from the sample because they represent transactions between the current owners. Spin-offs normally involve the allocation of shares to the parent company's shareholders and make a public capital raising prior to listing (Durand, Woodliff & Richards, 2003). These are included in the sample – although the price of the original company can be observed in the market prior to the IPO, the price of the line of business that creates the new company cannot be objectively determined.

3.2.2.10 No public offer of shares

Twenty two companies in the sample period listed without a public capital raising. These were mostly spin-offs (see previous section) where shares were allocated to existing shareholders (BHP's spin-off of Onesteel Ltd, for example) or where only existing shareholders could apply for shares in the new company (MyCasino's spin-off of Rox Ltd, for example). Issues raising capital by private placement then listing are excluded as they are not 'public' offers and no prospectus is available for analysis.

In conclusion, 665 of the 1161 corporate listings that occurred during the period from 1997 to 2006 are excluded as they fall into one of the ten categories discussed above. As shown in table 3.1, the total number of IPOs included in the underpricing sample is 496. The sample represents 43% of the corporate listings that occurred during the period from 1997 to 2006. The following section discusses the underpricing sample that will be used to test the baseline underpricing model developed in chapter 2.

3.3 Describing the sample

While industry classification is normally an important element in contextualising sample firms, such descriptive statistics are difficult to interpret for this sample period. Section 5.4.2 provides details of the change to the industry classification system used in Australia that occurred in 2002. This change has necessitated the application of the ASX system of industry classification to companies listing prior to May 2002 and classification using the General Industry Classification Standard (GICS) for the remaining sample firms. The absence of a single classification system for the sample period hampers meaningful inter-industry comparison of firms. Therefore, descriptive statistics for two measures of firm size, three measures of issue size and leverage are used to contextualise the sample.

As discussed in section 3.2.1, the CPI rose 30% during the sample period. Consistent with How and Howe (2001) and Balatbat, Taylor and Walter (2004), dollar amounts are expressed in end-of-sample period dollar equivalents. The dollar values are made comparable by adjusting them to 4th quarter 2006 dollars using the Consumer Price Index. The 4th quarter of 2006 represents the end of the sample period. CPI data were obtained from the Reserve Bank of Australia website.

Table 3.2 provides descriptive statistics for market capitalisation, total assets, issue size, gross proceeds to the company, gross proceeds to existing owners and leverage. These measures are not included in the baseline underpricing model but are presented to provide an indication of the size of IPOs during the sample period and to facilitate some preliminary analysis of the sample.

Table 3.2 Descriptive statistics for the sample of 496 Australian non-extractive IPOs between 1997 and 2006 (end 2006 A$'000 equivalents)

	Mean	Median	S.D.	Min	Max	K-S (*p-value*)	Skew	Kurtosis
Market cap	64 540	35 031	92 170	2 825	1 209 988	(0.000)	5.617	53.233
Total assets	44 165	18 577	118 380	189	2 283 654	(0.000)	14.375	261.240
Issue size	21 680	9 322	39 119	0	585 058	(0.000)	7.544	91.604
Gross to company	15 179	8 090	30 896	0	585 058	(0.000)	13.243	235.295
Gross to owners	7 603	0	24 721	0	264 500	(0.000)	5.607	40.793
Leverage %	24.397	16.480	23.083	0	96.444	(0.000)	0.873	-0.095

Market cap (market capitalisation) = minimum number of shares on offer multiplied by the offer price ($'000). Total assets = total assets from the pro-forma balance sheet ($'000). Issue size = minimum subscription size ($'000). Gross to company (gross proceeds to company) = minimum received from the sale of new shares ($'000). Gross to owners (gross proceeds to owners) = minimum received from the sale of vendor shares ($'000). Leverage % = [total liabilities from the pro-forma balance sheet / total assets from the pro-forma balance sheet]*100.

Share price data for the calculation of market capitalisation are primarily obtained from Float.com.au and are screened for data entry errors. The largest underpricing and overpricing returns are cross-checked with share prices on the SIRCA DataDisk and the financial press. Data for the number of shares on offer, new and vendor shares offered, total assets and total liabilities are hand-collected from the prospectuses. To minimise data entry errors, these data are entered into a spreadsheet that calculates a verification figure. For example, new shares and vendor shares are added together and compared to the number of total shares offered entered from the prospectus.

All prospectuses contain disclosure of the maximum and minimum number of shares that will be issued[10]. Sixty-eight percent of sample firms offer a fixed number of shares (i.e. they have a maximum subscription amount that is equal to the minimum subscription amount). The number of shares that will be issued cannot be definitively ascertained from the prospectus for the remaining 32% of the sample where a variable number of shares are offered. In prior Australian research, IPO size measures are frequently based on the number of shares offered [Finn & Higham (1988); Lee, Taylor & Walter (1996); Lee et al. (2003); Lee, Lee & Taylor (2003); How & Howe (2001); How, Izan & Monroe (1995); Da Silva Rosa, Velayuthen & Walter (2003); Dimovski & Brooks (2004); Cotter, Goyen & Hegarty (2005); Bayley, Lee & Walter, (2006)]. None of these, however, indicate if the minimum or maximum number of shares offered is used in the size measure.

To clarify whether the maximum or minimum number of shares offered is the more probable indicator of final offer size, data from ASX announcements[11] were examined to determine the level of oversubscriptions for sample IPOs. Announcements were available for 144 of the 159 sample IPOs offering a variable number of shares. The ASX announcements identify the total number of shares listed for the first day of trading. For those IPOs that were subject to the ASX's escrow requirements, the number of escrowed shares was added to the number of listed shares. The maximum offer size and the number of shares listed on the ASX were equal for 28% of the variable offer IPOs examined. Therefore, as the majority of IPOs offering a variable number of shares do not issue the maximum possible number of shares, market capitalisation, total assets, issue size and gross proceeds are measured using the minimum subscription specified in the prospectus.

[10] Terminology indicating the maximum amount of shares to be issued varies in the prospectuses. Some issuers simply refer to this as the 'maximum' subscription while others refer to any amount greater than the minimum subscription as 'oversubscriptions'. In this dissertation, the term 'oversubscription' will be reserved for applications in excess of the maximum number of shares offered in the IPO and 'maximum' subscription is used to identify the maximum number of shares that the issuer is offering.

[11] Announcements were obtained from the ASX website at http://www.asx.com.au

Mean-inflation adjusted market capitalisation for the sample is $64 540 000 while the typical (median) IPO has a market capitalisation of $35 031 000. The mean market capitalisation for companies already trading (including the ‘materials’ industry category) on the ASX is around $1 billion[12]. However, the median is much smaller at approximately $35 million. Thus, the typical IPO is about the same size as the typical company listed on the ASX[13].

The inflation adjusted mean (median) amount of total assets is $44 165 000 ($18 577 000). The range of total assets for issuers is $189 000 to $2 283 654 000 and the distribution exhibits highly significant positive skewness and kurtosis. Total assets are disclosed in the pro-forma balance sheet included in the prospectus. The pro-forma balance sheet represents the financial position of the company upon completion of the IPO. One set of figures is presented for the 68% of sample IPOs offering a fixed number of shares. If these companies are not underwritten and do not receive applications for the number of shares offered, the issue is withdrawn. The pro-forma balance sheets for the remainder of the sample include several sets of figures to indicate the financial position of the company if the minimum subscription is received, if the target subscription is received and if the maximum subscription is received.

The mean (median) issue size for the sample is $21 680 000 ($9 322 000). The largest issue is Babcock & Brown’s 2004 float which raised $585 058 000 while the next largest issue (Flexigroup Ltd in 2006) raised less than half this amount with $264 522 096. While seeking to raise funds from the prospectus, eight issuers in the sample period stated that no funds or new shareholders were required to meet the listing requirements of the ASX. Each of these issuers therefore had a minimum subscription amount of zero. They all offered new shares only and specified a non-zero maximum subscription amount. The variable offer size IPOs tended to have

[12] Market capitalisation ($A 2006) for each ASX listed company was sourced from the FinAnalysis database. NZX listed companies were removed from the dataset. Only the Australian listed component of market capitalisation was included for cross-listed companies. After excluding the ‘materials’ industry category, the mean (median) market capitalisation is $970 million ($42.3 million)

[13] The distribution of market capitalization for ASX listed firms is extremely leptokurtic (kurtosis = 334.99). Table 3.2 shows that, while still highly leptokurtic, the distribution of market capitalization for sample IPOs has a relatively lower level of kurtosis (53.23). Sample IPOs also display relatively less skewness (5.62) compared to all listed firms (21.54).

lower CPI-adjusted market capitalisation and lower CPI-adjusted total assets than those specifying a fixed subscription amount in the prospectus[14].

Gross proceeds to the company is measured as the CPI-adjusted amount raised from the sale of new shares. The minimum number of new shares to be issued and the offer price are disclosed in the prospectus. Gross proceeds are calculated as the minimum number of shares multiplied by the offer price. Sample issuers offered only new shares (75.6%), only shares sold by existing owners (3.6%) or a combination of new shares and vendor shares (20.8%). Average (median) gross proceeds to the company for the sample is \$15 179 000 (\$8 090 000). Those IPOs that offer only vendor shares have zero gross proceeds to the company. The largest value for gross proceeds for the company is \$585 058 000 raised by Babcock & Brown Ltd, followed by Flexigroup Ltd who, again, have less than half this amount.

Gross proceeds to owners represents the amount that is received from the sale of the minimum number of vendor shares offered. The prospectus identifies how many of the shares offered are new and how many (if any) are being sold by the existing shareholders. Mean gross proceeds to the owners in the sample is \$7 603 000. As 75.6% of sample IPOs do not offer vendor shares, the median gross proceeds to owners is zero. The largest inflation-adjusted amount of funds to existing owners is the \$264 500 000 received by Flexigroup Ltd's shareholders in 2006. Vendor shares were offered by 121 (or 24.4%) of the sample IPOs. Vendor shares are offered by larger issuers who expect to be able to raise sufficient funds to meet the needs of the company and allow the owners to realise some of the value in their holdings[15].

---

[14] Kolmogorov-Smirnov (K-S) tests reported in table 3.2 show market capitalisation ($p = 0.000$) and total assets ($p = 0.000$) are not normally distributed. Therefore, the Mann-Whitney U test is used to test for differences in the distributions of market capitalisation and total assets for issuers who choose to offer a fixed number of shares and those who offer a variable number of shares. Results show IPOs offering a variable number of shares have significantly smaller CPI adjusted market capitalisation (Mann-Whitney U = 18 231, $p = 0.000$) and CPI adjusted total assets (Mann-Whitney U = 18 241, $p = 0.000$).

[15] Mann-Whitney U tests are used to explore any differences in the distributions of gross proceeds to the company and size for this group compared to those offering only new shares. Those IPOs offering vendor shares in addition to or in place of new shares have significantly higher CPI adjusted total assets (Mann-Whitney U = 13 160, $p = 0.000$) and CPI adjusted market capitalisation (Mann-Whitney U = 10549, $p = 0.000$). Interestingly, there is no significant relationship between the gross proceeds raised by issuing new shares in the company and the sale of vendor shares (Mann-Whitney U = 21 284.5, $p = 0.306$).

Leverage is calculated as the ratio of total liabilities to total assets (Balatbat, Taylor & Walter, 2004). The mean and median leverage for the sample are 24.4% and 16.5% respectively. Roughly 5% (24) sample IPOs had no liabilities in the pro-forma financial balance sheet, resulting in zero leverage for these firms. The highest leverage was reported by Neverfail Springwater, with Mobile Innovations next at 96.26%.

Examination of the descriptive statistics in this section shows considerable variability in the size of issuers even after exclusions are made to homogenise the sample. Comparing the proportions of new-share-only issues to vendor-share-only issues and the combination of new and vendor shares provides evidence that most Australian fixed-price issuers (three quarters) go public with the objective of raising new funds for the company. Analysis of the measures in this section shows size is related to the issuer’s decision to offer a variable number of shares and to offer vendor shares. While some issuers have very high leverage, a small proportion does not include debt in the financial structure at listing.

3.4 Conclusions

The sample period for this research is 1 January 1997 to 31 December 2006. Approximately 43% of total corporate listings over the sample period are included in the sample. Exclusions from the sample are made to decrease heterogeneity in the issue method (fixed-price), types of securities offered (shares or shares with attaching options), nature of operations (non-extractive and not investment companies), ownership structure prior to listing (no demutualisations or co-operatives) and the amount of share price information available to the market (no cross listings, prior Australian listings or restructurings).

Having developed the baseline model in chapter 2 and identified and described the testing sample in this chapter, chapter 4 presents the empirical analysis of the model. The results from testing the baseline model will be used to develop extended models of underpricing in chapter 8 after the disaggregation of the components of underpricing in chapters 6 and 7.

CHAPTER 4
TESTING THE BASELINE UNDERPRICING MODEL

4.1 Introduction

This chapter provides the empirical testing to answer the first research sub-question: which factors explain underpricing in Australia? The rationale for the specification of the dependent variable is presented in the first section of this chapter. Prior literature was examined in chapter 2 to ascertain which variables contributed to the explanation of underpricing in Australia. The hypothesised relationships for these independent variables and underpricing are presented with the empirical model (or 'baseline' model) in section 4.3. This section also includes discussion on the measurement of each of the independent variables. Section 4.4 provides descriptive statistics and analysis of correlations between variables. The rationale for using regression analysis is given and results are presented in section 4.5. The final section presents conclusions.

4.2 Measuring underpricing

Underpricing is the return to an investor who purchases a share from the prospectus at the offer price and sells at the market price at the end of trading on the day of listing (Jenkinson & Ljungqvist, 2001). This section commences with the analysis of three different specifications of the underpricing measure. The different underpricing measures are then compared using the Wilcoxon Signed Ranks test to assess differences in distribution. Sample IPOs are categorised as overpriced, correctly priced and underpriced to examine potential differences in classification that are reliant on the choice of underpricing measure. The section concludes with a comparison of underpricing in this sample to underpricing in prior Australian literature.

Three main issues arise in the determination of the underpricing measure. The first and most fundamental concerns the question whether underpricing is viewed from the investors' or the issuers' perspective. The second relates to the opportunity cost to investors attributable to the lag between paying for shares and being able to realise a return. The third is the inclusion of the return on options in the underpricing measure for packaged issues. These three aspects of measuring underpricing are discussed in sections 4.2.1, 4.2.2 and 4.2.3.

4.2.1 Investor versus vendor return

Underpricing is frequently discussed in terms of 'return to investors' [c.f. Ritter (1991); Booth & Chua (1996)]. Alternately, underpricing can be analysed as the wealth loss to issuers (Barry, 1989). Habib and Ljungqvist (1998) argue a gain to the investor does not represent a symmetric opportunity loss to the issuer. In their study of Australian underpricing, da Silva Rosa, Velayuthen and Walter (2003) develop three further measures of underpricing based on Habib and Ljungqvist's concept of wealth loss to owners. The first of these adjusts for the level of retained ownership, the second standardises this wealth loss measure of underpricing by the market value of the firm while the third captures the loss to owners standardised by the value of the firm based on the offer price.

As the objective here is to ascertain if the explanatory power of previously-tested variables persists, the dependent variable will be measured from the investors' perspective. This approach facilitates comparison with the results of the majority of Australian studies.

4.2.2 Raw versus market-adjusted returns

Raw underpricing (*RUP*)[16] is the change from offer price to closing price at the end of the first day's trading divided by the offer price (c.f. Lee, Taylor & Walter, 1996). Market-adjusted underpricing (*MAUP*) is calculated by subtracting the return on the market index (from prospectus date to listing date) from the raw return (c.f. How, Izan & Monroe, 1995). The zero-one version of the market model with the All Ordinaries Accumulation Index is typically used to measure market-adjusted return (c.f. Lee, Taylor & Walter, 1996).

US investors bid for the number of shares they wish to acquire, then pay for the number of shares they are allocated up to five days after receiving their allocations

[16] Raw underpricing can also be identified as 'headline' underpricing (da Silva Rosa, Velayuthen & Walter, 2003)

(Shultz & Zaman, 1994). The capacity for market movements to impact on the US IPO investor's return is negligible as listing occurs within days or hours of price setting in the US [Ellis, Michaely & O'Hara (1999); Draho (2004); Ljungqvist, (2004)]. Thus, raw underpricing is used as the dependent variable in US studies (Ljungqvist, 2004).

In contrast, we saw in chapter 2 that investors in Australian fixed-price offers pay the full price for the number of shares they apply for at the time of making the application. The average number of days from prospectus issue to listing in fixed-price offers is around eight weeks [Lee, Taylor & Walter (1996); Cotter, Goyen & Hegarty (2005)]. The payment by potential investors and the relatively long lag to listing introduces an opportunity cost for funds that is not experienced by investors in the US. Market-adjusted underpricing reflects the opportunity cost to the investor in fixed-price issues. Lee, Taylor and Walter (1996, p. 1196) choose market-adjusted underpricing to avoid '… overstating the "abnormal" returns to IPO subscribers'.

The majority of Australian IPO research reports both raw and market-adjusted underpricing. Of those studies that model underpricing, most use a market-adjusted measure as the dependent variable [Finn & Higham (1988); How, Izan & Monroe (1995); Lee, Taylor & Walter (1996); How & Howe (2001); Cotter, Goyen & Hegarty (2005)].

In contrast, Dimovski and Brooks (2004) use raw underpricing as their dependent variable and include the change in the market index from the prospectus date to listing date as an independent variable to capture market sentiment. While return on the market index reflects an element of sentiment, it does not differentiate between a change in sentiment and a change in the level of systematic risk. Changes in systematic risk (or the risk premium) should not be confused with a measure of market sentiment (Baker & Wurgler, 2006). Raw returns are also used by How (1996).

Ljungqvist (2004) considers that it 'makes sense' to adjust for market movements in fixed-price settings where more time elapses between price setting and trading. The use of raw underpricing as the dependent variable disregards any opportunity cost borne by investors who must pay the subscription amount when they apply for the shares. Market-adjusted returns are used most frequently in Australian underpricing research and are the more theoretically-consistent measure of return.

4.2.2.1 Selecting the market adjustment method

The approach in this dissertation is to acknowledge that the benchmark for opportunity cost should consist of alternative investments that are as similar as possible to the sample firms. Some of the main Australian share price indices are investigated in this section to achieve this objective.

The S&P/ASX indices available for the Australian market are weighted by market capitalisation (ASX, 2008c) so large-company returns drive the return on the index[17]. Analysis of the relative size of Australian fixed-price IPOs compared to ASX-listed companies undertaken in chapter 3 revealed that both groups have similar medians (both about $35 million) but very different means ($65 million and $1 billion respectively).

The S&P/ASX 300 includes 300 companies selected primarily by market capitalisation with additional criteria for liquidity and investability (ASX, 2008c). The S&P/ASX Small Ordinaries Accumulation Index (SOAI) includes the smallest (by market capitalisation) 200 companies in the S&P/ASX 300 (ASX, 2008c). The mean market capitalisation of companies in the SOAI is roughly $748 million compared to a mean of about $3 billion[18] for the S&P/ASX All Ordinaries Accumulation Index.

During 2006, the S&P/ASX All Ordinaries Accumulation Index covered approximately one third of listed companies by including the largest 500 while representing 98% of total market capitalisation[19]. The SOAI is used in this research to provide a benchmark market return that excludes the influence of returns

[17] The FinAnalysis market capitalisation data (discussed in chapter 3) show the largest ten listed companies, for example, represented 47.6% of market capitalisation in 2006.
[18] The means are approximated by sorting market capitalization by size and calculating the means for the largest 500, 300 and 100 companies. As the SOAI consists of the S&P/ASX 300 minus the S&P/ASX 100, the mean for the SOAI is approximated by the mean of 200 companies that immediately follow the largest 100.
[19] This percentage is determined by approximating the market capitalization of the largest 500 companies and comparing this to total market capitalisation.

experienced by the largest listed companies. Index data for market adjustments are obtained from Datastream.

4.2.3 Including option returns in underpricing

As discussed in chapter 2, issues with attaching options are included in this sample while those with sold options are excluded. The justification for this approach is that the return on the separable option forms part of the return to the investor. Therefore, the argument in this research is for the inclusion of the return on attaching options in the underpricing measure.

In her investigation of earnings forecasts and underpricing, How (1996) includes the return on options in the measure of underpricing and reports a positive relationship for underpricing and an indicator variable for packaged issues. The role of options in Australian IPOs is specifically examined by How and Howe (2001) and Lee, Lee and Taylor (2003). How and Howe (2001) use the market value of both issued shares and options in their measure of size and discuss offer price in terms of 'securities issued'. Although they do not make an explicit statement about the inclusion of options in their measures of underpricing, their discussion of associated measures suggests that offer and market prices have been included. How and Howe (2001) find no difference in the level of underpricing for packaged issues when they model underpricing.

Lee, Lee and Taylor (2003) also include options in the determination of the offer price while making no explicit statement about the inclusion of the option's market price at listing in their measure of underpricing. Again, no difference in the level of underpricing for packaged issues is reported.

In their model of Australian underpricing, Dimovski and Brooks (2004) report significantly lower underpricing for packaged issues. This result is not directly comparable with those How and Howe (2001) or Lee, Lee and Taylor (2003) as the measure of underpricing includes the return on options but does not utilise a market adjustment.

Section 4.2.1 identifies the focus in this research on underpricing as the return to the investor rather than as a loss to the owners. Section 4.2.2 makes the case for market-adjusted returns in the Australian context and section 4.2.3 argues for the inclusion of the return on attaching options in the measure of return to the investor. Thus, from the theoretical perspective in the context of underpricing as the return to the investor, the dependent variable for the baseline model should be measured as market-adjusted returns that include the return on attaching options. Except for the studies of How and Howe (2001) and Lee, Lee and Taylor (2003), the baseline model has been developed from literature that uses market-adjusted returns that do not include the return on options. The baseline model will use market-adjusted returns to facilitate comparability with prior research. The model will also be tested using the more rigorous specification of underpricing that includes both a market adjustment and the return on options. The next section further explores the alternate measures of the dependent variable with discussion of the choice of underpricing measure and its impact on the identification of underpriced issues.

4.2.4 Comparing raw, market-adjusted and package underpricing

Underpricing measures relate offer price to market price at the end of trading on the listing date. Thus, descriptives for the underpricing measure commence with a discussion of offer and market prices.

Offer prices are obtained from the prospectus for each IPO. As shown in table 4.1, the mean (median) offer price for sample firms is \$0.75 (\$0.50). The lowest offer price in the sample is \$0.20 and the largest offer price is \$5. IPOs with offer prices below the mean are significantly lower market capitalisation at listing than those with offer prices above the mean[20]. Consistent with observed mean underpricing, market price has a higher mean (\$0.95) and median (\$0.74) than offer price. The standard deviations indicate that market prices are more variable than offer prices. The lowest market price (\$0.05) was recorded for one of the issues with the lowest offer price

[20] The K-S test shows that distribution of offer prices in this sample represent a significant departure from the normal distribution (p = 0.000). Mann-Whitney U tests reveal that the 286 IPOs with offer prices below the median of \$0.50 have significantly lower CPI adjusted total assets (p = 0.000) and CPI adjusted market capitalisation (p = 0.000).

($0.20). The highest market price ($7.98) was experienced by the issuer with the highest offer price.

Table 4.1 Descriptive statistics for underpricing measures - 496 Australian IPOs between 1997 and 2006

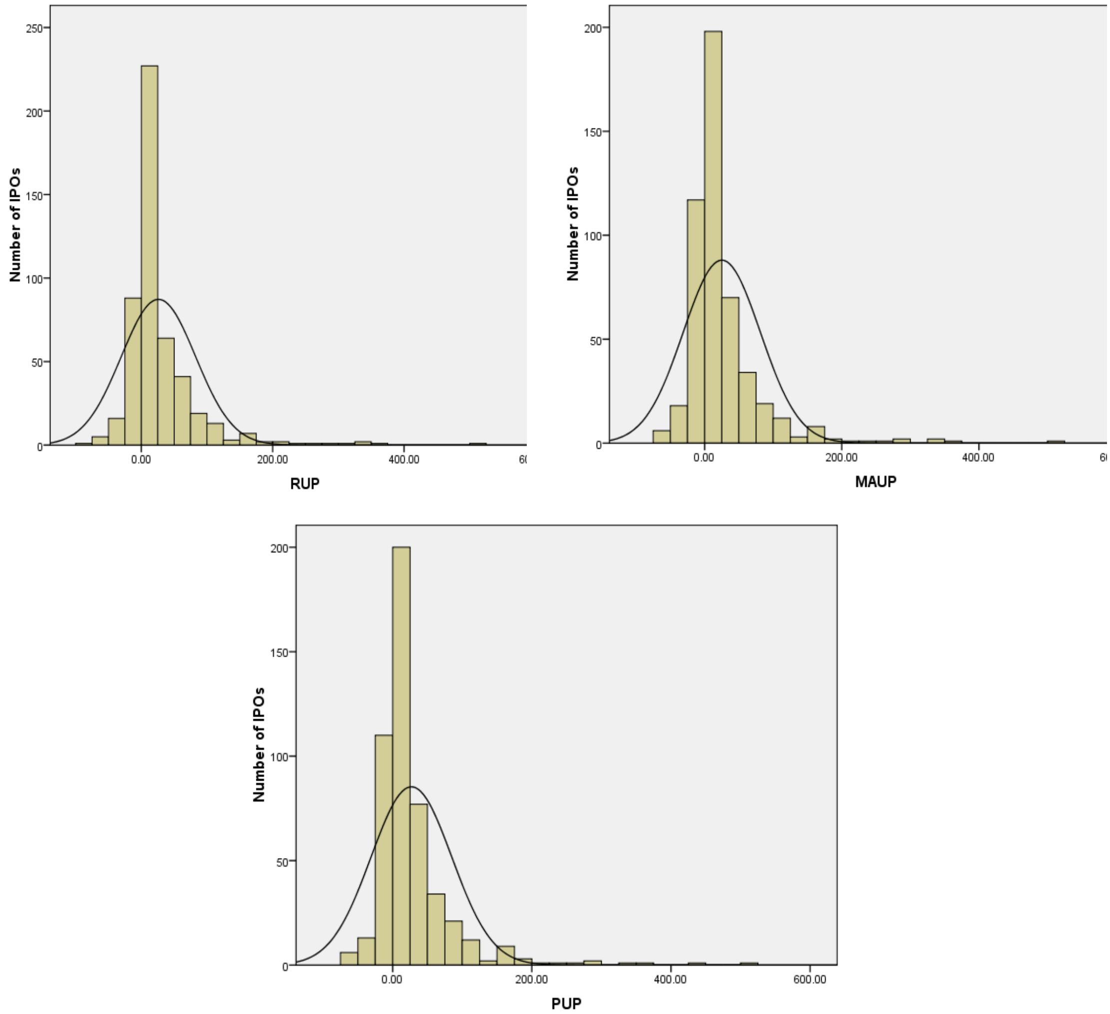
	Mean	Median	S.D.	Min	Max	K-S (*p*- value)	Skew	Kurtosis
OP $	0.75	0.50	0.573	0.20	5.00	(0.000)	2.072	8.350
P $	0.95	0.74	0.875	0.05	7.98	(0.000)	3.161	17.757
RUP (%)	26.05	10.00	56.673	-80.00	504.00	(0.000)	3.489	18.668
MAUP (%)	25.02	10.48	56.190	-74.18	504.19	(0.000)	3.559	19.185
PUP (%)	26.89	11.68	57.953	-74.18	504.19	(0.000)	3.679	20.149

OP = offer price = subscription price per share. *P* = market price = observed trading price at the end of the listing date. *RUP* = raw underpricing = [(Market price - offer price) / offer price] x 100. *MAUP* = market-adjusted underpricing = *RUP* – return on the market index. *PUP* = packaged underpricing = market-adjusted underpricing including the return on any attaching options.

Prior to analysis of the underpricing measures, the data are screened and the highest and lowest five percent of observations are checked for potential data errors. Each of the three measures of underpricing identifies the same companies as the most overpriced and the most underpriced. Emitch Ltd's 2000 IPO is the most underpriced generating a raw initial return of 504%. Epitan Ltd's 2001 IPO is the most overpriced with an 80% loss to investors purchasing from the prospectus and selling at the end of the first trading day.

The expected difference between raw and market-adjusted underpricing depends on the market conditions during the period from prospectus date to listing. A falling market will result in higher market-adjusted returns while a rising market will be associated with lower market-adjusted returns, ceteris paribus. Including the return on attaching options in market-adjusted underpricing will necessarily result in the former return being higher than the latter as the options are free to investors and the minimum possible return on them is zero. The means, medians and standard deviations for each of the three measures are similar.

Figure 4.1 <u>Distributions for *RUP*, *MAUP* and *PUP*</u>



Frequency histograms overlayed with the corresponding normal curve are shown for each of the three measures of underpricing in figure 4.1. As reported in table 4.1, these distributions are leptokurtic and exhibit positive skew, consistent with the typical non-normal distributions of returns data (Brooks, 2002). Kolmogorov-Smirnov tests reported in table 4.1 confirm that the distributions are significantly non-normal. Therefore, the non-parametric Wilcoxon Signed Ranks test is used to examine differences between the underpricing measures. The null hypothesis for the Wilcoxon test is no difference in distributions for the two groups (Siegel & Castellan, 1988).

Results from the Wilcoxon tests reported in table 4.2 show that *RUP* and *MAUP* have significantly different distributions. The number of negative ranks show *RUP* is higher than *MAUP* in around 58% of the sample IPOs while the positive ranks show *RUP* is lower in the remaining 42%. Package underpricing is, as expected, significantly higher than market-adjusted underpricing[21].

Table 4.2 Comparing underpricing measures

	RUP & *MAUP*	*MAUP* & *PUP*
Negative ranks	285	0
Positive ranks	211	63
Ties	0	433
Z statistic	-4.543	-6.902
Significance	0.000	0.000

RUP = raw underpricing. MAUP = market-adjusted underpricing. PUP = market-adjusted underpricing including the return on options.

The differences in distributions of the three underpricing measures have implications for the determination of which IPOs are underpriced, overpriced or correctly priced. Sample IPOs are categorised for each year and each measure of underpricing in table 4.3. The numbers of underpriced, overpriced and correctly priced issues are shown for each underpricing measure and each sample year. %UP indicates the percentage of issues classified as underpriced each year for each of the three underpricing measures.

For comparability with the majority of Australian underpricing literature, *MAUP* is used here as the yardstick measure of underpricing. Thus, the following analysis compares *RUP* and *PUP* to *MAUP* to determine misclassification of IPOs. The results for *MAUP*, presented in Panel A, show 28% of issues are overpriced.

Panel B of table 4.3 demonstrates the impact of omitting the return on the market index from the calculation of the initial return. In 2006, for example, the *RUP* measure classifies three IPOs as underpriced and a further five as correctly priced when these are classified as overpriced using *MAUP*. This measure of underpricing classifies 22% of issues as overpriced. The final row in Panel B shows that the *RUP* measure of underpricing misclassifies 16% of sample firms. Some issues are classified as overpriced when they are underpriced (with respect to *MAUP*), some as

[21] Parametric *t*-tests for difference in means confirm the results of the Wilcoxon tests.

underpriced when they are overpriced and some as correctly priced when they are either over- or underpriced. Further, the proportion of firms that are misclassified varies between years from a low of 6% in 1997 to a high of 46% in 1998.

Table 4.3 Underpricing and overpricing

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Total
Panel A: Market-adjusted underpricing measure (MAUP)											
Underpriced	30	18	66	84	20	17	16	42	33	29	355
Correct	0	0	0	0	0	0	0	0	0	0	0
Overpriced	3	8	19	35	10	5	8	22	17	14	141
%UP	91	69	78	71	67	77	67	66	66	67	72
Panel B: Raw underpricing measure (RUP)											
Underpriced	31	12	69	77	14	16	17	46	34	30	346
Correct	0	4	5	10	5	1	3	3	4	5	40
Overpriced	2	10	11	32	11	5	4	15	14	6	110
%UP	93	46	81	65	47	73	71	65	73	76	70
Number misclassified[a]	2	12	16	20	12	2	8	14	8	14	80
Percent misclassified[a]	6	46	18	17	40	9	33	22	15	34	16
Panel C: Market-adjusted underpricing including return on options (PUP)											
Underpriced	31	19	67	87	20	18	18	44	34	29	367
Correct	0	0	0	0	0	0	0	0	0	0	0
Overpriced	2	7	18	32	10	4	6	20	16	14	129
%UP	91	73	79	73	68	78	75	70	61	69	74
Number misclassified[a]	2	2	2	6	0	2	4	4	2	0	24
Percent misclassified[a]	6	8	2	5	0	9	17	6	4	0	5
Packaged	2	5	10	14	7	6	5	7	4	3	63

[a] The number and percent of misclassified IPOs identifies the deviations from the classification of issues as under-, over- and correctly priced relative to the market-adjusted return.

The market-adjusted package underpricing results are shown in Panel C. Using *MAUP* as the yardstick for underpricing results in 26% of issues classified as overpriced. Lee, Taylor and Walter (1996) report around one third of their sample is overpriced using Australian data for the earlier period from 1976 to 1989. Comparing these two sample periods, it appears that the distributions of underpriced and overpriced issues vary over time.

As mentioned previously, 71 (14%) of the sample firms issued attaching options. The final row of panel C identifies the number of issues each year that have attaching options traded on the listing day. The options for seven packaged IPOs were not traded on the listing date and no return on the option component of the issue has been included in the initial return for these firms. In contrast to the *RUP* measure, only 5% of issues are misclassified when the *PUP* measure is applied. This result is attributable to both *MAUP* and *PUP* including adjustments for movements in the market during the time from prospectus date to listing. However, comparing *PUP* to *MAUP* shows that more issues are classified as underpriced when the return on options is considered. Omitting the option component of return understates the number of underpriced IPOs.

The underpriced, overpriced and correctly priced trichotomy is often utilised in underpricing research. Whilst the above analysis demonstrates differences in classification dependent on the choice of underpricing measure, there are also important implications for measuring the extent of underpricing. There is zero underpricing, for example, in the 40 IPOs (or 8% of the sample) that *RUP* classifies as correctly priced. Using the *MAUP* measure, most of these IPOs will experience negative returns while some will display positive returns.

In summary, results in this section indicate significant differences for *MAUP* compared with *RUP* and for *MAUP* compared with *PUP*. Consistent with the statistically-significant differences between the three underpricing measures, the classification of issues as overpriced, correctly priced and underpriced (and hence, the extent of underpricing) is partly reliant on which underpricing measure is utilised. The next section examines reported underpricing in Australian IPO studies.

4.2.5 Underpricing in Australian literature

For comparative purposes, a summary of reported underpricing from prior Australian studies is included in table 4.4. Most Australian studies report both raw and market-adjusted underpricing [How & Howe (2001); How & Low (1993); How (1996); How, Izan & Monroe (1995); Cotter, Goyen & Hegarty (2005); Wong (2005)].

Table 4.4 Summary of reported underpricing

Authors	Sample years	Raw underpricing		Market-adjusted underpricing	
		All firms	Industrials	All firms	Industrials
Finn & Higham (1988)	1966-78				29.2%
Lee, Taylor & Walter (1996)	1976-89		16.4%		11.86%
Lee et al. (2003)	1976-89				11.8%
Balatbat, Taylor & Walter (2004)	1976-93		15.5%		
Lee, Lee & Taylor (2003)	1976-94				15.16%
How & Low (1993)	1979-89		16.4%*		16.1%*
How (1996)	1979-90		21.8%		22%
How & Howe (2001)	1979-90	49.98%		49.8%	
Brailsford, Heaney & Shi (2001)	1976-97	37.09%	23.3%		
How, Izan & Monroe (1995)	1980-90		19.74%		8.72%
Sharpe & Woo (2005)	1983-95	28% 60%✣			
Da Silva Rosa, Velayuthen & Walter (2003)	1991-99	25.47%			
How & Yeo (2000)	1980-96		18%		
Wong (2005)	1996-99	31.6% 32.4%• 27.9%•• 35.8%•••		29.6% 30.5%• 25.5%•• 34.3%•••	
Shi, Bilson & Powell (2008)	1990-97	23%			
Dimovski & Brooks (2004)	1994-99	25.6%	27%		
Cotter, Goyen & Hegarty (2005)	1995-98		11.87%		9.49%
How, Lam & Yeo (2007)	1993-2000		33%		
Bayley, Lee & Walter (2006)	1996-2000	26.72%			
Chang et al (2008)	1996-2003	15%			

* natural log of underpricing

• issues are underwritten
•• issues with an offer price lower than AUD$ 1
••• issues with an offer price greater than or equal to AUD$ 1
✣ issues made by private placement prior to listing

Examination of table 4.4 shows underpricing varies with the selected sample period. The highest level of market-adjusted underpricing for industrial companies (29.2%) is reported from Finn and Higham's (1988) sample for the 1966-1978 period while the lowest (8.72%) is reported from How, Izan and Monroe's (1995) sample period from 1980 to 1990. Variation in underpricing is also found over time in the US. Ljungqvist (2004) reports average raw underpricing of 19% for the 1960-2004 period but finds annual average underpricing at a low of 12% for the 1960s and a high of 40% for the years from 2000-2004.

How and Low (1993) and How and Howe (2001) draw their samples from very similar time periods but report large disparities in their measures of raw and market-adjusted return. These differences are attributable to the application of different measures of return. The first study uses the natural log of the unadjusted return and the natural log of the market-adjusted return, while the second study does not use logarithms. There is also a difference in sample selection for the two studies. The second study (n = 396) required that a hardcopy prospectus be available, while the second study (n = 523) only required that the IPO be traded on the twentieth day following listing. It is unlikely that there is some systematic underpricing factor associated with the availability of printed prospectuses.

Mean market-adjusted underpricing of 25.02% is reported for the 1997-2006 sample employed in this dissertation. This provides support for the assertion that market-adjusted underpricing varies over time. The annual comparisons in table 4.3 show the number of issues classified as over- or underpriced also varies across time irrespective of the choice of underpricing measure.

Although not directly comparable to any other sample time frame, the lower underpricing reported in Cotter, Goyen and Hegarty (2005) would appear to be attributable to sample selection. Cotter, Goyen and Hegarty (2005) include only those industrial IPOs that provide earnings forecasts in their prospectuses. Thus, forecasting earnings may systematically reduce underpricing. With the discussion of the measurement of the dependent variable now complete, the next section presents the measurement of independent variables.

4.3 The baseline model and independent variables

The hypothesised relationships for underpricing and the independent variables identified from the prior literature are shown in HO_1.

$H0_1$ *Underpricing in Australia is unrelated to time from prospectus issue to listing, the level of retained ownership, ex ante uncertainty, the participation of an underwriter and the inclusion of options at floatation.*

The empirical model used to test the hypothesis (the baseline model) is given as follows:

$$UP = \beta_0 + \beta_1 DELAY + \beta_2 OWN + \beta_3 SIGMA + \beta_4 UW + \beta_5 OPT + \varepsilon \qquad \textbf{(baseline model)}$$

Differing measures for the same independent variable are identified from the prior research used to develop the baseline model. In this section, differences in measurement are identified and discussed with a view to selecting the more appropriate measure for inclusion in the underpricing model.

4.3.1 Time to listing

DELAY, as the proxy for the level of informed demand, is measured as the number of days from prospectus registration to listing on the exchange. Lee, Taylor and Walter (1996) and Lee, Lee and Taylor (2003) use a simple count of days. The natural logarithm of the number of days is used by Finn and Higham (1988), How, Izan and Monroe (1995), How (1996), and How and Howe (2001). In this dissertation, the choice between a simple count and the natural logarithm of the count will be determined after the examination of the distributional properties of the variable in section 5.

The issue date for the prospectus is hand collected from each of the sample IPO prospectuses. The listing date is initially obtained from the float.com.au website. Listing dates are then cross-checked in the financial press. The data are then screened and the prospectus dates are rechecked for the longest and shortest five percent of observations.

4.3.2 Retained ownership

Retained ownership is measured as the percentage of equity retained by the issuers in How (1996), Lee, Taylor & Walter (1996), How and Howe (2001) or Lee, Lee and Taylor (2003). Dimovski and Brooks (2004) use the proportion of retained ownership to net proceeds. In keeping with the majority of Australian studies, retained ownership is calculated in this research as the proportion of shares held by the original owners at the completion of the issue.

$$OWN = \frac{\textit{Number of shares retained}}{\textit{Number of shares at listing}} \qquad \textbf{(4.1)}$$

The number of shares retained by the original owners and the number of shares at completion of the issue are hand-collected from the prospectus. Consistent with the analysis undertaken in chapter 3, retained ownership is calculated using the minimum proposed issue size and the associated number of shares at completion of the issue for those IPOs offing a variable number of shares. The data are screened and the number of shares issued and the number of shares retained are rechecked for the highest and lowest five percent of observations.

4.3.3 Information asymmetry

SIGMA is measured as the standard deviation of the first 10 days of returns data (excluding the initial day's trading) by Finn and Higham (1988)[22]. Some later studies calculate *SIGMA* using returns for 20 days post listing, but exclude day one [How, Izan & Monroe (1995); How (1996); How & Howe (2001)]. How, Lam and Yeo (2007) use 40 daily returns excluding day one. Others use monthly returns (including the first month) for 12 months post listing [Lee, Taylor & Walter (1996); Lee, Lee & Taylor (2003)] but do not explain why the longer period is chosen. The choice between the alternative measures of *SIGMA* is made by selecting the measure that is most often found to explain underpricing in prior research. Therefore, as shown in

[22] Finn and Higham do not find a significant relationship for *SIGMA* and underpricing.

equation 4.2, *SIGMA* is calculated as the standard deviation of the first 20 daily returns (excluding the day one return) in this research.

$$SIGMA = \sqrt{\frac{\sum_{i=1}^{n}\left(r_i - \bar{r}\right)^2}{n-1}} \qquad \textbf{(4.2)}$$

The observations for *SIGMA* are then screened using the procedure discussed earlier.

4.3.4 Underwritten and packaged issues

Underwriter participation (*UW*) is a dummy variable that indicates the issue is underwritten. Analysis of prior Australian underpricing literature in chapter 2 identifies five different measures of underwriter reputation. With the exception of How (1996), no relationship between underwriter reputation and underpricing is found. These results suggest that results are either sample-specific or reliant on how underwriter reputation is measured. *UW* is used in this model to investigate the contribution to underpricing of the functions performed by underwriters. Unlike underwriter reputation variables, *UW* is readily observable and free of contentious measurement issues. The prospectus is used to identify which issues are underwritten.

The association between underpricing and the issuer's choice to make a packaged offer has been tested using a dummy variable to indicate which issues are packaged [How (1996); Lee, Lee & Taylor (2003); Dimovski & Brooks (2004); How, Lam & Yeo (2007)] and the number of options issued (How & Howe, 2001). While results are mixed for the association between the dummy variable and underpricing, the number of options issued was unrelated to underpricing. In this dissertation, a dummy variable is used to indicate which issues are packaged. The prospectus is the source of data for this variable. The next section provides descriptive statistics for the baseline model's independent variables.

4.4 Describing the data

Theoretical justifications for the inclusion of the independent variables were presented in chapter 2. Measurement issues were discussed in the previous section. This section now provides descriptive statistics for the independent variables, examines their distributions and analyses bivariate relationships between each of the independent variables and the three specifications of the dependent variable.

4.4.1 Descriptive statistics for independent variables

As shown in table 4.5, the mean (median) number of days from prospectus date to listing (*DELAY*) is 54 (48). The shortest period for the sample firms of 13 days was for Sanford Ltd's 2000 IPO. Labtech Sytems Ltd's 2006 IPO experienced the longest time to listing with 270 days.

Existing shareholders retain an average of 62% of total shares at listing (median = 65%). The original owners sold all of their shares in six of the sample firms. The highest level of retained ownership (99.52%) is for One.Tel Ltd's 1997 IPO. Unsurprisingly, the level of *OWN* is significantly lower for issuers offering vendor shares for sale (Mann-Whitney U = 15 990, p = 0.000).

Table 4.5 Descriptive statistics for independent variables – 496 IPOs between 1997 and 2006

Panel A: Continuous measures

	Mean	Median	S.D.	Min	Max	K-S (*p-value*)	Skew	Kurtosis
DELAY	54	48	26	13	270	(0.000)	3.143	15.770
OWN (%)	62.142	64.656	19.756	0	99.520	(0.006)	-0.934	0.931
SIGMA	5.043	4.116	3.442	0.407	27.098	(0.000)	1.856	5.575

Panel B: Dichotomous variables

	Proportion of 1s
UW	0.686
OPT	0.143

DELAY = number of days from prospectus registration to listing on the exchange. *OWN* = shares retained by pre-IPO owners / number of shares at listing. *SIGMA* = standard deviation of the first 20 daily returns (excluding the day one return). *UW* = dichotomous variable coded as 'one' when an issue is underwritten *OPT* = dichotomous variable coded as 'one' when the issue is packaged with options.

The mean (median) level of *SIGMA* is 5% (4%). The minimum value for *SIGMA* is 0.4% while highest (27.1%) is experienced by CogState Ltd's 2004 IPO. The dichotomous variables indicate that 69% of sample IPOs are underwritten while attaching options are used by 14% of the sample.

Descriptive statistics from prior Australian research for the independent variables used in the baseline model are replicated in appendix B. Means are reported first with medians (where available) reported in parentheses below. The reported percentage of the sample is shown for the dichotomous variables *UW* and *OPT*. Comparing the descriptives for this sample with those in table 4.5 indicates that IPO firms in this dissertation are not dissimilar to those of samples used in prior Australian underpricing research.

4.4.2 Variable distributions

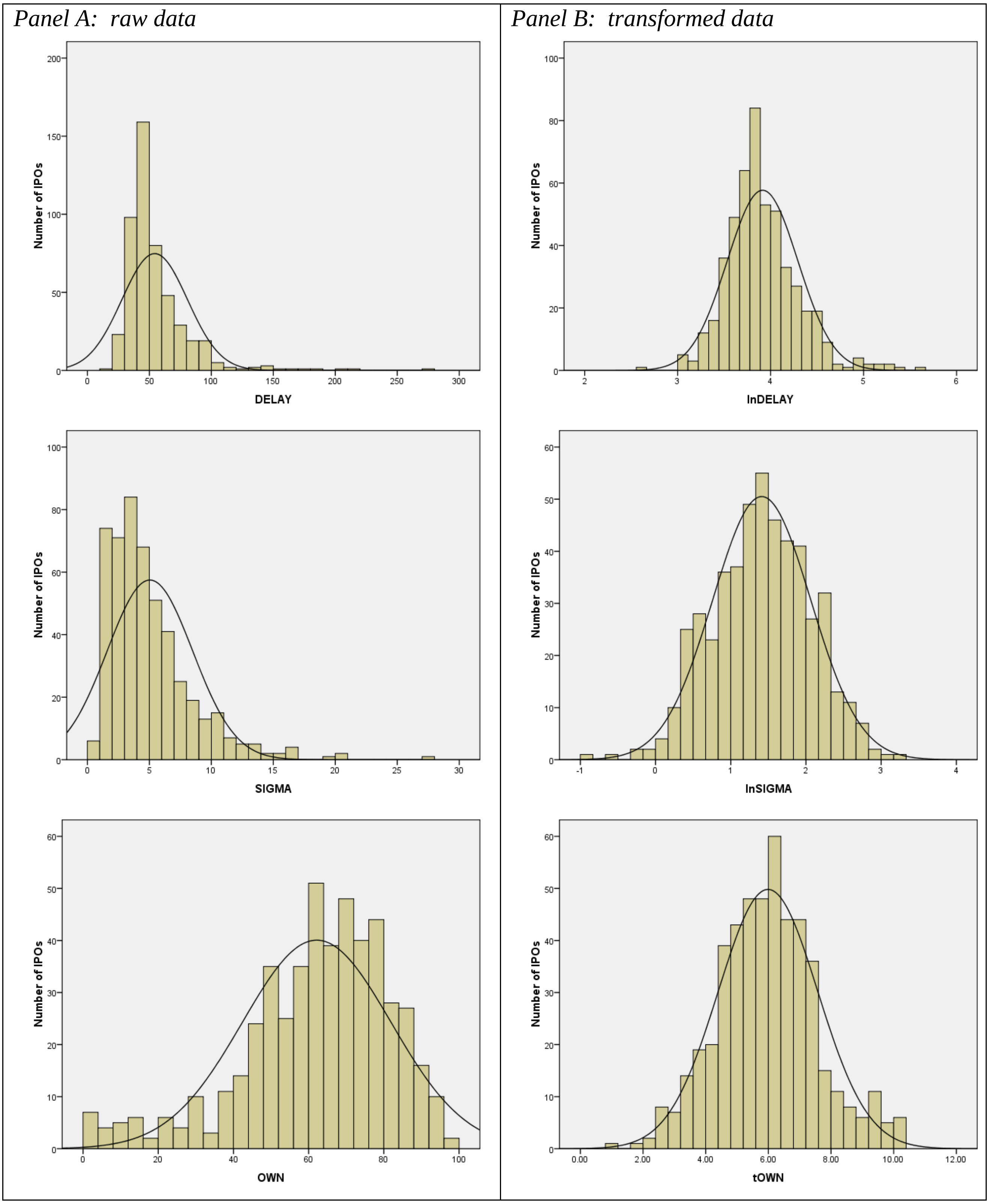
Variable distributions are examined in this section. The analysis commences with the decomposition of the sample descriptives by listing year presented in table 4.6. The annual means (medians) for the independent variables do not reveal any obvious time-dependent trends when the sample is split according to calendar year. The difference between the lowest annual mean *MAUP* (2.24% in 2001) and the highest (42.11% in 1999) shows the considerable variation in underpricing across years.

Table 4.6 Inter-year analysis of mean (median) statistics - 496 IPOs

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Issues	33	26	85	119	30	22	24	64	50	43
RUP	28.02	9.87	45.07	34.16	0.65	22.90	21.73	23.57	10.88	17.36
	(12.50)	(0.00)	(22.00)	(6.00)	(0.00)	(10.00)	(16.25)	(13.00)	(5.75)	(15.00)
MAUP	28.42	9.32	42.11	37.10	2.24	24.28	17.68	20.05	8.46	11.70
	(14.27)	(2.54)	(17.91)	(12.78)	(4.15)	(14.53)	(10.40)	(8.61)	(5.69)	(7.39)
PUP	29.33	12.32	44.12	39.47	5.25	28.03	19.78	21.12	9.32	12.47
	(14.28)	(4.02)	(23.18)	(13.26)	(4.71)	(15.96)	(16.35)	(10.57)	(7.92)	(10.66)
DELAY	57.22	64.04	48.72	51.88	66.93	50.91	60.67	50.12	54.60	59.05
	(49)	(64)	(47)	(44)	(56.50)	(46)	(49.50)	(47)	(46)	(42)
OWN	57.41	62.33	59.57	66.10	68.56	57.17	59.08	60.24	61.04	63.69
	(62.48)	(64.67)	(61.59)	(68.06)	(68.34)	(59.20)	(63.19)	(63.68)	(63.28)	(67.39)
SIGMA	3.47	5.45	5.35	6.23	5.44	5.05	4.89	4.36	4.15	3.97
	(3.22)	(3.37)	(4.47)	(5.66)	(4.88)	(4.33)	(3.80)	(3.36)	(3.47)	(2.85)
UW%	82.00	69.00	92.00	74.00	53.00	73.00	46.00	50.00	58.00	60.00
OPT%	6.00	19.00	13.00	13.00	37.00	27.00	21.00	11.00	10.00	9.00

RUP = raw underpricing = [(Market price - offer price) / offer price] x 100. *MAUP* = market-adjusted underpricing = *RUP* – return on the market index. *PUP* = packaged underpricing = market-adjusted underpricing including the return on any attaching options. *DELAY* = number of days from prospectus registration to listing on the exchange. *OWN* = shares retained by pre-IPO owners / number of shares at listing. *SIGMA* = standard deviation of the first 20 daily returns (excluding the day one return). *UW* = dichotomous variable coded as 'one' when an issue is underwritten *OPT* = dichotomous variable coded as 'one' when the issue is packaged with options.

Figure 4.2 Distributions for continuous independent variables



Skewness in regressors is another potential source of heteroscedasticity (Gujarati, 2003). Data transformation can be used to remove undesirable characteristics (Hair et al., 1998) including skewness and kurtosis.

The distributions for the transformed variables are shown in Panel B of figure 4.2. A logarithmic transformation is frequently applied to produce normality in distributions exhibiting severe positive skew and kurtosis (Tabachnick & Fidell, 1996). *DELAY* and *SIGMA* are suitable candidates for log transformation as these variables do not take on zero or negative values (Brooks, 2002). The Kolmogorov-Smirnov statistic shows the logarithmic transformation of *SIGMA* (*lnSIGMA*) does not make a significant departure (p = 0.81) from the normal distribution. The transformed *DELAY* variable, while improved, still exhibits sufficient skewness and kurtosis to depart from the normal distribution[23]. A square root transformation for 'moderate' skewness[24] is applied to the *OWN* distribution after the data are reflected[25] to adjust for the negative nature of the skew (Tabachnick & Fidell, 1996). The Kolmogorov-Smirnov statistic (p = 0.60) confirms that transformed *OWN* (*tOWN*) takes a normal distribution.

As discussed in section 4.2.4, the three specifications of the dependent variable (*RUP*, *MAUP* and *PUP*) are distributed as non-normal with significant skew and kurtosis. The baseline model includes the dependent variable linearly as there is no theoretical reason to suggest it take some other functional form. Therefore, to avoid a potential model specification error, the dependent variable is not transformed (Gujarati, 2003).

4.4.3 Correlations

Correlations for the continuous independent variables and each of the three specifications of the dependent underpricing variable are shown in table 4.7. Pearson correlations can be calculated for a continuous and a dichotomous variable only when the two categories for the dichotomous variable are approximately equal (Coakes,

---

[23] K-S p = 0.001

[24] To assist in the choice between the log and square root transformations, each was applied to *DELAY*, *SIGMA* and reflected *OWN*. The transformation that resulted in the closest fit to the normal distribution was then chosen.

[25] The largest value of the variable is increased by one and used as the constant from which each observation on *OWN* is subtracted prior to the application of the square root transformation.

Steed & Dzidic, 2006). Spearman's *rho* requires data that are at least ordinal (Sprent, 1993). Therefore, the dummy variables *UW* and *OPT* are analysed in section 4.4.4 and are not included in table 4.7. Pearson correlation coefficients are shown on the right hand side of the matrix with *p* values shown in brackets below. Spearman's *rho* coefficients are on the left-hand side. Panel A shows the correlations for the raw data while Panel B shows the correlations for the transformed independent variables.

Table 4.7 Correlations for the sample of 496 non-extractive IPOs

Panel A – raw data						
	RUP	*MAUP*	*PUP*	*DELAY*	*OWN*	*SIGMA*
RUP		0.994**	0.986**	-0.148**	0.034	0.188**
		(0.000)	(0.000)	(0.001)	(0.450)	(0.000)
MAUP	0.958**		0.991**	-0.167**	0.027	0.191**
	(0.000)		(0.000)	(0.000)	(0.552)	(0.000)
PUP	0.949**	0.986**		-0.158**	0.030	0.210**
	(0.000)	(0.000)		(0.000)	(0.499)	(0.000)
DELAY	-0.351**	-0.372**	-0.359**		0.190**	0.197**
	(0.000)	(0.000)	(0.000)		(0.000)	(0.000)
OWN	0.008	-0.013	0.001	0.205**		0.105*
	(0.854)	(0.781)	(0.990)	(0.000)		(0.019)
SIGMA	0.023	0.017	0.046	0.196**	0.139**	
	(0.617)	(0.697)	(0.308)	(0.000)	(0.002)	
Panel B – transformed data						
	RUP	*MAUP*	*PUP*	*lnDELAY*	*tOWN*	*lnSIGMA*
RUP				-0.182**	-0.035	0.175**
				(0.000)	(0.440)	(0.000)
MAUP				-0.198**	-0.028	0.176**
				(0.000)	(0.541)	(0.000)
PUP				-0.185**	-0.032	0.195**
				(0.000)	(0.475)	(0.000)
lnDELAY	-0.351**	-0.372**	-0.359**		-0.214**	0.192**
	(0.000)	(0.000)	(0.000)		(0.000)	(0.000)
tOWN	-0.008	0.013	0.000	-0.205**		-0.136**
	(0.854)	(0.781)	(0.990)	(0.000)		(0.002)
lnSIGMA	0.023	0.017	0.046	0.196**	-0.139**	
	(0.617)	(0.697)	(0.308)	(0.000)	(0.002)	

** Correlation is significant at the 0.01 level (2-tailed)
* Correlation is significant at the 0.05 level (2-tailed)
RUP = [(Market price - offer price) / offer price] x 100. *MAUP* = *RUP* – return on the market index. *PUP* = Market-adjusted underpricing including the return on any attaching options. *DELAY* = days from prospectus date to listing date. *lnDELAY* = natural logarithm of *DELAY*. *OWN* = (shares retained by pre-IPO owners / minimum shares offered) x 100. *tOWN* = square root of the reflected value of *OWN*. *SIGMA* = standard deviation of 20 daily returns from listing date. *lnSIGMA* = natural logarithm of *SIGMA*.

Pearson correlational analysis assumes the two variables are normally distributed and are homoscedastic. As discussed in the previous section, examination of the raw data shows that none of the baseline model variables are normally distributed. Scatterplots of the variables also indicate heteroscedasticity. Thus, the following analysis of raw data uses the non-parametric Spearman's *rho* as the measure of association.

SIGMA and *OWN* show no association with any of the underpricing measures. Indicative of lower underpricing for IPOs that take longer to list, *DELAY* shows significant negative associations with each of the three specifications of the dependent variable. This result provides support for the use of *DELAY* as a measure of demand (informed or otherwise).

The significant positive association between *DELAY* and *OWN* indicates that issues with higher levels of retained ownership take more time to complete. *SIGMA* and *OWN* show a positive association that indicates higher levels of retained ownership are associated with higher levels of ex ante uncertainty. Taken together, these results suggest two different interpretations of *OWN* as a signal of firm value. The first is that investors do not heed a signal of quality indicated by higher levels of *OWN*. The alternate explanation is that high levels of retained ownership are responsible for levels of information asymmetry. Analysis of this issue is beyond the scope of this research and is suggested as a potential area for future research.

As discussed in chapter 2, *SIGMA* and *DELAY* are included in the baseline underpricing model as proxies for ex ante uncertainty and the level of informed demand for an issue respectively. The significant positive association between *SIGMA* and *DELAY* suggest that these two proxies for information asymmetry reinforce each other. Although highly significant, the low absolute values of the associations suggest multicollinearity is not a problem in this model.[26].

---

[26] Results of unreported Spearman's *rho* analysis show that the size measures (issue size, total assets and market capitalisation) have significant associations with each other but not with any of the three measures of underpricing. Gross proceeds to owners and gross proceeds to the company are not associated with each other nor with the measures of underpricing but have significant associations with the other size measures. Leverage has significant but low association with the size measures and with each measure of underpricing. Smaller and less leveraged IPOs are associated with longer time to listing (*DELAY*). Larger and more highly levered firms are associated with lower levels of information asymmetry.

Offer price is not associated with *RUP* or *PUP* and has a very low correlation with *MAUP* ($\rho = 0.016$, $p < 0.05$). In contrast, market price has a *rho* of at least 0.4 ($p < 0.001$) with each of the three measures of underpricing. Lower offer and market prices are associated with longer *DELAY*.

Panel B shows correlations for the transformed data remain substantively the same as those reported for the raw data[27]. The transformed variables, *tOWN* and *lnSIGMA*, are distributed as normal and the Pearson correlation coefficient indicates the same significant negative association between these two variables as that identified in the raw data. Therefore, the underlying relationships between variables are not altered by transforming the data. Whilst *lnSIGMA* is normally distributed the three measures of underpricing are not. Therefore, the Pearson and Spearman coefficients for *lnSIGMA* and the underpricing measures show different results.

4.4.4 Dichotomous independent variable associations

As noted in the previous section, the *UW* and *OPT* variables in this model do not meet the requirements for correlational analysis. The Cramér coefficient (*V*) is an appropriate measure of association between two categorical variables because it does not assume any underlying distribution or continuity for the variables (Siegel & Castellan, 1988). Cramér's V gives a measure of nominal association and takes a value between 0 and 1 (Mendenhall, Reinmuth & Beaver, 1982).

There is a significant association between *UW* and *OPT* (V = 0.196, approximate $p = 0.000$). The Cramér's V statistic does not provide an unambiguous measure of the strength of the association, so cannot be interpreted in the same way as a correlation coefficient (Siegel & Castellan, 1988). Examination of the proportions of issuers using underwriters when the sample is split on the basis of *OPT* shows about 46% of packaged issues are underwritten. This proportion increases to 72% for the no-options group and suggests a negative relationship between the incidence of underwriting and issuing options.

Table 4.8 presents Mann-Whitney U tests for differences in distributions where the data are categorised by the presence of an underwriter (Panel A) and making a packaged issue (Panel B)[28]. Underwritten issues experience higher underpricing

[27] The sign on *rho* reverses on correlation coefficients for *tOWN* as the *OWN* variable is reflected in the transformation process.

[28] Point biserial correlations were considered as a potentially useful measure of association for the nominal (*UW* and *OPT*) and continuous variables. As discussed in section 4.4.2, with the exception of *lnSIGMA* and *tOWN*, all continuous variables follow distributions other than the normal distribution. Therefore, Mann-Whitney U and median tests are conducted for differences in distribution and median based on groupings of the dichotomous variables.

Table 4.8 <u>Differences in distributions where data are grouped on *UW* and *OPT*</u>

	RUP	*MAUP*	*PUP*	*DELAY*	*OWN*	*SIGMA*	*lnDELAY*	*tOWN*	*lnSIGMA*
UW group median	13.000	13.677	13.617	45	62.500	3.838	3.801	6.166	1.345
No *UW* group median	5.000	2.413	4.890	60	71.834	5.295	4.094	5.356	1.667
Mann-Whitney *U*	21 213	19 694	20 656	16 762	18 891	19 883	16 762	18 891	19 883
Asymp. Sig. (2-tailed)	(0.003)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Median test (2-tailed)	(0.000)	(0.000)	(0.003)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
OPT group median	2.500	-0.660	n.a.	55	70.553	5.440	4.007	5.474	1.694
No *OPT* group median	11.667	13.000	n.a.	46	63.694	3.920	3.829	6.068	1.366
Mann-Whitney *U*	10 019	9 573	n.a.	10 397	12 583	10 267	10 397	12 583	10 267
Asymp. Sig. (2-tailed)	(0.000)	(0.000)	n.a.	(0.000)	(0.025)	(0.000)	(0.000)	(0.025)	(0.000)
Median test (2-tailed)	(0.001)	(0.001)	n.a.	(0.003)	(0.015)	(0.001)	(0.003)	(0.000)	(0.015)

[n.a.] No comparison is made for PUP with a sample split made on the issue of options as PUP is the measure of underpricing that includes the return on options.

RUP = [(Market price - offer price) / offer price] x 100. *MAUP* = *RUP* – return on the market index. *PUP* = Market-adjusted underpricing including the return on any attaching options. *DELAY* = days from prospectus date to listing date. *OWN* = (shares retained by pre-IPO owners / minimum shares offered) x 100. *SIGMA* = standard deviation of 20 daily returns from listing date. *lnDELAY* = log of *DELAY*. *tOWN* = transformation of *OWN*. *lnSIGMA = log of SIGMA*. *UW* = dichotomous variable equal to one if the issue is underwritten. *OPT* = dichotomous variable equal to one if the issue includes attaching options.

(irrespective of how underpricing is measured), fewer days to listing (*DELAY* & *lnDELAY*), lower levels of retained ownership (*OWN* & *tOWN*) and have a lower median level of post-listing volatility (*SIGMA* & *lnSIGMA*). These results suggest some level of association between *UW* and underpricing and with each of the continuous independent variables.

Vendors choosing to make packaged issues take longer to list (*DELAY* & *lnDELAY*) and they experience higher post-listing volatility (*SIGMA* & *lnSIGMA*) and have higher median retained ownership (*OWN & tOWN*). Again, these results suggest some level of association between *OPT* and each of the continuous independent variables.

Packaged issues are less underpriced when *RUP* and *MAUP* are used as measures of the dependent variable. These results support the analysis of measures of underpricing and the resultant classifications of issues as over- and underpriced presented in section 4.2.4. With the investigation of relationships between the variables now complete, the next section tests the baseline model.

4.5 Testing the baseline model

This section provides the rationale for using regression analysis. The process of identifying outliers and their treatment is discussed. Empirical results for the model are presented. Finally, the rationale for the selection of the definitive baseline model is presented.

4.5.1 Ordinary least squares regression

Consistent with prior Australian underpricing research [How, Izan & Monroe (1995); How (1996); Lee, Taylor & Walter (1996); Lee, Lee & Taylor (2003); How & Howe (2001); Dimovski & Brooks (2004); Cotter, Goyen & Hegarty (2005); How, Lam & Yeo (2007)], ordinary least squares (OLS) regression is used to estimate the baseline model in this research.

4.5.2 Outliers

Multivariate outliers are discrepant data cases where unusual pattern of scores are identified when two or more variables are considered together (Tabachnick & Fidell, 1996). Multivariate outliers can exert excessive influence that results in a shift in the regression line (Hair et al., 1998). Therefore, Mahalanobis distance is used to identify which multivariate outliers to exclude. Mahalanobis distance is calculated with a discriminant function that weights unusual combinations of scores heavily so cases with a Mahalanobis distance greater than the relevant chi-squared critical value are significantly different from the centroid of other cases (Tabachnick & Fidell, 1996). Analysis of the Mahalanobis D^2 identifies nine significant (p = 0.001) outliers and these are removed from the data set[29].

4.5.3 Results

Table 4.9 reports the results for three versions of the baseline model, each using a different specification of the dependent variable. Raw data are used here and 487 observations are included (i.e. 9 outliers have been omitted). The adjusted R-squared (AR^2) for the models ranges from 11% (with *RUP* as the dependent variable) to 12.2% (where *MAUP* is the dependent variable). Even though the R^2s for cross sectional data are typically lower than those found using time series data (Kennedy, 1985), the baseline model AR^2s would generally be considered to be poor fits. These AR^2s are, however, within the range of those reported in prior Australian underpricing research (see table 2.2) and *F* tests show the regressions are significant. The low explanatory power suggested by the AR^2s for the baseline model could be taken as an indication that the model suffers a specification error (i.e. some important variables have been omitted)[30]. This issue is explored further in section 4.5.4.

---

[29] The chi-squared critical value is determined as p = 0.001, d.f. = 5. The multivariate outliers, their listing dates and industries are as follows: Australian International Carbon Ltd (1998, miscellaneous industrials); Queste Communications Ltd (1998, telecommunications); AquaCaretone Ltd (1999, healthcare & biotechnology); ST Synergy Ltd (2001, miscellaneous industrials); CogState (2004, healthcare & equipment); Medical Therapies Ltd (2005, pharmaceuticals & biotechnology); Labtech Systems Ltd (2006, healthcare & equipment); Richfield International Ltd (2006, transportation) and BigAir Group (2006, telecommunications).

[30] One potential alternative explanation for a low R^2 is a high variance in the error term (Kennedy, 1985).

Examination of the prior Australian literature in chapter 2 provides the rationale for specifying directional relationships for some independent variables in the baseline model. As a proxy for the level of informed demand, *DELAY* is expected to have a negative relationship with underpricing. *SIGMA* is the proxy for the speed of resolution of ex ante uncertainty so a positive relationship is expected for *SIGMA* and underpricing. As such, the *p* values shown for *DELAY* and *SIGMA* in table 4.9 are for one-tailed tests.

Table 4.9 Regression results (raw data) for 487 IPOs

		Dependent variable		
Independent variables		*RUP*	*MAUP*	*PUP*
constant	coefficient	5.280	3.521	3.494
	t-stat	0.345	0.233	0.202
	p	(0.731)	(0.816)	(0.840)
DELAY	coefficient	-0.383#	-0.391#	-0.394#
	t-stat	-2.043	-2.116	-2.026
	p	(0.083)	(0.070)	(0.087)
OWN	coefficient	0.174	0.160	0.170
	t-stat	1.335	1.242	1.259
	p	(0.182)	(0.215)	(0.209)
SIGMA	coefficient	5.247**	5.412**	5.593**
	t-stat	4.054	4.241	4.023
	p	(0.000)	(0.000)	(0.000)
UW	coefficient	11.977*	13.866*	13.297*
	t-stat	2.180	2.563	2.165
	p	(0.023)	(0.011)	(0.031)
OPT	coefficient	-23.694**	-23.736**	-10.247
	t-stat	-3.565	-3.641	-1.286
	p	(0.000)	(0.000)	(0.199)
AR^2		0.110**	0.122**	0.100**
JB		7 501**	8 172**	7 559**
	p	(0.000)	(0.000)	(0.000)
White's	*p*	(0.000)	(0.000)	(0.000)
DW		1.601	1.648	1.601
RESET	*F*	4.815*	6.136*	10.1723**
	p	(0.029)	(0.014)	(0.000)

** Significant at <1% (two-tailed for *OWN*, *UW* and *OPT* and one-tailed for *DELAY* and *SIGMA*)
* Significant at <5% (two-tailed for *OWN*, *UW* and *OPT* and one-tailed for *DELAY* and *SIGMA*)
# Significant at <10% (two-tailed for *OWN*, *UW* and *OPT* and one-tailed for *DELAY* and *SIGMA*)
All *t*-statistics are White's heteroscedasticity adjusted.
RUP = [(Market price - offer price) / offer price] x 100. *MAUP* = *RUP* – return on the market index. *PUP* = Market-adjusted underpricing including the return on any attaching options. *DELAY* = days from prospectus date to listing date. *OWN* = (shares retained by pre-IPO owners / minimum shares offered) x 100. *SIGMA* = standard deviation of 20 daily returns from listing date. *UW* = dichotomous variable equal to one if the issue is underwritten. *OPT* = dichotomous variable equal to one if the issue includes attaching options.

As reported in chapter 2, Australian studies do not find the theorised negative relationship between *OWN* and underpricing. While some Australian studies report a positive relationship, others find no significant relationship. Theory provides the justification for a negative relationship between underwriter reputation and underpricing, but either a positive or negative relationship between the participation of an underwriter (*UW*) can be theoretically justified. Similarly, a positive or negative relationship can be theoretically justified for the use of packaged issues. Therefore, no directional relationship is specified for *OWN*, *UW* and *OPT* in the baseline models. The *p*-values reported in table 4.9 for these variables are for two-tailed tests.

DELAY is in the expected direction but has only marginal significance for the explanation of underpricing. This result is in contrast to prior Australian research [How, Izan & Monroe (1995); Lee, Taylor & Walter (1996); How & Howe (2001); Lee, Lee & Taylor (2003)] where *DELAY* is found to be highly significant. The highly significant ($p < 0.001$) positive relationship of *SIGMA* to underpricing (irrespective of the measurement of the dependent variable) provides support for the results of How, Izan & Monroe (1995), How (1996) and Lee, Lee & Taylor (2003) rather than for those of Lee, Taylor & Walter (1996) and How and Howe (2001). As the proxy for ex ante uncertainty, this positive relationship suggests investors are compensated with greater underpricing when the IPO is more difficult to value.

The level of retained ownership (*OWN*) is not significant for any measure of the dependent variable. This result is consistent with the majority of the Australian literature [Lee, Lee & Taylor (2003); How & Howe (2001); Lee, Lee & Taylor (2003); How & Howe (2001); Dimovski & Brooks (2004)]. The significant relationship between retained ownership and underpricing reported by How (1996), and Lee, Taylor & Walter (1996) is not supported in this more contemporary sample.

The presence of an underwriter (*UW*) is significantly ($p < 0.05$) and positively associated with underpricing. As discussed in chapter 2, several studies include underwriter reputation in their underpricing models but the results of those studies are not comparable with *UW*[31]. Logue (1973) provides a rationale for this observed positive relationship between *UW* and underpricing. He argues that, in the absence of mitigating factors[32], underpricing minimises underwriters' costs and risks and only reduces the demand from new issuers if the level of underpricing is 'gross'. Overpricing, while increasing the underwriters' costs and risks, will reduce demand from new issuers who observe the underwriters' inability to sell the issues.

As discussed in chapter 2, except for the difference in pricing mechanisms, Australian issues that are not underwritten should have characteristics similar to those of best efforts US issues. US best efforts issues are more underpriced than are US underwritten issues [Chalk & Peavy (1987); Smart, Megginson & Gitman (2004)]. The positive sign of the coefficient on *UW* shows that Australian fixed-price underwritten issues are more underpriced than those without underwriter participation. One-tailed tests show *UW* retains significance at the conventional level for *RUP* and *MAUP*. While inconsistent with US results for bookbuild issues, this result tends to support signalling theory where issuers use an underwriter to signal the quality of the issue and the underwriter influences the offer price downward.

The significance of *UW* for the *RUP* and *MAUP* measures of underpricing and the marginal significance for *PUP* draws attention to the impact of including the return on options in the measure of underpricing. As discussed in section 4.4.4, fewer packaged issues are underwritten while most underwritten issues do not include options.

How (1996) reports a significant positive coefficient on *OPT* in one of her underpricing models that uses *MAUP* as the dependent variable. Conversely, Dimovski and Brooks (2004) report a significant negative coefficient on *OPT* with raw returns as the dependent variable. Table 4.9 shows issues offering free options with shares are significantly ($p < 0.001$) less underpriced when underpricing is measured by *RUP* and *MAUP*. As discussed in section 4.2.4, the mean and median values for the distribution of *PUP* are significantly higher than those for *MAUP*. The significant negative coefficients on *OPT* suggest the lower underpricing found for

[31] One study that does include *UW* (Dimovski & Brooks, 2004) reports a significant positive relationship between *UW* and *RUP*.
[32] Logue (1973) identifies competition among underwriters as a potential mitigating factor, and concludes that US underwriters behave as monopsonists.

packaged issues is attributable to errors of measurement in the dependent variables. There is no relationship between *OPT* and *PUP*. These results indicate that *RUP* and *MAUP* understate the level of underpricing for IPOs making packaged issues. Further, they provide evidence to support Chemmanur and Fulghieri's (1997) theory of options as a signalling mechanism.

Table 4.10 Regression results (transformed data) for 487 IPOs

		Dependent variable		
Independent variables		*RUP*	*MAUP*	*PUP*
constant	coefficient	110.845**	108.995**	110.800**
	t-stat	3.444	3.351	3.144
	p	(0.000)	(0.000)	(0.002)
lnDELAY	coefficient	-27.299**	-27.834**	-27.949**
	t-stat	-3.010	-3.106	-2.950
	p	(0.006)	(0.004)	(0.007)
tOWN	coefficient	-2.625	-2.482	-2.627
	t-stat	-1.400	-1.334	-1.339
	p	(0.162)	(0.183)	(0.181)
lnSIGMA	coefficient	23.251**	23.852**	24.441**
	t-stat	4.507	4.668	4.548
	p	(0.000)	(0.000)	(0.000)
UW	coefficient	12.625*	14.505*	13.955*
	t-stat	2.220	2.588	2.213
	p	(0.027)	(0.010)	(0.027)
OPT	coefficient	-23.571**	-23.588**	-10.074
	t-stat	-3.435	-3.505	-1.221
	p	(0.000)	(0.000)	(0.223)
AR^2		0.104**	0.114**	0.100**
JB		7 680**	8 377**	8 169**
	p	(0.000)	(0.000)	(0.000)
White's	*p*	(0.000)	(0.000)	(0.000)
DW		1.590	1.632	1.591
RESET	*F*	15.242**	18.337**	17.489**
	p	(0.000)	(0.000)	(0.000)

** Significant at <1% (two tailed for *tOWN*, *UW* and *OPT* and one tailed for *lnDELAY* and *lnSIGMA*)
* Significant at <5% (two tailed for *tOWN*, *UW* and *OPT* and one tailed for *lnDELAY* and *lnSIGMA*)
All *t*-statistics are White's heteroscedasticity adjusted.
RUP = [(Market price - offer price) / offer price] x 100. *MAUP* = *RUP* – return on the market index. *PUP* = Market-adjusted underpricing including the return on any attaching options. *lnDELAY* = log of days from prospectus date to listing date. *tOWN* = square root of reflected [(shares retained by pre-IPO owners / minimum shares offered) x 100]. *lnSIGMA* = log of standard deviation of 20 daily returns from listing date. *UW* = dichotomous variable equal to one if the issue is underwritten. *OPT* = dichotomous variable equal to one if the issue includes attaching options.

Table 4.10 shows the results for the baseline model using transformed data. The AR^2s are marginally lower for the *RUP* and *MAUP* measures of underpricing compared to the raw data regression in table 4.9. Results for *lnSIGMA* are highly similar to those for *SIGMA*. The coefficients on *UW* and *OPT* and their associated *t*-statistics show only minor changes when the baseline model includes transformed data. In contrast to the untransformed *DELAY* variable, the one-tailed significance level for *lnDELAY* is highly significant. While the sign on the coefficient for *tOWN* becomes negative as the data are reflected in the process of transformation, no significant association between retained ownership and underpricing is identified.

The most notable change in results from transformation of the continuous independent variables is the impact on the constant. Significant constants are an empirical regularity when transformed data are used in Australian underpricing studies [see Finn & Higham (1998); How, Izan & Monroe (1995); How (1996); How & Howe (1996)]. Using untransformed variables for *DELAY* and *SIGMA*, Lee, Taylor and Walter (1996) report three from six of their regressions do not have significant constants. The intercepts become significant when the number of variables is reduced in subsequent models. Only the regression that includes all hypothesised independent variables in Lee, Lee and Taylor (2003) is without a significant intercept. Dimovski and Brooks (2004) do not report intercepts.

4.5.4 Analysis of residuals

The Jarque-Bera (JB) test statistics reported in Tables 4.9 and 4.10 show residuals from all models depart significantly ($p < 0.01$) from the normal distribution. Brooks (2002, p. 182) argues that OLS, even with non-normal residuals, is superior to other methods of estimation that do not assume normality because 'its behaviour in a variety of circumstances has been well researched'. For large samples, test statistics are expected to asymptotically follow the normal distribution [Brooks (2002); Guajarati (2003)]. Notwithstanding, analysis of residuals is still necessary to determine if the OLS assumptions of homoscedasticity, uncorrelated errors and regressors uncorrelated with the error term[33] are met (Kennedy, 1985).

[33] The first assumption of OLS – that the expected mean value of the errors is zero – is met by the inclusion of the constant in the regression equation (Brooks, 2002). Kennedy (1985 p. 90), however, notes that the assumption can be violated if there are 'systematically positive or systematically negative errors of measurement in calculating the dependent variable'.

White's test rejects the null hypothesis of homoscedasticity ($p < 0.0001$) for all versions of the baseline model. Therefore, the *t*-statistics presented in tables 4.9 and 4.10 use White heteroscedasticity-consistent standard errors and covariance and represent a more conservative test of the coefficients (Brooks, 2002).

Autocorrelation of residuals for sequential data can be assessed using the Durban-Watson statistic (Tabachnick & Fidell, 1996). The Durban-Watson *d* indicates significant positive autocorrelation in residuals for each regression irrespective of the measurement of the dependent variable and of any data transformations. The JB statistics show that the normality of residuals assumption of the Durban-Watson test (Gujarati, 2003) cannot be met in these regressions. However, graphs of the residuals provide support for the existence of positive autocorrelation.

A significant DW statistic in cross-sectional data can indicate model specification error as it is consistent with the effects of an omitted variable being captured by the residuals [Kennedy (1985); Gujarati (2003)]. Ramsey's RESET (regression specification error test) is a general test for misspecification of a model's functional form [Brooks (2002); Gujarati (2003)].

A significant *F* statistic from the RESET test is indicative of non-linear parameters in the model or a relevant variable omitted from the model [Brooks (2002); Gujarati (2003)]. OLS estimation produces biased and inconsistent parameter estimates when non-linear parameters are assumed linear in the model (Kmenta, 1971). When the specification error takes the form of an incorrect assumption of linearity for a non-linear parameter, the effects on the OLS results are the same as those for an omitted relevant variable [Kmenta (1971); Brooks (2002)]. The specific impact on inferences from OLS cannot be ascertained unless the correlations of the omitted variable with the included dependent variables are known [Kmenta (1971); Brooks (2002); Gujarati (2003)].

The RESET tests the *RUP* and *MAUP* regressions in table 4.9 show significant model misspecification errors while the RESET for *PUP* is highly significant. Those reported for transformed data in table 4.10 show highly significant misspecification errors, indicating that the specification errors are not the result of non-linearity in these independent variables. Clearly, the results from a correctly-specified model are preferred to those from a model with specification error. Results from the RESET tests provide justification for investigating additional variables to those that have been found significant in prior research.

Kennedy (1985) identifies 'inertia' as a potential cause of autocorrelation in error terms. He states that

> Owing to inertia or psychological conditioning, past actions often have a strong effect on current actions, so that a positive disturbance in one period is likely to influence activity in succeeding periods (Kennedy, 1985, p. 99).

While the data used in this sample are cross sectional, the issues are entered in chronological order. Taken together, these points suggest the inclusion of a market sentiment variable to improve the baseline model. This issue will be investigated further in chapter 8.

OLS regression relies on the assumption of non-stochastic regressors but stochastic explanatory variables are, however, common in economic data (Kmenta, 1971). Kennedy (1985) states that the desirable properties of the OLS estimator are maintained where the regressors are stochastic but contemporaneously uncorrelated with the residuals. Correlation analysis is conducted to test this assumption for the baseline model with each of the three measures of the dependent variable with either the untransformed or transformed regressors. The residuals and *SIGMA* or *lnSIGMA* have significant negative Spearman's *rho* ($p < 0.01$) in the order of about 0.2. *DELAY* and the residuals also have significant negative Spearman's *rho* ($p < 0.05$) with a magnitude of about 0.1[34]. These results show the OLS estimators for *SIGMA*, *lnSIGMA* and *DELAY* are biased because some of the variation attributable to the variation in the residuals has been incorrectly identified as the stochastic regressor's ability to explain variation in the dependent variable (Kennedy, 1985).

Measurement error in the variables is a further potential source of contemporaneous correlation of stochastic regressors and residuals (Kennedy, 1985). *SIGMA*, *lnSIGMA* and *DELAY* are good candidates for the errors in variables problems because they are

[34] Pearson correlation coefficients do not show any significant correlations.

used as proxies for the unobservable level of informed demand (*DELAY*) and the level of ex ante uncertainty (*SIGMA*). Weighted least squares regression and the use of instrumental variables can be used to remedy such contemporaneous correlations (Kennedy, 1985). No remedial actions will be taken for this baseline model but the issue will addressed if the chapter 8 regressions exhibit significant autocorrelation in the residuals.

4.5.5 Selection of the baseline model

The foregoing analysis discusses the relatively low values of AR^2 for models using both raw data and transformed data. While econometrics texts state that the AR^2 should not be used as the definitive gauge of a 'good' model [c.f. Kennedy (1985); Gujarati (2003)] there is nothing in the AR^2s to identify which data provide the 'better' model.

The analysis of residuals conducted in section 4.5.4 reveals violations of the OLS assumptions in models using either raw or transformed data. Further, the results of Ramsey RESET tests indicate significant model misspecification for all six regressions reported in tables 4.9 and 4.10[35].

A point in favour for modelling untransformed variables is the lack of a significant intercept. There is no theoretical reason to support a significant constant in the model. Although the significant intercept could be remedied in the transformed variable models, there are no strong a priori expectations that the constant should always be zero. In such cases Gujarati (2003, p. 168) advises against regression through the origin.

Discussion in section 4.2 identified *PUP* as the more theoretically-correct measure of underpricing. However, comparison of results with most prior Australian literature

[35] Based on prior Australian underpricing research discussed in chapter 2 and the empirical analysis presented in chapter 3, size is the main candidate for an omitted variable. Each of the models was run including the natural log of market capitalisation at listing to control for size. This variable has no explanatory power for any of the three specifications of the dependent variable. AR^2 decreases by 0.002 in each raw data model and by 0.01in the transformed data models when size is included. Removing size shows minimal impact on the magnitude and significance levels of the coefficients for the independent variables in the models. The significance level for the constant in the transformed models changes from $p < 0.05$ to $p < 0.001$ when size is omitted. The addition of size to the baseline model does not remedy model misspecification error.

requires *MAUP*. Further, the decomposition of underpricing into mispricing (chapter 6) and misvaluation (chapter 7) factors is undertaken without market adjustments to the differences between value, offer price and market price. As such, the baseline model will be tested using RUP, MAUP and PUP as alternate measures of the underpricing dependent variable.

4.6 Conclusions

Analysis of the reported level of underpricing in prior Australian research reveals that underpricing, consistent with US studies, appears to vary with the sample period chosen. The sample data for this research confirm this feature. Further, sample selection methods also appear to influence the level of reported underpricing.

RUP and *MAUP* are found to be significantly different measures of underpricing. The classification of IPOs as underpriced, correctly priced or overpriced and hence the extent of underpricing is shown to be reliant on the choice of underpricing measure. This suggests researchers should take care when comparing their results with those from prior Australian research. Not only can differences in underpricing be attributed to different sampling periods and the criteria used for the type of firms included, differences in distributions show the choice of underpricing measure as a dependent variable is not a trivial matter.

The measures for the continuous independent variables in the baseline model are found to have significant skewness and kurtosis. Transformation of these variables did not, however, result in noticeable improvements in the regression results. Results for the baseline model reveal that *SIGMA* and *UW* are significant in the explanation of underpricing. In contrast to prior research, *DELAY* is only marginally significant. The measurement error in *MAUP* is confirmed by the *OPT* dummy variable's significant association with *MAUP* but not for *PUP*. *OWN* does not contribute to the explanation of underpricing in this sample. Correlation analysis suggests that *OWN*, rather than determining underpricing, is associated with the level of ex ante uncertainty (*SIGMA*) experienced by the issue.

The disaggregation of underpricing now commences in chapter 5 with analysis of intrinsic value and continues with analysis of mispricing in chapter 6 and misvaluation in chapter 7. Chapter 8 then presents extended models of underpricing developed by including significant mispricing and misvaluation factors identified from the disaggregation of underpricing.

CHAPTER 5
ESTIMATING THE VALUE OF AUSTRALIAN FIXED-PRICE IPOs

5.1 Introduction

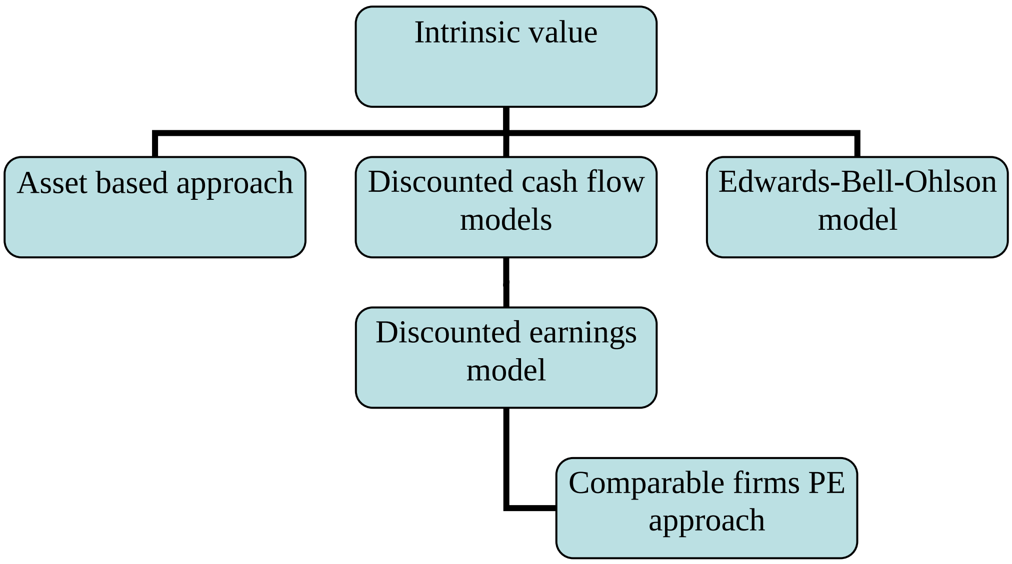
This chapter examines several different proxies for intrinsic (or fundamental) value (*V*). The process used to disaggregate underpricing in this research involves the identification of mispricing and misvaluation. Mispricing (*MP*) is defined here as the difference between the offer price (*OP*) of an IPO share and its intrinsic value (*V*). Misvaluation (*MV*) is defined as the difference between the market price (*P*) at the end of trading on the day of listing and *V*. *MP* and *MV* are the dependent variables in the models of mispricing (chapter 6) and misvaluation (chapter 7). The selection of proxies for the unobservable intrinsic value of the IPO is pivotal for a reliable estimation of the *MP* and *MV* dependent variables.

Three theoretical approaches to the valuation of equity (the asset-based approach, discounted cash flows and the Edwards-Bell-Ohlson model) are discussed. The comparable-firms PE ratio approach, which stems from the discount model and is widely used by practitioners, is also discussed. The rationale for selecting the comparable-firms approach as the primary proxy for *V* is given. A second proxy, derived from the Edwards-Bell-Ohlson model, is used to estimate *V* for application in robustness checks of the models in chapters 6 and 7. The implementation of these models is then discussed and descriptive statistics are presented for the distributions of the comparable-firms PE estimates of value (V_{PE}) and the Edwards-Bell Ohlson estimates of value (V_{EBO}). Section 5.7 describes the relationships between mispricing (*MP*), misvaluation (*MV*) and underpricing by grouping sample IPOs according to observed levels of *MP*, with each group then classified by the observed level of *MV* and raw underpricing (*RUP*). Section 5.8 concludes.

5.2 Choice of value measures

While the theoretical concept of intrinsic value is well established, the selection of a proxy is somewhat contentious. Therefore, this section analyses competing valuation models. First, intrinsic value is defined. Second, the suitability of *P* as a proxy for *V* is investigated. The three main theoretical valuation methods available for estimating the unobservable *V* are the asset-based approach, discounted cash flow (DCF) models and the Edwards-Bell-Ohlson (EBO) model (White, Sondhi & Fried, 1998). These three theoretical valuation models are discussed, with particular reference to their applicability in the IPO setting. The comparable firms PE approach, which is widely used by practitioners, is also discussed. Figure 5.1 summarises the relationships of the valuation models discussed in this section.

Figure 5.1 Valuation models



5.2.1 Intrinsic value and market price

This section provides a definition of intrinsic value and compares this to market price. There are two main reasons *P* cannot provide a reliable proxy for *V*. First, the horizons for *P* and *V* do not necessarily correspond. Second, the day one price for listing companies has to be established in an efficient market if *P* is to provide an unbiased proxy for *V*.

Intrinsic value reflects the rights associated with the ownership of the security over its lifetime rather than the investor's horizon. Thus, intrinsic value is the

> … value of an equity investment that is held over the long term, as opposed to the value that can be realized by short-term, speculative trading (Barker, 2001).

This definition clearly differentiates intrinsic value (the long term value) from price and casts doubt on the validity of the assumption that *P* is synonymous with *V*. In their investigation of post-listing trades in the Australian IPO market, Bayley, Lee and Walter (2006) report 51.9% of total trades during the first three days are attributable to day traders. This observation provides support for the notion that aftermarket prices are heavily influenced by 'short-term, speculative trading' and that they are unlikely to reflect longer-term value.

As noted in chapter 2, the extent of underpricing and mispricing will be equal when the market is efficient and *P* is an unbiased representation of *V*. The equivalence of *P* and *V* relies on the assumption of insignificant arbitrage costs (Lee, Myers & Swaminathan, 1999). Where arbitrage is not possible, *P* will only incorporate the views of optimistic investors as pessimistic investors are unable to take short positions (Miller, 1977). Arbitrageurs are unable to borrow IPO shares prior to listing so they are unable to complete both sides of the covered short-selling arbitrage transaction (Geczy, Musto & Reed, 2002). Chapter 7 discusses the institutional features that prevent arbitrage activity in Australian IPO markets. Further, the assumption that *P* instantaneously reflects all available information is required if *P* is to provide an unbiased estimate of *V*. This assumption is contrary to the process of continuous convergence of *P* to *V* described by Lee, Myers and Swaminathan (1999) and Bhojraj and Lee (2002).

P is not, therefore, a suitable proxy for *V* as the aftermarket price is heavily influenced by speculative trades and the market for IPO shares is unlikely to be efficient. Further, the objective in this dissertation of disaggregating underpricing into mispricing and misvaluation components cannot be achieved with the assumption that *P* equals *V*.

The attractive feature of an assumed equivalence of *P* and *V* is that *P* is readily observable while *V* is unobservable and cannot be objectively verified. Boatsman and Baskin (1981 p. 44) note that, while '… some might be repulsed at the prospect of drawing inferences about an unobservable … on the basis of a data set consisting of only observables …', theories involving unobservable phenomena require an observable proxy for testing. Proxies for unobservable constructs (expected return, terminal value and the market portfolio, for example) are frequently used in both academic research and practice. While market price provides an observable proxy for V, P will not necessarily meet the definition of intrinsic value. As Lee (2001, p. 246) states '… fundamental value is concerned with measuring firm value regardless of market conditions'. The following sub-sections discuss competing models for estimating V.

5.2.2 Asset-based valuation approach

Asset-based models value equity according to the current market value of the firm's individual assets less the current market value of liabilities (White, Sondhi & Fried, 1998). This relationship is shown in equation 5.1.

$$V_{AB} = assets - liabilities \qquad \textbf{(5.1)}$$

where V_{AB} = asset-based value of the firm's equity
$assets$ = current market value of recognised and unrecognised assets
$liabilities$ = current market value of liabilities

Application of the asset-based model requires an effective restatement of the balance sheet after collection of current market values for the firm's assets (including unidentified assets such as intangibles) and liabilities (Penman, 2007). The pragmatic application of the approach is to proxy the assets component in equation 5.1 with book value (B) to give a conservative estimate of V (White, Sondhi & Fried, 1998). Application of an asset-based approach to the IPO setting has little relevance as most of the value in an IPO comes from growth opportunities rather than from assets in place (Kim & Ritter, 1999).

5.2.3 Discounted cash flow valuation

DCF models discount forecasted future cash flows at the required return to calculate present value (White, Sondhi & Fried, 1998). This relationship is shown in equation 5.2. The future flows (CF_{t+i}) in the numerator can be measured as expected dividends, expected free cash flows or expected earnings (White, Sondhi & Fried, 1998). Each of these specifications of CF, discussed in the following sections, gives theoretically equivalent results.

$$V_{DCF} = \sum_i \frac{CF_{t+i}}{(1+r)^i} \tag{5.2}$$

where V_{DCF} = discounted cash flow value of the firm's equity
CF_{t+i} = future cash flows
r = required return on equity

5.2.3.1 Dividend discount model

The intrinsic value of a firm is frequently defined in finance textbooks in terms of discounted future cash flows [c.f. Bodie et al. (2007)]. However, expected dividends should include expected share repurchases and equity issues to reflect all distributions to shareholders (Lundholm & Sloan, 2004).

Application of the dividend discount model (DDM) requires either forecast dividends to infinity or a forecast of terminal value at time *t* based on forecast dividends from *t* to infinity. Assumptions about future growth are made to simplify the forecasting process. The DDM becomes a simple perpetuity with the assumption of no dividend growth (Penman, 2007). Alternately, estimation of *V* can be simplified with the assumptions of a constant growth rate or variable growth rates that settle to some future constant growth rate. The zero or constant growth assumptions are unlikely to represent the actual future dividend patterns of IPOs. While Barker (2001) notes the conceptual applicability of the DDM for start-up companies, estimating when dividends will be initiated, their size and future growth rates are problematic (Curtis & Fargher, 2003).

The DDM is difficult to apply to companies that provide returns to shareholders via capital gains rather than dividends (Penman, 2007). Further, while the dividend payout ratio affects the capacity for generating returns from retained earnings, dividends distribute value rather than create value in the firm (Penman, 2007).

5.2.3.2 Discounted free cash flow model

In the valuation context, free cash flows are defined as '… cash available to debt- and equityholders after investment' (White, Sondhi & Fried, 1998, p. 1059). As the forecasting horizon in equation 5.2 is infinite, finite horizons require the estimation of a 'continuing value' analogous to the terminal value in the dividend discount model

(Penman, 2007)[36]. Firms can increase free cash flow by making fewer investments and this method is more suitable for valuing mature 'cashcows' than it is for firms with variable future growth (Penman, 2007). In addition, it is difficult to forecast free cash flows without having first forecast earnings [White, Sondhi & Fried (1998); Penman (2007)]. Discounting free cash flows will prove problematic for many IPO firms with negative free cash flows over the shorter horizons (Curtis & Fargher, 2003). Lack of history also makes implementation of discounted cash flows difficult in the IPO setting (Jog & McConomy, 2003).

5.2.3.3 Earnings based models

As for the dividend discount and discounted free cash flow models, assumptions about future growth and the required return are necessary when CF_{t+i} in equation 5.2 is measured by earnings. If we assume no growth in earnings, equation 5.2 simplifies to the perpetuity shown in equation 5.3.

$$V_{DCF} = \frac{E}{r} \tag{5.3}$$

where V_{DCF} = discounted cash flow value of the firm's equity
E = future earnings
r = required return on equity

Under the assumption that P equals V, equation 5.3 demonstrates that the price-to-earnings (PE) ratio is the inverse of the firm's capitalisation rate[37] (White, Sondi & Fried, 1998). This relationship is shown in equation 5.4.

$$\frac{P}{E} = \frac{1}{r} \tag{5.4}$$

where P = market value of the firm's equity
E = future earnings
r = required return on equity

[36] Penman (2007, p. 124) states the 'continuing value is not the same as the terminal value' because the latter is the terminal payoff while the former is the value omitted when the forecast horizon is finite. Theoretically, the terminal value (or price of the equity at time T) in the dividend discount model is the present value of future cash flows from the point of the terminal value to infinity. Penman's characterisation of the 'terminal payoff' as derived from 'selling the firm at time T' is consistent with a finite rather than infinite forecast horizon. From the perspective of valuing a share, continuing and terminal value are, therefore, theoretically equivalent.

[37] The numerator in the PE ratio should, theoretically, represent P + expected dividends. From a pragmatic perspective, the calculation of PE is not materially affected by the omission of the dividend component as dividends are normally small compared to price (White, Sondi & Fried, 1998).

It is again important to note that the research in this dissertation rejects the assumption that *P* equals *V*. Without this assumption, the PE approach loses its theoretical underpinning. Further, research (c.f. Zarowin, 1990) shows the 'no-growth' assumption in equations 5.3 and 5.4 does not provide an adequate representation of most observed PE ratios. A more detailed discussion of the application of the PE model is presented in the following sub-section.

5.2.3.4 Comparable firms approach

Comparing the theoretical DCF valuation models with the comparable firms approach, Bhojraj and Lee (2002) describe the former as 'direct valuation' as value is determined without reference to the prices of other firms. They identify the latter approach as 'relative valuation' as value is determined after examining the prices of comparable assets. The comparable firms approach to valuation involves the identification of a set of companies in a comparable situation to infer the value of another firm (Finnerty & Emery, 2004).

Price multiple ratios relate price to an accounting variable such as earnings, sales, cash flow or book value. Equation 5.5 shows the price-earnings multiple.

$$PE = \frac{P_t}{E} \quad \textbf{(5.5)}$$

where P_t = current market price
E = relevant earnings measure

Multiples are calculated for several comparable firms and averaged for the group (Damodaran, 2001). *V* is then estimated by multiplying the relevant firm-specific accounting variable by a price multiple derived from the comparable firms.

Use of the comparable firms approach is documented in the literature [c.f. Boatsman & Baskin (1981); Alford (1992); Kim & Ritter (1999); Bhojraj & Lee (2002)] and is advocated in fundamental analysis textbooks (c.f. Penman, 2007). Kim and Ritter (1999) posit that theoretical models provide the justification for the value relevance of both the PE and price-to-book (PB) multiples.

The comparable firms approach avoids the problems of estimating terminal value, discount rates and assessing the impact of imputation credits, all of which are experienced when applying the DDM (How, Lam & Yeo, 2007). The popularity of price multiples among practitioners can be attributed to the multiple's capacity to provide a '… convenient valuation heuristic that produces satisfactory results without incurring extensive time and effort costs' (Bhojraj & Lee, 2002, p. 408). The Australian brokers surveyed by Cotter, Goyen and Hegarty (2005) said they utilised a comparable firms approach when setting *OP*. The high correlation of V_{PE} with *OP* (ρ = 0.725) in that study provides corroborative evidence. Practical issues associated with the implementation of the comparable firms approach in the Australian IPO context are discussed in section 5.3.2. The final valuation method considered in this research, the Edwards-Bell-Ohlson model, is discussed in the following sub-section.

5.2.4 Edwards-Bell-Ohlson valuation

The Edwards-Bell-Ohlson (EBO) model is based on an accounting measure of the capital invested (book value) and the present value of residual earnings (Frankel & Lee, 1998). Return on equity (ROE) is expected to be close to the typical firm's cost of equity (*r*) in a competitive equilibrium, so residual earnings are those in excess of *r* (Frankel & Lee, 1998). Equation 5.6 shows the EBO estimation of *V* where forecast return on equity (*FROE*) reverts to some pre-specified level over *T* periods.

$$V_{EBO} = B_t + \sum_{i=1}^{T} \frac{\left(FROE_{t+1} - r\right)}{\left(1+r\right)^i} B_{t+i-1} + \frac{\left(FROE_{t+T+1} - r\right)}{\left(1+r\right)^T r} B_{t+T} \qquad \textbf{(5.6)}$$

where V_{EBO} = Edwards-Bell-Ohlson measure of intrinsic value
B = book value per share
FROE = forecast return on equity
r = required return on equity

The EBO model uses the clean surplus relation shown in equation 5.7. Clean surplus earnings (or 'comprehensive income') include all gains and losses that affect book value.

$$B_{t+1} = B_t + E_{t+1} - D_{t+1} \quad or \qquad \textbf{(5.7)}$$
$$B_{t+1} = B_t\left(1 + \left(1-k\right) \times ROE_{t+1}\right)$$

where B_{t+1} = forecast book value per share
B_t = current book value per share
E_{t+1} = forecast earnings
D_{t+1} = forecast dividends
k = forecast dividend payout ratio

Testing a variety of residual income models (including EBO) with US data, Dechow, Hutton and Sloan (1999, p. 3) report these models offer '… modest improvements in explanatory power over past empirical research using analysts' earnings forecasts in conjunction with the traditional dividend-discounting model'. Whilst it offers a different set of limitations (including the identification of the appropriate level of persistence in earnings), the EBO model generates valuations that are not biased from the selection of comparable firms[38].

Several studies compare discounted dividends or cash flow models and find higher valuation accuracy with the EBO model. Francis, Olsson and Oswald (2000) show higher valuation accuracy with forecast earnings in the EBO model. Penman and Sougiannis (1998) report the EBO model, even with historic earnings, has higher valuation accuracy than discount models over finite horizons. Further, Frankel and Lee (1998) argue that the EBO model provides a more precise estimate of *V* than estimates based on multiples. Practical issues associated with the implementation of the EBO model in the Australian IPO context are addressed in section 5.3.3. The next section discusses how the asset-based, discounted cash flow and EBO models are related.

5.2.5 Relationships between valuation models

Asset-based valuation takes a 'stock' approach, DCF methods utilise the 'flows' from assets and the EBO model includes both stock and flow measures in the valuation. As expected free cash flows, earnings and dividends are generated by the firm's assets, the three DCF valuation methods are linked via the use of the required return and are theoretically equivalent in a perfect information environment (White, Sondhi & Fried, 1998). The EBO model is derived from the DDM [Frankel & Lee (1998); Dechow, Hutton & Sloan (1999); Lo & Lys (2000); Bhojraj & Lee (2002)]. Discounted

[38] As for PE multiples, EBO valuations based on management forecasts are potentially biased where earnings management occurs prior to the IPO and is reflected in the earnings forecast.

dividends, cash flows and earnings are equivalent approaches when the payoffs are predicted to infinity (Penman & Sougiannis, 1998). Real world constraints of imperfect costly information and finite horizons cause disparities in valuation from the application of these models (White, Sondhi & Fried, 1998).

While the models are theoretically consistent, the ease with which the models can be applied in practice varies. The usefulness of a model is dependent on the availability of data to implement it (Barker, 2001). Market professionals use the discounted cash flow and comparable firms approaches most frequently to establish the *OP* for IPOs (Jenkinson & Ljungqvist, 2001). While forecasted earnings are generated by analysts regularly, forecast cash flows are less common [c.f. White, Sondhi & Fried (1998); Penman (2007)]. Thus, the methods for estimating of *V* in this research are based on valuation theory and the observed behaviour of market participants.

5.2.6 Selection of valuation models

Based on the foregoing discussion, this section identifies the valuation models that will be applied in this research. The asset-based approach is not considered further as it lacks relevance in the IPO context (Kim & Ritter, 1999). As discussed in section 5.2.3, the DDM requires assumptions about future growth rates. These growth assumptions can be little more than speculations in the IPO context, especially for firms planning to reinvest profits for further investment rather than pay dividends as soon as they are listed. Valuations using discounted free cash flows are more appropriate for mature firms (Penman, 2007) than for IPO firms that may have forecast negative free cash flows in the shorter term (Curtis & Fargher, 2003).

In the absence of a ‘perfect’ valuation model, this research proxies for *V* with the model most used by practitioners (PE comparable firms) and the most theoretically sound valuation technique (the EBO model). The primary measures of *V* will be based on the PE comparable firms approach. As discussed in the following section, the potential for biased valuations from the PE approach can arise from the selection of comparable firms. To determine if such bias drives the results in this research, *V* is also estimated using the EBO model. While the EBO model is also subject to criticism, it will not be biased by the selection of comparable firms.

5.3 Implementing the valuation approaches

This section discusses the implementation of the comparable firms approach and the EBO model in the Australian IPO context. Management earnings forecasts are required to implement both valuation methods and practical issues relating to these are discussed in the next sub-section.

5.3.1 Selection of earnings measurements

The value relevance of the type of earnings measure is a potential source of bias in the application of PE multiples in the IPO setting (Kim & Ritter, 1999) and, as earnings are also a primary input, to the EBO model. In this section, selection of the specific measure of earnings is discussed. The choice between trailing and forecast earnings measures is then examined.

5.3.1.1 EBIT and EPS

The choice of the accounting earnings measure is discussed in this section. Whilst not including as much detail as the financial statements for listed firms, the pro-forma income statements included in IPO prospectuses normally show a number of earnings ‘line items’. Either *EPS* or diluted *EPS* are generally found as the bottom line figure in the income statement while several alternative earnings measures, including earnings before interest and tax (EBIT) and earnings before interest, taxes, depreciation and amortisation (EBITDA).

Purnanandam and Swaminathan (2004) argue EBITA is a more stable measure of profitability than *EPS* as it is unaffected by non-operating items. Kim and Ritter (1999) consider the advantage EBITDA over earnings per share available to ordinary shareholders (*EPS*) is that the former is not affected by leverage. However, using leverage as a matching criterion for the selection of comparable firms decreases valuation accuracy of the PE method (Alford, 1992). The issue of leverage is further complicated in the Australian dividend imputation setting as tax shields from debt, which are a source of value for investors in the classical tax system, do not benefit Australian resident investors. Thus, the perceived leverage-related benefits of EBITDA over *EPS* are negated.

White, Sondhi & Fried (1998) argue the appropriate measure of earnings is determined by the valuation objective. They identify earnings prior to interest payments (i.e. net operating income) as the appropriate measure for *firm* valuation. Earnings after interest (i.e. net income) is the appropriate measure for valuing *equity* (White, Sondi & Fried, 1998). *EPS* is the most frequently utilised measure of earnings in equity valuation [c.f. Boatsman & Baskin (1981); Alford (1992); Berkman, Bradbury & Ferguson (2000); How, Lam & Yeo (2007)]. Earnings before extraordinary items are also used to implement the PE comparable firms approach [c.f. Kim & Ritter (1999); Cotter, Goyen & Hegarty (2005)] and the EBO model (Cotter, Goyen & Hegarty, 2005).

The valuation objective in this research is equity shares, so *EPS* is the appropriate measure of earnings. In the EBO context, *EPS* is closer than EBIT to the clean surplus accounting assumption made in the model [Dechow, Hutton & Sloan (1998); Lo & Lys (2000)]. A potential source of valuation bias in both the EBITDA and *EPS* measures arises from earnings management prior to the IPO. Evidence on the existence and extent of this source of bias is beyond the scope of this research and is suggested as a potentially fruitful avenue for further research.

5.3.1.2 Trailing and forecast earnings

The fundamental choice of earnings measure for valuation is between historic (or trailing) earnings and forecast earnings. Trailing earnings (for both the comparable and valuation firms) frequently feature in US PE valuation academic research [c.f. Boatsman & Baskin (1981); Alford (1992); Curtis & Fargher (2003); Purnanandam & Swaminathan (2004); Zheng (2007)]. Forecast earnings are used in preference to trailing earnings in academic studies conducted in countries where forecasts are available [c.f. Cotter, Goyen & Hegarty (2005); Berkman, Bradbury & Ferguson (2000); How, Lam & Yeo (2007)].

Trailing earnings are less relevant than leading (or forecast) earnings in the IPO setting as the former will not reflect the impact of the generally-larger capital base achieved by the listing process (Firth, 1998). Kim & Ritter (1999) criticise the use of trailing earnings in the IPO context as historic accounting data do not provide a reliable benchmark for expectations about the firm's post-listing performance. Kim and Ritter report that greater valuation accuracy is achieved with the use of forecast earnings in the PE approach. This result is supported by the use of IPO forecasts in preference to historic earnings by Australian brokers in setting *OPs* (Cotter, Goyen & Hegarty, 2005).

Implementation of the EBO model with analyst-forecast earnings outperforms the historic earnings version of the EBO with respect to explaining prices in the US [c.f. Dechow, Hutton & Sloan (1999)]. In their international study, Barniv and Myring (2006) find the forecast-based EBO has greater explanatory power for prices in Anglo-Saxon markets (including Australia and the US), Japan, Germany and three Nordic countries while they exhibit similar performance in the remaining sample countries.

Table 5.1 (see page 113) shows that 58% of sample industrial IPOs in Australia provided positive earnings forecasts in prospectuses issued between 1997 and 2006. As forecast earnings are available for a substantial proportion of sample IPOs, forward earnings collected from the prospectuses will be used in the application of the PE comparable firms approach. Having established the selection of forecast earnings as the appropriate basis for estimating *V* in this research, the following sub-section discusses the length of time to which the forecasts apply and implications for the sample.

5.3.1.3 EPS forecast horizon

There is substantial variation in horizon used for earnings forecasts in Australian IPO prospectuses. Forecasts for the first financial year post-listing (where available) are used to estimate value in this analysis as these reflect a full year of operating using the post-listing capital structure[39]. First post-listing financial year forecasts may be the second forecast of earnings provided in the prospectus. The first forecast normally includes an earnings figure for the current financial year that consists of actual results up to the prospectus date plus an estimate of earnings to the end of the period. This

[39] How, Lam and Yeo (2007) state that higher valuation accuracy is achieved with earnings forecasts for the first operating year after listing than for either forecasts based on the next fiscal year or for historic earnings. Their methodology and results for valuation accuracy are unreported.

practice can result in the release of actual earnings prior to listing where there is a relatively short time reflected in the estimated component of earnings or a relatively long time between the prospectus date and listing. In such cases, the current period 'forecast' is not information about the future at the time of listing and does not reflect the post-listing capital base for the full period. IPOs that 'forecast' for a period ending prior to the listing date (and did not include a subsequent period forecast) are excluded from the sample[40].

Fifteen sample IPOs provided part-year forecasts based on the post-listing capital structure. These part-year forecasts are annualised for those IPOs that do not include an additional forecast for the first post-listing financial year[41]. With the discussion of earnings measures now complete, the following section discusses the practical aspects of applying the comparable firms approach in this dissertation.

5.3.2 Implementing the PE comparable firms approach

The PE multiple is used most frequently in academic studies (Kim & Ritter, 1999) and is commonly used by practitioners (Finnerty & Emery, 2004). Alford (1992) notes the 'extensive' use of PE valuations for IPOs in the US. Australian brokers identify PE as the main multiple examined when establishing *OP*s for fixed-price issues (Cotter, Goyen & Hegarty, 2005).

Equation 5.8 demonstrates the calculation of V_{PE} via the application of the PE multiple. It shows that the two major components of the comparable firms approach are the choice of matching firms to establish the multiple (Alford, 1992) and selection of the earnings measurement (Kim & Ritter, 1999). Earnings measurement was addressed in the previous section, with forecasted earnings identified as being the most relevant for value. Although widely used by practitioners and academics, little theory is available to guide the application of price multiples and the process remains subjective (Bhojraj & Lee, 2002).

---

[40] The period of time covered by the earnings forecast and the time from prospectus date to listing were compared to identify IPOs that could have released actual earnings for the 'forecast' period prior to listing.

[41] One firm stated that annualising its part year forecast would not reflect the operating performance in the financial year post-listing. This firm was excluded from the sample of forecasters.

$$V_{PE} = PE_{Match} \times E_{t+1} \quad \textbf{(5.8)}$$

where V_{PE} = PE measure of IPO value
PE_{Match} = mean or median comparable firms' PE multiple
E_{t+1} = management forecasted IPO earnings

In addition to the PE, other multiples used in academic research include price to sales, price to cash flow and PB. In the Australian context, How, Lam and Yeo (2007) compare *V* estimates based on PE and PB multiples to both *OP* and *P* and report lower median prediction errors for PB multiples. In the US IPO setting, Kim and Ritter (1999) also find PB ratios give the highest valuation accuracy. However, they argue this result is driven by endogeneity arising from the inclusion of offer proceeds in both the numerator and the denominator of the PB multiple. Considering this endogeneity issue and the documented use of the PE multiple in setting Australian *OPs*, the PB multiple it is not a preferred method for estimating *V* in this research. Section 5.3.2.1 now presents discussion of alternatives for the selection of comparable firms and provides the rationale for the selection of comparables in this dissertation.

5.3.2.1 Selection of comparable firms

The comparable firms approach relies on the identification of a benchmark PE to determine the value of the IPO. Two different approaches for the selection of the comparable firms are identified in the IPO literature. The first involves the identification of a set of fundamental criteria that are used to match the IPO to a small set of listed comparable firms [c.f. Boatsman & Baskin (1981); Alford (1992); Kim & Ritter (1999); How, Lam & Yeo (2007)]. The second approach matches by industry only and includes all listed firms in the IPO's industry as the set of comparable firms [Berkman, Bradbury & Ferguson (2000); Cotter, Goyen & Hegarty (2005)]. These two approaches are discussed in the following sub-sections.

5.3.2.1.1 Few comparable firms with several matching criteria

The selection of comparable firms generally begins at the industry level with additional refinements to remove firms with lower levels of comparability (Bowman & Graves, 2004). Matching firms by industry provides controls for operating risks, profitability and growth (Purnanandam & Swaminathan, 2004). One comparable firm matched by industry and historic growth gives higher valuation accuracy than a randomly-selected firm from the same industry in the US market (Boatsman & Baskin, 1981).

Also in the US setting, Alford (1992) forms portfolios of at least six comparable firms based on industry, firm size and earnings growth. The findings indicate that the valuation accuracy for listed firms, where industry is used as the matching criterion, is not improved by including the additional criteria of size (as a proxy for risk), leverage or historic earnings growth (Alford, 1992). He concludes that matching on industry subsumes the effects of size and ROE. Further, selecting comparables based on analysts' long-term growth forecasts does not add to the predictive ability of those selected on industry alone (Alford, 1992).

Kim and Ritter (1999) use a specialist IPO research boutique to select two comparable firms. These comparable firms are selected by matching forecast earnings rather than industry matching. Kim and Ritter (1999) have analysts' forecast earnings available for 75% of their sample of US IPOs[42]. While 58% of Australian IPO fixed-price offers provide positive management earnings forecasts that will be utilised in this research, analysts' forecasts for Australian fixed-price offers are the exception rather than the rule. A generous assumption would be that Australian IPOs have a similar analyst interest as currently-listed firms. Such an assumption would still result in analysts' coverage for very few IPOs[43]. Therefore, while Kim and Ritter achieve higher valuation accuracy for this method, the availability of analyst earnings forecasts for the majority of Australian firms precludes its use here.

In the Australian context, How, Lam and Yeo (2007) select two comparable firms on the basis of industry, historic growth rates and size at listing[44]. They find significant associations for the comparable firms' PEs and those of IPOs. However, the comparable firms' PEs provide little explanatory power for the IPO PEs (where *OP* is

---

[42] Chemmanur & Krishnan (2008) report the median number of analysts forecasting earnings for each IPO during the 1980s and 1990s is three.

[43] While 96% of the largest 200 ASX listed firms have analyst coverage, the proportion of the next largest 400 firms is less than 50% (ASX, 2006b). As the number of companies listed on the ASX is about 2 000, these figures translate to about 25% receiving any analyst coverage with smaller companies neglected. As discussed in chapter 3, companies listed on the ASX and fixed-price IPOs have about the same median size.

[44] How, Lam and Yeo (2007, p. 104) state that PEs based on two comparable firms are 'more appropriate' than those based on the best comparable firm, three comparable firms or the industry mean. Their methodology and results for these tests are unreported.

the numerator). AR^2s for three models regressing IPO PEs on average PEs for two comparable firms range from 1.75% to 4.43%. How, Lam and Yeo report median prediction errors in the range of -21.54% to -6.44% when *V* is compared to *OP*. These large prediction errors give support to notion that issuers adjust the comparable PE when setting *OP*[45] (Cotter, Goyen & Hegarty, 2005).

Application of the PE comparable firms approach is not guaranteed to result in accurate valuations. Incorrect valuation of comparable firms is a potential source of bias in the application of PE multiples in the IPO setting (Kim & Ritter, 1999). The application of an average or median PE multiple derived from a small number of overvalued firms will, ceteris paribus, result in an estimation of V_{PE} that is too high. The converse also applies if the comparable firms are undervalued. Analysis of the US market PEs shows prices deviate from fundamentals during bull markets but return to equilibrium levels during bear markets (Coakley & Fuertes, 2006)[46]. Therefore, PE comparables will provide unbiased (biased) estimates of *V* in bear (bull) markets.

Not all IPOs will have a comparable listed firm for matching (Jog & McConomy, 2003). The relatively small size of the Australian market severely constrains the number of matching firms in the same industry (How, Lam & Yeo, 2007). This constraint on the number of available matching firms increases the risk of selecting comparable firms that lack sufficient similarity to the IPO firm to provide a sound basis for valuation. Further, use of a mechanical algorithm for the selection of comparable firms does not select the same comparable firms that would be selected by analysts (Kim & Ritter, 1999). Some practitioners consider the selection of comparable firms more an 'art form' that is not replicated in academic research (Bhojraj & Lee, 2002).

[45] Cotter, Goyen and Hegarty (2005) report relative size and growth prospects make positive significant contributions to the explanation of offer price for Australian fixed-price IPOs

[46] The market PE is a function of the individual PEs for listed companies. As such, evidence that the market PE is not always unbiased implies that industry PEs and those of individual firms will also be biased during bull market phases.

5.3.2.1.2 Many comparable firms with industry as the criterion

Rather than identify several firms using a number of criteria, Berkman, Bradbury and Ferguson (2000) use industry as the sole criterion in New Zealand's IPO market. They identify difficulties when selecting matching firms and attribute these to the very small size of New Zealand's exchange. In the Australian context, Cotter, Goyen and Hegarty (2005) measure the PE for comparable firms with the median PE for all listed firms in the same industry[47]. This 'all industry' approach reduces the risk of introducing valuation bias via the selection of a small number of comparable firms that are misvalued in the market or several firms that are unsuitable for comparison to IPO firms.

Large variation among the PEs of US firms in the same industry contributes to large valuation errors when using historic earnings (Kim & Ritter, 1999). Thus, there is a risk that the application of industry PEs will result in lower valuation accuracy. This risk is lessened by the use of the median PE which reflects the PE for the 'typical' firm rather than the 'average' firm represented by the mean. While Australian industry median PEs exhibit substantial variation across industries and display considerable time-series variation within industries (Cotter, Goyen & Hegarty, 2005), the US PEs reported by Kim and Ritter (1999) are much higher than those observed in Australia during the sample period for this research[48]. The tighter clustering around Australian median PEs and the application of forecasted earnings (discussed in the next section) in this research reduces the risk of large valuation errors.

The impact on valuation accuracy of the variability of industry median PEs depends on the reasons large deviations occur. The PE ratio for the Australian stock market is

[47] When estimating the abnormal returns for earnings forecasters, Shi, Bilson and Powell (2008) match IPOs to the relevant industry index as they consider the number of Australian listed firms too small to allow individual matching.

[48] The mean PE in Kim & Ritter's sample is 33.5 and the standard deviation is 26.9. More than 50% of their IPO have PE ratios above 20 where PE is measured using offer price and historic earnings (see Kim & Ritter, 1999, figure 2, p. 419). In the Australian IPO context, How, Lam and Yeo (2007) report mean PE of 17.43 and standard deviation of 49.47 for their IPO sample. Therefore, while the Australian mean PE (using offer price and forecast earnings) for IPOs is about half that of those in the US, the standard deviation is almost double. Unfortunately, these results cannot be used to draw conclusions about the relative volatility of PEs as the sample periods are not directly comparable. Kim and Ritter use two years of data while How, Lam and Yeo use eight years and only one year of the former study period is included in the latter research. Market movements over the longer How, Lam and Yeo sample period are the likely explanation of the higher standard deviation.

driven by fundamentals, consistent with market rationality (Shamsuddin & Hillier, 2004). If this result were to hold at the industry PE level and the industry median PE is used for comparable firms, valuation accuracy would be of less concern when applying this median in the PE approach. However, no research into the relationship of industry PEs and fundamentals at the industry level has been identified. While unable to provide protection from the use of inflated PEs attributable to overvaluation of an entire industry, industry PEs prevent the inadvertent selection of one or two comparable firms that happen to be overvalued.

In summary, selecting two comparable firms using multiple criteria may result in biased estimations of V when the comparable firms are incorrectly valued in the market. For example, V will be optimistically biased if the two selected comparable firms are overvalued in a bull market. Using industry as the only criterion, including all firms may result in lower valuation accuracy as dissimilar firms are included in the comparison. Prior literature, however, demonstrates the importance of industry as a selection criterion for comparable firms. Given the low number of comparable firms available for selection in the Australian context after controlling for industry, industry median PEs are used in this research. Broadly consistent with the approach used by Cotter, Goyen and Hegarty (2005), V_{PE} will be estimated by the application of the industry median PE to the management earnings forecast in the prospectus. The industry median PE for the year prior to listing is used in this research.

Therefore, the PE comparable firms approach will be implemented in this research by using industry median PEs applied to management earnings forecasts to estimate V. Industry median PE is based on the historic earnings of comparable firms as forecast earnings data are unavailable for all firms in the industry. The industry median PE for the year preceding listing is used to reflect market conditions contemporaneous with the preparation of the prospectus and setting of offer price.

5.3.3 Implementing the EBO approach

As discussed earlier, PE multiples will give biased estimates of V_{PE} when the comparable firms are misvalued in the market. While the use of industry-median PEs protects the V_{PE} estimate from errors arising from the selection of one or two comparable firms that are incorrectly valued, it cannot eliminate bias where most firms in the industry are misvalued. Therefore, valuations derived from the EBO model are used in this research to test the sensitivity of results to changes in the method of valuation.

5.3.3.1 Two-period expansion of the EBO model

A two-period expansion of the EBO model is employed in this research. The EBO model shown in equation 5.6 assumes mean reversion in residual income (Dechow, Hutton & Sloan, 1999). This implies that *FROE* reverts to some specific level within a given timeframe. The speed of reversion for *FROE* is called the 'fade' rate. Identification of a theoretically-appropriate fade rate for *FROE* is difficult in the IPO setting (Cotter, Goyen & Hegarty, 2005). Equation 5.9 shows a two-period expansion of the EBO model that does not require the identification of a fade rate as it assumes that forecast ROE for the coming year ($FROE_t$) is earned in perpetuity (Frankel & Lee, 1998). The terminal value in equation 5.9 is the discounted perpetuity of next period's residual earnings.

$$V_{EBO\,2\,period} = B_t + \frac{(FROE_t - r)}{(1+r)} B_t + \frac{(FROE_t - r)}{(1+r)r} B_t \qquad \textbf{(5.9)}$$

where $V_{EBO\,2\,period}$ = Edwards-Bell-Ohlson measure of intrinsic value
B_t = current book value per share
FROE = forecast return on equity
r = required return on equity

Frankel and Lee (1998) contend that shorter expansions (such as equation 5.9) outperform their longer-horizon counterparts (equation 5.6) because forecast future ROEs become less accurate and forecast errors are compounded in longer expansions. The implication contained in equation 5.9 is that investors overestimate the persistence of abnormal earnings. This implication is consistent with the empirical results in Dechow, Hutton and Sloan (1998).

Curtis and Fargher (2003) compare differing specifications of the EBO model for a sample of US IPOs. Using pre-IPO ROE to proxy *FROE*, they find estimates of V_{EBO2} from equation 5.9 exhibit higher explanatory power for offer value (i.e. *OP* x number of shares issued)[49] than the more complex implementations of equation 5.6. Similarly, values estimated from equation 5.9 in the Australian fixed-price setting yield higher correlations with both *OP* and *P* than are found for a 5-year or 12-year expansion of the EBO model shown in equation 5.6 (Cotter, Goyen & Hegarty, 2005). Equation 5.9 will be used to estimate the EBO valuation in this research. This choice is founded on the empirical superiority of the two-period expansion of the EBO model[50]. The two-period EBO model requires estimates of the cost of equity capital (r), $FROE_t$ and B_t. These are discussed in the following subsections.

5.3.3.2 Cost of equity capital

The cost of equity capital is used to discount future earnings streams in the EBO model. The firm-specific cost of equity capital is the theoretical discount rate in the EBO model but there is little consensus in the practical identification of this rate (Frankel & Lee, 1998).

Dechow, Hutton and Sloan (1999) use the approximate long-run average realised return on US securities (12%) as their discount rate for listed companies. Industry-specific discount rates have been applied to US data [Frankel & Lee (1998); Ali, Hwang & Trombley (2003)]. Lee, Myers and Swaminathan (1999) find time-varying interest rates are a critical component of valuation models when predicting the returns of large US companies[51]. Estimates based on short-term bills outperform those using long-term bonds [Lee, Myers & Swaminathan (1999); Cotter, Goyen & Hegarty (2005)].

In the spirit of Frankel and Lee (1998), Cotter, Goyen and Hegarty (2005) use an industry-based discount rate in the Australian IPO context. They apply industry Scholes-Williams betas and a constant risk premium of 6% to the CAPM to estimate

---

[49] Curtis and Fargher (2003) report the highest AR^2 of 61% for the naïve model of offer value where value is estimated as the sum of book value and a perpetuity of pre-IPO earnings. The next highest was 54.5% for the model in equation 5.11. AR^2s of about 45% and lower were reported for alternate specifications of EBO models. The naïve model will not be used to estimate *V* in this dissertation. First, it does not have a strong theoretical basis. Second, it does not utilize the earnings forecasts available in the prospectuses of firms in this sample.

[50] As future book values are not required in this version, there is no requirement to forecast the dividend payout ratio. This allows a larger sample size as more IPOs forecast EPS alone rather and dividends and EPS (see table 5.1).

[51] Changes in a firm's leverage over time are not expected to impact on the EBO measure of *V* because higher leverage increases ROE and increases r at the same time (Lee, 1996).

r. The 90-day bank-accepted bill rate is used to proxy the risk-free rate and results are insensitive to longer-term proxies derived from the 180-day bill rate and 5- or 10-year bonds[52] (Cotter, Goyen & Hegarty, 2005).

In their examination of the historical risk premium in Australia, Brailsford, Handley and Maheswaran (2008) highlight the potential impact of the Australian dividend imputation system on the estimation of the risk premium post-1987. They derive a series of market-risk premia based on differing assumptions about the value of imputation credits to the market. If imputation credits carry no (50%, 100%) value for the market, the historic risk premium over the 90-day bill rate for the 1988-2005 period is 5.2% (6.1%, 7%) (Brailsford, Handley & Maheswaran, 2008).

Cost of equity in this research will be estimated using the CAPM. Given the empirical links between short-term rates and future returns, the 90-day bank-accepted bill rate is used to proxy for the risk free-rate (r_f). The bill rates are sourced from the RBA website. The time-varying nature of interest rates is incorporated into *r* by using the annualised rate relevant to the twelve-month period prior to the IPOs listing date.

Scholes-Williams industry betas are obtained from the Australian Graduate School of Management (AGSM). Scholes-Williams betas are calculated to incorporate the effects of thin trading and are, therefore, more suitable for the trading patterns of most IPOs in the short- to medium-term. The industry beta for the year prior to the prospectus date will be applied to the relevant Australian historic market risk premium estimated by Brailsford, Handley and Maheswaran (2008)[53]. Given the empirical uncertainty associated with the value of imputation credits, three specifications of the cost of equity will be derived for application in the EBO model. The first is the application of the post-imputation historic risk premium of 5.2%. The next two specifications also use the risk premium of 5.2% (no value for imputation

---

[52] The Australian government suspended the issue of Treasury notes in December 2002 (Brailsford, Handley & Maheswaran, 2008).

[53] Rather than use the historic risk premium based on all available data (1883-2005) reported in Brailsford, Handley & Maheswaran (2008) the historic risk premium used here is for the post-dividend-imputation sub-period from 1988 to 2005. Brailsford, Handley & Maheswaran (2008) caution against the use of data pre-dating a structural break in the market and the introduction of dividend imputation may represent such a break.

credits) when forecast dividends are zero and when no dividend is forecast[54]. For those IPOs forecasting dividends, the risk premiums of 6.1% (imputation credits have 50% value) and 7% (imputation credits are valued at 100%) are used in the alternate specifications.

5.3.3.3 Future ROEs and book values

Frankel and Lee (1998, p. 288) identify forecasting future ROEs as the 'most important and difficult task' in implementing the EBO model. They identify prior period earnings or analysts' earnings forecasts as two ex ante alternatives. As discussed in section 5.3.1, pre-floatation earnings lose relevance in the IPO context. Analyst-forecast earnings have greater predictive ability for stock returns in the US (Lee, Myers & Swaminathan, 1999). As analyst following is low for Australian firms, reliance on analysts' earnings forecasts for IPOs would require a sample size more appropriate for a case study approach than for quantitative analysis. The Australian institutional setting facilitates the provision of management earnings forecasts (see section 5.4 below) and these are used to estimate the future ROE in this study.

While noting the theoretical requirement for beginning-of-year book values, Frankel and Lee (1998) use average book values to avoid problems associated with unusually low values in one period leading to inflated *FROE*. Ali, Hwang and Trombley (2003) use opening book value (B_t) and delete observations where *FROE* takes an absolute value larger than 100% and find this approach does not cause results to change. In the Australian context, Cotter, Goyen and Hegarty (2005) use B_t as reported in the prospectus pro-forma statements assuming full subscription of the issue. This approach will be used to measure B_t here. Data screening will be conducted to identify any firms where *FROE* has an absolute value greater than 100%. Forecast *EPS* is used in preference to alternative forecast earnings measures. Both forecast *EPS* and B_t are hand-collected from the sample prospectuses.

[54] It is very unlikely that a dividend will be paid when the prospectus contains a zero forecast or does not contain any forecast for dividends (Dimovski & Brooks, 2005).

5.4 Institutional setting

Both the PE and EBO estimates of *V* utilise earnings in their calculation and the Australian institutional setting facilitates the provision of management earnings forecasts in prospectuses. The institutional setting with respect to the provision of earnings forecasts is outlined in the first part of this section. The second institutional feature, relevant to the estimation of V_{PE}, is the industry classification system. Changes that occurred to the industry classification system over the sample period are also discussed.

5.4.1 Provision of earnings forecasts

Disclosure of earnings forecasts in IPO prospectuses was completely voluntary prior to the introduction of the *Corporations Law* (now the *Corporations Act 2001*) in 1991 (Brown et al., 2000). Rather than prescribe a list of information for inclusion in prospectuses, the *Corporations Act* places the onus for selecting the type and amount of relevant information for investors on prospectus preparers (Law & Callum, 1997).

Section 710 (1) of the *Corporations Act 2001* requires that a prospectus contain '… all the information that investors and their professional advisers would reasonably require to make an informed assessment…' about the rights and liabilities of the securities and the financial position and performance of the issuer. There is no requirement for forecast information under the *Corporations Law* (Law & Callum, 1997) or under the *Corporations Act* (Chapple, Clarkson & Peters, 2005)[55]. Forecasts or other forward-looking statements should only be included in the prospectus where the issuer has reasonable grounds for making the statement (*Corporations Act 2001*, Section 728 (2)). Companies without a reasonable basis for a reliable forecast will not breach the *Corporations Act* when they do not provide forecasts (ASC, 1997)[56]. Further, ASIC (2001) considers that start-up companies, those making substantial

[55] Lee et al. (2003 p 384) contend that earnings forecasts became "de facto" mandatory after changes to the Corporations Law that took effect in January 1991 and that 'almost 100% of IPO firms' provide earnings forecasts after this time. The proportions of industrial issuers providing earnings forecasts reported by Brown et al. (2000) and How and Yeo (2001), combined with the low propensity for mining IPOs to disclose earnings forecasts (Brown et al. 2000) suggest, with the benefit of hindsight, that issuers did not view the provision of forecasts as 'de facto mandatory'.

[56] ASC (1997) Practice Note 67 was replaced by ASIC (2002) Policy Statement PS 170 (since renamed RG 170) in September 2002. RG 170 states that prospective financial information without reasonable grounds should not be included in the prospectus. Forecasts without reasonable grounds will be considered misleading under the provisions of the *Corporations Act* (RG 170.24)

changes to their operations after the capital raising, and research and development companies not ready to commercialise their products should refrain from providing forecasts. However, the *Corporations Act* introduced uncertainty about the type of information to be disclosed resulting in an increase in the proportion of prospectuses containing earnings forecasts and '… made it easier for issuers and experts to be held liable for inaccurate forecasts' (Brown et al., 2000, p. 320).

The most recent regulatory change with respect to earnings forecasts is the introduction of the *Corporate Law Economic Reform Program Act* 1999 (*CLERP*) which came into effect in March 2000. The *CLERP* fundraising reforms reduced the litigation risk associated with the provision of earnings forecasts (Chapple, Clarkson & Peters, 2005). The regulatory changes discussed in this section are not expected to have a confounding influence on the results in the research. As the sample period employed commences with 1997 listings, all forecasters in the sample period have made forecasts only where they had reasonable grounds to do so. While forecast frequency decreased after the introduction of *CLERP* (Chapple, Clarkson & Peters, 2005), the integrity of the PE valuation model depends on the consistency of earnings forecasts rather than the number of forecasters. Given that Australian legislation and regulation do not prescribe the provision of earnings forecasts, factors associated with the provision of voluntary forecasts are now discussed.

Earnings forecasts are provided voluntarily by managers expecting improved firm performance, those wishing to signal management quality and those aiming to reduce the uninformed investors' level of ex ante uncertainty (Jog & McConomy, 2003). Firm age is positively associated with the provision of earnings forecasts in Australia [How (1996); Chapple, Clarkson & Peters (2005); Bilson et al. (2007)]. Larger Australian firms provide earnings forecasts more frequently [How (1996); Chapple, Clarkson & Peters (2005)] with those forecasting seeking to raise up to three times the amount of funds raised by non-forecasters (Bilson et al., 2007). There is a positive association between the provision of earnings forecasts and the level of post-IPO managerial ownership (How, 1996) and forecasters are less likely to have past-period losses (Bilson et al. 2007). While the choice of a high-quality auditor is positively associated with the provision of earnings forecasts in Australian samples prior to 1991

[How (1996); Lee et al. (2003)], no significant relationship is found during the period from 1988 to 2002 (Chapple, Clarkson & Peters, 2005).

5.4.2 Industry classification systems

Industry classification is used as the benchmark for comparable firms in this research. Therefore, industry classification systems used during the sample period are discussed in this section. The ASX produced an industry classification system for companies until May 2002. After this date, the ASX adopted the General Industry Classification Standard (GICS). The ASX classification system was divided into the two broad areas of resources[57] and industrials. While this broad distinction can be seen in the GICS[58], some old sectors have been regrouped and new sectors added. For example, the ASX industry categories of media, retailing and tourism and leisure are now included as media, retailing and consumer services industries in the new sector called 'consumer discretionary'. The ASX system included information technology companies as 'miscellaneous industrials'. Information technology now forms a discrete GICS sector. Chemicals and paper and packaging, classified as 'industrials' under the ASX system, are classified as materials in the GICS.

Standard and Poor's do not retrospectively reclassify companies so there is no single classification system that covers the whole of the sample period. Therefore, the ASX classification is used for listings prior to May 2002 and the GICS is used for the remainder of the sample. The absence of a single classification system presents a potential limitation for the research. While the GICS shares many of the characteristic groupings of the previous ASX system, its introduction during the sample period potentially results in some quite different classifications for some firms listing around the changeover.

In summary, examination of the Australian institutional features shows that the *CLERP* legislative changes introduced during the sample period are not expected to impact on the results of this research. The change to the GICS industry classification scheme and the resultant absence of a single classification scheme that covers the

[57] Resources and the energy sector (i.e. oil, gas, coal and uranium exploration and extraction)
[58] Resources are replaced by the 'materials' sector.

entire sample period do present a potential limitation for the research. The next section describes the data used to calculate *V*.

5.5 Sample and data description

In order to contextualise the sample of earnings forecasters in this research, this section commences with a brief comparison of forecasting and non-forecasting IPOs during the sample period. The following two sections then discuss empirical considerations associated with calculating V_{PE} and V_{EBO} and the determination of the samples used for each of these measures of value. The final section presents descriptive statistics for each value measure.

5.5.1 Characteristics of forecasters and non-forecasters

Table 5.1 shows the forecasting behaviours of the 496 sample IPOs described in chapter 3. Positive earnings forecasts are presented by 58% of the sample for the period from 1997 to 2006. Negative earnings forecasts are disclosed by about 4% of the sample while 189 (or 38%) of prospectuses do not contain forecasts for earnings or dividends. Only three sample firms provided dividend forecasts while omitting earnings forecasts for the next financial year.

Table 5.1 Percentage of earnings and dividend forecasters, 1997-2006

	All IPOs	+ *EPS* forecast		- *EPS* forecast		+ *DPS* forecast		+ *EPS* & + *DPS*		No forecast	
Year	*n*	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
1997	33	26	79	1	3	20	61	20	61	6	18
1998	26	19	73	0	0	11	42	11	42	7	27
1999	85	57	67	10	12	33	39	33	39	18	21
2000	119	72	61	5	4	43	36	42	35	42	35
2001	30	14	47	1	3	10	33	10	33	15	50
2002	22	14	64	0	0	9	41	9	41	8	36
2003	24	13	54	0	0	11	46	11	46	11	46
2004	64	31	48	1	2	29	45	27	42	32	50
2005	50	17	34	0	0	15	30	15	30	33	66
2006	43	26	60	0	0	19	44	19	44	17	40
Sample	496	289	58%	18	4%	200	40%	197	40%	189	38%

EPS = earnings per share. *DPS* = dividends per share

The proportion of IPOs providing positive earnings forecasts varies across the sample period but shows no clear trend. The proportion of prospectuses providing negative earnings forecasts decreases dramatically in the latter sample years, providing some support for the Chapple, Clarkson and Peters (2005) argument that *CLERP* reduced litigation risk (with respect to disclosure) for issuers. While the evidence is not unequivocal, there appears to be a trend toward more issuers omitting forecasts from their prospectuses.

Explicit forecasts of zero dividends were made by 12.3% of IPOs forecasting positive earnings, while 6.25% of earnings forecasters did not make a dividend forecast. Dimovski and Brooks (2005) compare realised dividend payments for Australian IPOs forecasting zero dividends and those omitting forecasts of dividends. Only 1.7% of Australian IPOs pay a dividend after omitting a dividend forecast in the prospectus (Dimovski & Brooks, 2005). They conclude that an omitted forecast can be interpreted as a zero dividend forecast. Given the effective equivalence of IPOs forecasting zero dividends and those omitting dividend forecasts, only positive dividend forecasts are shown in Table 5.1.

There are 97 start-up firms[59] in the sample identified in chapter 3. The majority of these (83.6%) do not forecast earnings while sixteen start-ups (16.4%) provide positive earnings forecasts. 95% of IPOs with positive earnings forecasts have an operating history. 17.6% of these report losses for either the financial year of the IPO or the year preceding it. In contrast, 40.6% of IPOs with negative or no earnings forecasts have prior period losses while a further 39.1% are start-ups.

The first full-forecast year post-listing is used for forecast earnings per share in the analysis from this point forward. Thirteen IPOs that forecast negative earnings for the first financial year of operation are excluded from the calculation of value as positive forecasts are required to implement both the PE comparable firms approach and the EBO method. There are 289 IPOs during the sample period that provide positive earnings forecasts for the financial year after listing. The mean (median) earnings

[59] Start-ups are defined here as companies without an operating history and historic financial statements that include only the costs of establishing the business.

forecast per share for this group is $0.095 ($0.081) and the standard deviation of forecasts is $0.10. The range of forecasts is from $0.0006 to $1.11.

Table 5.2 shows the forecasting behaviour of IPOs in different industries over the sample period. This analysis is undertaken to identify any propensity for industry membership to determine the forecasting behaviour of firms. Further, industry membership is used to identify the comparable PE ratio and to determine the relative size measure based on market capitalisation. Comparison of forecasting behaviour across industries is constrained by the change of industry classification system in 2002. Similar groupings (the ASX group 'investment and financial services' with the GICS group 'diversified financials', 'food and household' with 'food and drug retailing', healthcare and biotechnology' with 'healthcare equipment and services' and 'hotels, tourism and leisure' with 'tourism and leisure') have been combined across time to facilitate comparability. The telecommunications, retailing and transportation groupings are fairly consistent in both systems.

Inter-industry comparison of forecasting behaviour is further hampered by the small number of listings in some industries (engineering, banks and finance and insurance, for example). Therefore, this analysis is confined to those industries with more than ten listings in the sample period. The highest proportion of forecasters in these industries is 78.8% in retailing. The lowest proportion (12.5%) is found in pharmaceuticals and biotechnology. This result supports the notion that earnings predictability plays an important role in the decision to provide earnings forecasts.

While the relative proportions of forecasters increase over the sample period in healthcare and retailing, the remaining industries appear to maintain reasonably stable proportions of forecasters. The ASX grouping 'miscellaneous industrials' represents the largest number of listings (114) in the sample, with about 65% of these IPOs providing earnings forecasts. This grouping, however, includes companies from several of the GICS classifications, thus hampering any meaningful interpretation of these data.

Table 5.2 Earnings forecasters (*F*) and non-forecasters (*NF*) by industry, 1997-2006

	1997		1998		1999		2000		2001		2002		2003		2004		2005		2006		Industry
Industry	*F*	*NF*	*F*	*NF*	*F*	*NF*	*F*	*NF*	*F*	*NF*	*F*	*NF*	*F*	*NF*	*F*	*NF*	*F*	*NF*	*F*	*NF*	total
Automobiles & components																		1			1
Banks & finance							2		1												3
Diversified financials	1				3	3	7	5	2	1	1	1	3		2	1	2	1	2	2	37
Insurance																	1				1
Building materials	1						1														2
Capital goods													2	2	5	6	5	3	6	1	30
Developers & contractors	3		1				2														6
Engineering			1																		1
Food & drug retailing	1				3		1	2	2							2			1	1	13
Alcohol & tobacco	2		1	1	1		2		1												8
Food, beverage & tobacco												1	1	1		1	1		1	2	8
Healthcare	1	1	1	2	3	5	6	9		7	1	3	1	3	3	4		8		2	60
Pharmaceuticals & biotech											1			4	1	9		7	1	1	24
Tourism & leisure	1		1		2	1		2	1		1		1		1	1	1	1	2		16
Consumer services																				2	2
Infrastructure & utilities	1				1		1	1	1	1											6
Media	1		1		6	5	6	5			1				1	2		2			30
Miscellaneous industrials	9	4	9	2	24	8	24	17	4	6	4	3									114
Information technology													2		5	2		2	4	2	17
Commercial services & supplies											4		1	1	2	3	2	5	3	1	22
Consumer durables & apparel															1					1	2
Paper & packaging					1		5														6
Real estate													2		1	2	1		2		8
Retailing	1		2		5	3	5	3	2						6		3	1	2		33
Telecommunications	3	2	2	2	7	3	9	3		1					3			2		2	39
Transportation	1				1		1										1		1		5
Utilities											1								1		2

5.5.2 *Sample data for V_{PE}*

Empirical considerations for calculating V_{PE} are discussed in this section. The first of these considerations is the exclusion of 'diversified financials' from the sample. This industry category includes listed investment companies (LICs) and other investment vehicles whose PEs will not provide suitable comparables for other firms in this group. The second sub-section describes the calculation of industry median PEs.

5.5.2.1 Exclusion the 'diversified financials' industry category

The ASX industry classification 'investment and financial services' and the GICS classification 'diversified financials' both include LICs. While sample IPOs do not include such funds, it was not possible to obtain sufficiently-fine industry classifications to exclude these from the calculation of industry medians. There is no reason to assume the PEs of investment funds will provide meaningful comparable PEs for other types of companies (such as stock brokers, for example) in this industry grouping. Therefore, 13 sample IPOs classified as investment and financial services and a further 9 classified as diversified financials are excluded from the calculations of PE intrinsic value.

5.5.2.2 Constructing industry median PEs

Industry median PEs (rather than averages) are used in prior valuation research [c.f. Kim & Ritter (1999); Cotter, Goyen & Hegarty (2005)]. Visual inspection of the distributions of the PEs for listed companies by industry confirms that the median is the more appropriate measure of central tendency. As outliers exert less influence on the median than the mean, the choice of median PE also provides some protection from valuation bias associated with the misvaluation of some firms in an industry.

Industry median PEs for the years 1997, 1998 and 1999 were obtained for a prior study from Aspect Financial. As these data vendors now focus on the provision of databases rather than providing tailored data on request, the median PEs for 2000 to 2005 are constructed for this research. Lists of companies in each industry were purchased from the AGSM. The PE for each company was obtained from the FinAnalysis database.

The range of PEs for comparable-firm industries during the 2000-2005 period is 1 226 to negative 15 180 and the standard deviation of these is 361.56. Kim and Ritter (1999) deal with outliers by winsorising all values of PE over 100 to 100. How, Lam and Yeo (2007) exclude negative PE ratios and those exceeding 15 when selecting comparable firms. Extreme observations in this sample are trimmed via the removal of the highest and lowest 5% of PEs. The remaining 90% of PEs are within the range of 43.62 to negative 32.33.

Some industries exhibit negative median PE ratios for some sample years. Negative median PEs cannot be used to generate values with the comparable firms approach so 13 healthcare IPOs[60], three pharmaceuticals and biotechnology[61], 11 information technology[62] and 18 telecommunications[63] IPOs were excluded. In total, negative median PEs resulted in the exclusion of 41 sample IPOs from the calculation of PE intrinsic value and V_{PE} is calculated for 222 sample firms.

5.5.3 Sample data for V_{EBO}

FROE is calculated for the 289 earnings forecasters identified from the baseline sample. These are screened for extreme observations exceeding an absolute value of 100 [Frankel & Lee (1998); Ali, Hwang & Trombley (2003)]. Twenty sample IPOs where *FROE* exceeds 100% are excluded[64]. Whilst the listing dates of the excluded firms are broadly consistent with the distribution of listing dates across the sample, the excluded IPOs have significantly larger market capitalisation[65].

Ten of these exclusions were also removed from the V_{PE} sample as these companies have negative median PEs (six) or membership of the diversified financials industry group (four). Four of the remaining exclusions are ‘miscellaneous industrials, three

[60] The median PEs for healthcare were negative in 1999, 2000 and 2003, so healthcare IPOs in 2000, 2001 and 2004 are excluded. Healthcare’s median PE was positive in 1996, 1997 and 2002 and one healthcare IPO listing in 1997, 1998 and 2003 is included.
[61] Negative median pharmaceutical and biotechnology PEs in 2001, 2003 and 2005 led to the exclusion of one IPO in this industry in 2002, 2004 and 2006.
[62] Information technology median PEs are negative for 2002, 2003 and 2005.
[63] The median PEs for telecommunications are negative for 1996, 1998, 2000 and 2005, leading to the exclusion of telecom IPOs in 1997, 1999, 2001 and 2006. The median is positive for 1999, so six telecom IPOs listing in 2000 are included.
[64] No IPO included in the calculation of value has a negative *FROE* as only positive earnings forecasts are included here.
[65] Mann-Whitney U = 2 135 $p = 0.000$ and t-test for difference of mean $p = 0.003$.

are 'retailing', two are 'real estate' and the final exclusion is the only sample representative from the 'insurance' industry classification. After these exclusions, V_{EBO} is calculated for 269 IPOs.

5.5.4 Descriptive statistics for V_{PE} and V_{EBO}

This section provides descriptive statistics for values calculated using the PE comparable firms and the EBO approaches. Descriptive statistics for earnings forecasts and other components used in the calculation of V_{PE} and V_{EBO} are presented here. As the sample sizes for each value measure differ, descriptive statistics for *EPS* are shown in table 5.3 (V_{PE} descriptives) and table 5.4 (V_{EBO} descriptives).

Table 5.3 presents the descriptive statistics for 222 sample IPOs included for the estimation of V_{PE}. While V_{PE} is the key variable of interest, descriptive statistics are also presented for *EPS* and industry median PEs to provide comparative data for future research. The mean and median *EPS* are quite close at \$0.092 and \$0.081 respectively and the hypothesis of a normal distribution is not rejected at the conventional level. The distribution of PE is significantly non-normal[66].

Table 5.3 V_{PE} descriptive statistics for 222 IPOs

	Mean	Median	S.D.	K-S (p-value)	Min	Max
EPS (\$)	0.092	0.081	0.064	(0.061)	0.001	0.587
Industry median PE	9.709	8.629	3.092	(0.000)	2.167	20.840
V_{PE}	0.900	0.710	0.723	(0.001)	0.005	5.040

EPS = earnings per share. PE = price-earnings ratio. V_{PE} = comparable firms estimate of value

The lowest industry median PE (2.1665) is provided by the healthcare and biotechnology industry during 1996[67]. The highest (20.84) is reported in the GICS classification 'healthcare equipment and services' for 2005[68]. V_{PE} ranges from \$0.0049 to \$5.04, with a mean (median) of \$0.90 (\$0.71). Figure 5.2 shows the

[66] The Kolmogorov-Smirnov statistic is 3.004 (p = 0.001)
[67] The sample contains IPOs listing from January, 1997. The median PE for 1996 is relevant as the prior calendar year is used to estimate V_{PE}.
[68] All other median PEs in the healthcare industries are negative for the sample period, demonstrating the volatile nature of PE ratios.

distribution of V_{PE} for the sample, overlaid with the normal curve. The distribution is significantly non-normal[69] and exhibits significant skewness and kurtosis[70].

Figure 5.2 Distribution of V_{PE} for 222 IPOs

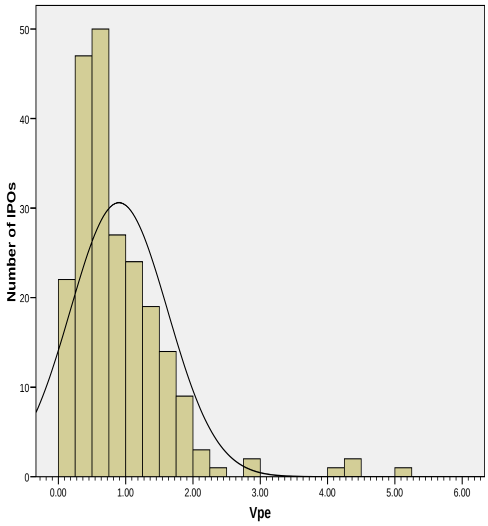


Table 5.4 V_{EBO} descriptive statistics for 269 IPOs

	Mean	Median	S.D.	K-S (*p*-value)	Min	Max
EPS	0.088	0.080	0.060	(0.040)	0.001	0.476
B_t	0.438	0.333	0.354	(0.000)	0.016	2.494
FROE	0.275	0.222	0.198	(0.000)	0.002	0.951
Industry beta	1.186	1.200	0.592	(0.452)	0.200	3.390
r_f	0.056	0.056	0.006	(0.008)	0.043	0.066
r_0	0.117	0.118	0.033	(0.349)	0.050	0.230
r_{50}	0.125	0.124	0.036	(0.349)	0.052	0.261
r_{100}	0.132	0.127	0.041	(0.270)	0.053	0.291
V_{EBO0}	0.906	0.831	0.663	(0.013)	-0.145	6.359
V_{EBO50}	0.857	0.783	0.639	(0.011)	-0.145	6.359
V_{EBO100}	0.815	0.728	0.621	(0.008)	-0.145	6.359

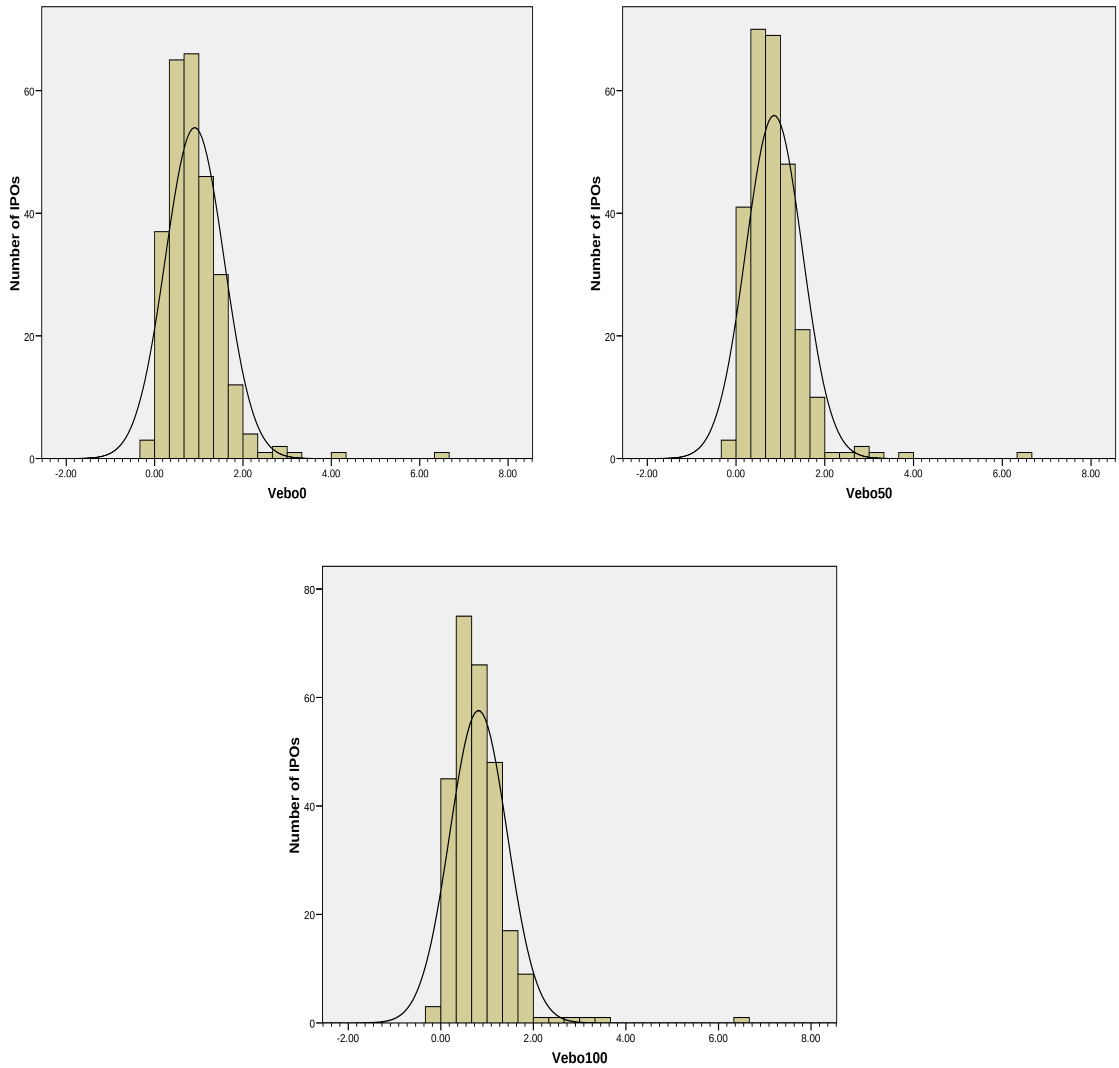
EPS = earnings per share. B_t = pro-forma book value of equity per share at listing. *FROE* = forecast earnings per share / B_t. Industry beta = Scholes-Williams industry beta. r_f = annual return on 90-day bank accepted bills measured at the prospectus month. r_0 = annual return on equity where imputation credits have zero value. r_{50} = annual return on equity where imputation credits are valued at 50%. r_{100} = annual return on equity where imputation credits are valued at 100%. V_{EBO0} = EBO model value where r_0 is the discount rate. V_{EBO50} = EBO model value where r_{50} is the discount rate. V_{EBO100} = EBO model value where r_{100} is the discount rate.

Table 5.4 presents the descriptive statistics for the 269 sample IPOs included in the estimation of V_{EBO}. Again, while V_{EBO} are the primary measures of interest,

[69] The Kolmogorov-Smirnov statistic is 1.962 (p = 0.001).
[70] The skew statistic is 2.489 and kurtosis is 9.625.

descriptive statistics for *EPS*, B_t, *FROE*, industry beta and the risk-free rate are provided to assist the identification of any potential time-period-specific trends in future research. The mean (median) *EPS* is \$0.0876 (0.80) and the distribution of *EPS* for these IPOs makes a significant departure from the normal distribution[71]. The mean (median) pro-forma book value of equity per share at listing is \$0.43 (\$0.33), exhibits a wide range of values and has a significantly non-normal distribution. *FROE* is also non-normal with a range of 0.19% to 95% and a mean (median) of 27.45% (22.19%).

Figure 5.3 Distribution of V_{EBO} for 269 IPOs, 1997-2006



[71] The Kolmogorov-Smirnov statistic is 1.399 (p = 0.001).

Consistent with higher valuation of imputation credits, the increasing discount rates for *r50* and *r100* result in lower valuations as measured by V_{EBO50} and V_{EBO100}. The mean value of V_{PE} is very similar to that of V_{EBO0} while the median for V_{EBO100} is closest to (but higher than) median V_{PE}. Maxima and minima are identical for each of the V_{EBO} measures. The firms providing these do not forecast dividends so V_{EBO} measures are unaffected by the imputation credit assumption used to determine the discount rates. The distributions of the three V_{EBO} measures are shown in figure 5.3. As for V_{PE}, the distributions of V_{EBO} are significantly different from the normal distribution[72].

5.6 Correlation of value proxies

Correlation analysis is now used to assess the relationships between the different measures of value. Table 5.5 presents both Pearson (right-hand side) and Spearman coefficients (left-hand side) for the 212 sample IPOs for which both V_{PE} and V_{EBO} are calculated. Even given the non-normal distributions of the value measures, the Pearson coefficients confirm the results shown by the Spearman coefficients.

Table 5.5 Correlation of V_{PE} and V_{EBO} measures, 212 IPOs from 1997-2006

	V_{PE}	V_{EBO0}	V_{EBO50}	V_{EBO100}
V_{PE}		0.785** (0.000)	0.768** (0.000)	0.750** (0.000)
V_{EBO0}	0.822** (0.000)		0.998** (0.000)	0.993** (0.000)
V_{EBO50}	0.805** (0.000)	0.997** (0.000)		0.998** (0.000)
V_{EBO100}	0.791** (0.000)	0.990** (0.000)	0.998** (0.000)	

Spearman correlations are shown on the left-hand side of the table and Pearson's are on the right.
** Correlation is significant at the 0.01 level (2-tailed)
V_{PE} = comparable firms estimate of value. V_{EBO0} = EBO model value where r_0 is the discount rate. V_{EBO50} = EBO model value where r_{50} is the discount rate. V_{EBO100} = EBO model value where r_{100} is the discount rate.

There are strong and highly significant relationships between each of the value measures. The three EBO proxies for value are expected to have high correlations as V_{EBO0}, V_{EBO50} and V_{EBO100} will be identical for those IPOs without dividend forecasts

[72] Kolmogorov-Smirnov statistics are 1.586, 1.608 and 1.653 for V_{EBO0}, V_{EBO50} and V_{EBO100} respectively. Skewness (kurtosis) is 2.922 (18.426), 3.197 (21.631) and 3.460 (24.762) for V_{EBO0}, V_{EBO50} and V_{EBO100} respectively. Compared to V_{PE}, kutosis is even more extreme in the EBO value.

(i.e. 40% of the forecasting sample). The high correlations between V_{PE} and each of the V_{EBO} measures provide support for the notion that V_{PE} and V_{EBO} both capture the same underlying phenomenon (i.e. the value of a share). With the description and analysis of the value proxies now complete, section 5.7 examines the empirical relationships of mispricing, misvaluation and underpricing for the sample.

5.7 Observed relationships of mispricing, misvaluation and underpricing

In order to contextualise the development of the mispricing and misvaluation models in the following two chapters, figure 5.4 shows the range of possible relationships of positive and negative mispricing, misvaluation and underpricing. While all possible relationships are included in figure 5.4, classification of IPOs from the sample of 212 IPOs for which both V_{PE} and V_{EBO} are calculated show that not every possible relationship is observed in the data.

MP and *MV* are measured with V_{PE} in figure 5.4 and underpricing is measured as raw underpricing (*RUP*). Few differences are observed when V_{EBO} and market-adjusted underpricing (*MAUP*) are used to classify the data so only the V_{PE} measures of *MP* and *MV* and the *RUP* measure of underpricing are presented to achieve clarity.

In panel A, mispricing (*M*P) remains positive ($OP<V$) while misvaluation (*MV*) and initial returns (underpricing or *RUP*) vary. A.1, for example, shows positive *MP*, negative *MV* and negative *RUP* with *V* located between *P* and *OP*. Panel B shows scenarios for zero mispricing ($OP = V$) and panel C shows negative mispricing ($OP>V$). Again, the directions on *MV* and *RUP* vary. The final column in figure 5.4 indicates the number of sample IPOs that exhibit the specified relationships of *MP*, *MV* and *RUP*.

Positive mispricing is reported for the majority (56%) of sample IPOs. Roughly three-quarters (76%) of IPOs with positive mispricing are also underpriced, indicating a positive relationship between *MP* and underpricing. However, the majority of IPOs with negative mispricing (panel C) are also underpriced, indicating that any relationship between *MP* and underpricing is not constant. Similarly, positive misvaluation does not always correspond with underpricing.

Figure 5.4 Underpricing, mispricing and misvaluation, 212 forecasters

		MV	*RUP*	No.
Panel A: positive mispricing (n = 118)				
A.1	*P* | *V* | *OP* |	-ve	-ve	3
A.2	*P = V* | *OP* |	nil	-ve	0
A.3	*V* | *P* | *OP* |	+ve	-ve	15
A.4	*V* | *OP* | *P* |	+ve	+ve	90
A.5	*V* | *OP = P* |	+ve	nil	10
Panel B: no mispricing (n = 0)				
B.1	*OP = V* | *P* |	+ve	+ve	0
B.2	*OP = P = V* |	nil	nil	0
B.3	*P* | *OP = V* |	-ve	-ve	0
Panel C: negative mispricing (n = 94)				
C.2	*P* | *OP* | *V* |	-ve	-ve	19
C.1	*OP* | *P* | *V* |	-ve	+ve	39
C.3	*OP=P* | *V* |	-ve	nil	10
C.4	*OP* | *P = V* |	nil	+ve	0
C.5	*OP* | *V* | *P* |	+ve	+ve	26

V = value estimated using forecast earnings and the industry median PE multiple. *OP* = offer price. *P* = market price. *MP* = *OP* minus *V*. *MV* = *P* minus *V*.

On the whole, IPOs with positive mispricing tend to have positive misvaluation and those with negative mispricing tend to have negative misvaluation. This conclusion is supported by the large positive and highly significant correlations between *MP* and *MV* shown later in table 8.6. The strong association between *MP* and *MV* has an important implication for the disaggregation of underpricing: *MP* and *MV* are not independent and should not be included in one model of underpricing. The positive relationship observed for *MP* and *MV* is investigated further in chapter 7.

5.8 Conclusions

After the examination of three broad approaches to the valuation of equity, two earnings-based models have been selected to operationalise value in this research. Using both the PE comparable firms and the Edwards-Bell-Ohlson model protects the research from potential biases that may arise in either of the valuation methods. While much prior research assumes that market price is an unbiased estimate of V, this research applies independent estimates of V to determine the extent of mispricing (in the next chapter) and misvaluation (in chapter 7) in order to achieve the disaggregation of underpricing.

Both selected valuation models are implemented with forecast earnings for the financial year following the prospectus date. The comparable firms approach applies industry median PEs for the year prior to listing to forecast earnings to estimate V_{PE}. The EBO model uses a two-year expansion with *FROE* calculated from prospectus data and return on equity estimated using the CAPM.

Correlation analysis shows strong but imperfect relationships between the measures of value. This result suggests that while both methods of determining value do, in fact, determine value, they do so with error. The measurement of V with error for each of the models demonstrates the importance of assessing the robustness of results with alternative measures of value. The V_{PE} and V_{EBO} measures of value described in this chapter are related to *OP* and *P* to estimate mispricing and misvaluation in the next and subsequent chapters.

CHAPTER 6
MISPRICING OF AUSTRALIAN FIXED-PRICE IPOs

6.1 Introduction

This chapter takes the first step in the disaggregation of underpricing with the investigation of mispricing. Mispricing (*MP*) is defined as the difference between the offer price (*OP*) of an IPO share and its intrinsic value (*V*). Investors consider the relationship of *OP* to *V* in their decisions to apply for shares[73] (Ellul & Pagano, 2006). This chapter addresses the second research sub-question: which issuer-related factors determine the level of IPO mispricing?

Measures of *V* have been discussed in chapter 5 and this chapter commences with a discussion of *OP*. The measurement of mispricing is addressed in section 6.3 and relevant institutional features are discussed in section 6.4. Potential factors associated with mispricing are identified and the mispricing model is developed in section 6.5. Section 6.6 presents descriptive statistics and measures of association for the dependent and independent variables. The mispricing model is tested in section 6.7 and robustness checks are discussed in section 6.8. Conclusions are then presented in the final section.

6.2 Offer price and the number of shares offered

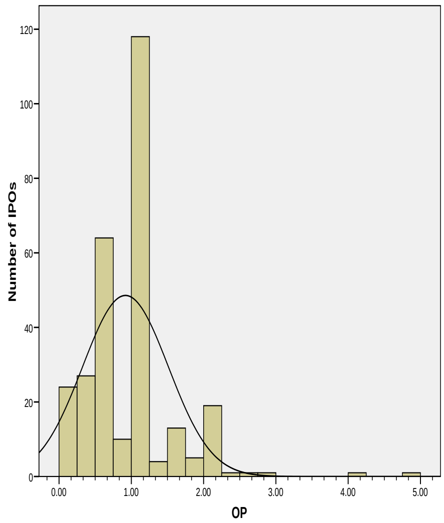
As mispricing represents the divergence of *OP* from *V*, the mispricing model is developed with reference to factors that are posited to have an influence on *OP*. In the fixed-price setting, Welch (1992) theorises that issuers with some given number of shares reduce offer price to achieve greater certainty with respect to the level of proceeds. Ellul and Pagano (2006) model after-market liquidity and underpricing in the UK fixed-price context. They also posit that the number of shares issued is exogenous with issuers setting the highest *OP* that is consistent with selling the number of shares offered. In contrast, Habib and Ljungqvist (2001) report that issuers

[73] Ellul & Pagano (2006, p. 388) identify *V* as the ‘expected value of the share’ to the investor, conditional on the information held by the investor.

in the US bookbuild setting select the number of shares to generate offer prices within pre-specified ranges[74].

Figure 6.1 provides empirical evidence that Australian *OPs* cluster around specific values. The earnings forecasting sample of 289 fixed-price IPOs described in chapter 5 is used to generate this distribution. Sample offer prices range from \$0.20 to \$5.00 with a standard deviation of \$0.5934. The mean (median) offer price is \$0.9188 (\$1.00) and the distribution is significantly non-normal[75].

Figure 6.1 <u>Distribution of *OP* for 289 forecasting IPOs, 1997-2006</u>



While there are 481 possible discrete *OPs* within this range (based on increments of \$0.01), only 38 are observed in the sample. Further, 62% of issues have offer prices of \$0.20, \$0.50 or \$1.00[76]. These data suggest issuers set *OP* with reference to market conventions and adjust the number of shares on offer rather than set a clearing offer price to ensure the full sale of offered shares.

---

[74] Standard economic theories of supply and demand, where the interplay of supply and demand determines both the price and quantity sold of some product, are somewhat complicated in the equities context. Holding constant the proportion of the company offered, the value of the IPO should not depend on the number of shares offered. The relevant 'quantity' that should respond to price is the proportion of the company sold, not the (arbitrary) number of shares. Issuing relatively more shares facilitates liquidity in the secondary market.

[75] Kolmogorov-Smirnov statistic = 3.927, p = 0.000. The distribution exhibits significant skewness (5.096) and kurtosis (12.413).

[76] 64% of the sample described in chapter 3 have offer prices of \$0.20, \$0.50 or \$1.00. The main difference between the full sample and the earnings forecaster sub-sample is the former contains a higher proportion of IPOs with offer prices in the range of \$0.25 to \$0.50.

This evidence is contrary to the expectations of Welch (1992) and Ellul and Pagano (2006) with respect to issuers selecting *OP* rather than the number of shares to offer. It is, however, supportive of Habib and Ljungqvist's (2001) evidence on issuer behaviour with issuers selecting the number of shares to achieve the desired *OP*. To illustrate this point, consider an IPO where the issuers intend to sell the company for $100 000. Following the expectations of Welch and Ellul and Pagano, issuers may select an offer price of, say, $0.80 per share. The number of shares offered is then determined by dividing the sale price of the company by the offer price, resulting in the offer 125 000 shares. Alternately, the issuer may choose to offer 100 000 shares to achieve an offer price of $1. This later approach is consistent with the relatively low diversity of offer prices in the Australian fixed-price setting.

While the total amount of mispricing will not necessarily be determined by the number of shares offered, the amount of mispricing per share will be affected by the method of determining offer price. This issue is addressed by robustness tests in section 6.8.5. The next section discusses the measurement of the dependent variable for the mispricing model developed in this chapter.

6.3 Measuring mispricing

Grounded in the early IPO literature that relies on market price as the appropriate measure of value, the term 'underpricing' is used when market prices exceed offer prices. Thus, 'mispricing' is the divergence of offer price from value. 'Mispricing' is also used in the broader finance literature to indicate the divergence of market price from value. The objective in this research is to disaggregate underpricing via the investigation of factors that influence offer price and those that influence market price. Rather than use the term 'mispricing' to describe these two distinct components of underpricing, mispricing (*MP*) is used here to identify a divergence of offer price (*OP*) from value (*V*), consistent with the bulk of prior IPO literature. Equation 6.1 demonstrates this relationship.

$$MP_i = OP_i - V_i \qquad \textbf{(6.1)}$$

where MP_i = per share level of mispricing
OP_i = per share offer price
V_i = per share proxy for value

Misvaluation (*MV*) indicates a divergence of subsequent market price (*P*) from value (*V*). The stickiness of *OP*s, discussed in the previous section, suggests the level (rather than the proportion) of *MP* as the appropriate dependent variable. Discussing the relative merits of dependent variables measured as 'levels' versus 'returns', Easton and Sommers (2003, p. 51) note that levels '… capture all returns since the firm came into existence'. Pre-listing prices are non-existent for start-up IPOs and are not generally observable for trading firms prior to listing. Returns should be specified as the dependent variable where the research objective is to assess the impact of some change over time (Easton & Sommers, 2003). From the IPO investor's perspective, the IPO effectively comes into existence at listing. Therefore, levels provide the appropriate dependent variable in this research design.

6.3.1 Relating value to offer price

Prior to investigating the factors associated with mispricing, it is first necessary to establish a relationship between *OP* and *V*. This section examines simple regressions of *OP* on *V* to establish the nature and magnitude of the relationship. Table 6.1 reports the results of these regressions.

Consistent with the four methods for estimating value presented in chapter 5, regression results for the four estimates of *V* are shown in table 6.1. The regressions show *V* explains about 25-32% of the variation in *OP*. These results provide justification for the investigation of mispricing factors as *OP* is not determined solely in relation to *V*. The results also support those of Cotter, Goyen and Hegarty (2005) who find factors in addition to value are significant in the explanation of *OP*[77]. The residuals for the V_{EBO} models are symmetric with excess positive kurtosis while those of the V_{PE} model have both significant skew and kurtosis[78].

The mechanical interpretation of the highly significant constants for each regression of *V* on *OP* is that they represent the divergence of *OP* from *V* when *V* is zero. A mechanical interpretation is valid when zero values for the independent variable can be observed in the sample (Gujarati, 2003). Thus, this interpretation could be valid

[77] Cotter, Goyen and Hegarty (2005) find V_{PE}, relative size and growth prospects are significant determinants of *OP*. Their model also has a significant constant of the magnitude of 0.327.
[78] Residuals from the V_{PE} regression have skewness of 3.714 and kurtosis of 27.71.

Table 6.1 OLS estimation of the relationship of *OP* and *V*

		Dependent variable			
		OP (n = 222)	*OP* (n = 269)	*OP* (n = 269)	*OP* (n = 269)
constant	coefficient	0.551**	0.456**	0.486**	0.515**
	t-stat	8.885	4.089	4.298	4.570
	p	(0.000)	(0.000)	(0.000)	(0.000)
V_{PE}	coefficient	0.393**			
	t-stat	5.442			
	p	(0.000)			
V_{EBO0}	coefficient		0.493**		
	t-stat		3.345		
	p		(0.000)		
V_{EBO50}	coefficient			0.487**	
	t-stat			3.101	
	p			(0.002)	
V_{EBO100}	coefficient				0.477**
	t-stat				2.913
	p				(0.004)
R^2		0.315	0.303	0.275	0.248
JB		37.27	397.52	440.872	479.51
	p	(0.000)	(0.000)	(0.000)	(0.000)
White's	*p*	(0.000)	(0.000)	(0.000)	(0.000)
DW		1.870	1.973	1.974	1.974
RESET	*F*	16.120**	16.238**	17.272**	17.498**
	p	(0.000)	(0.000)	(0.000)	(0.000)

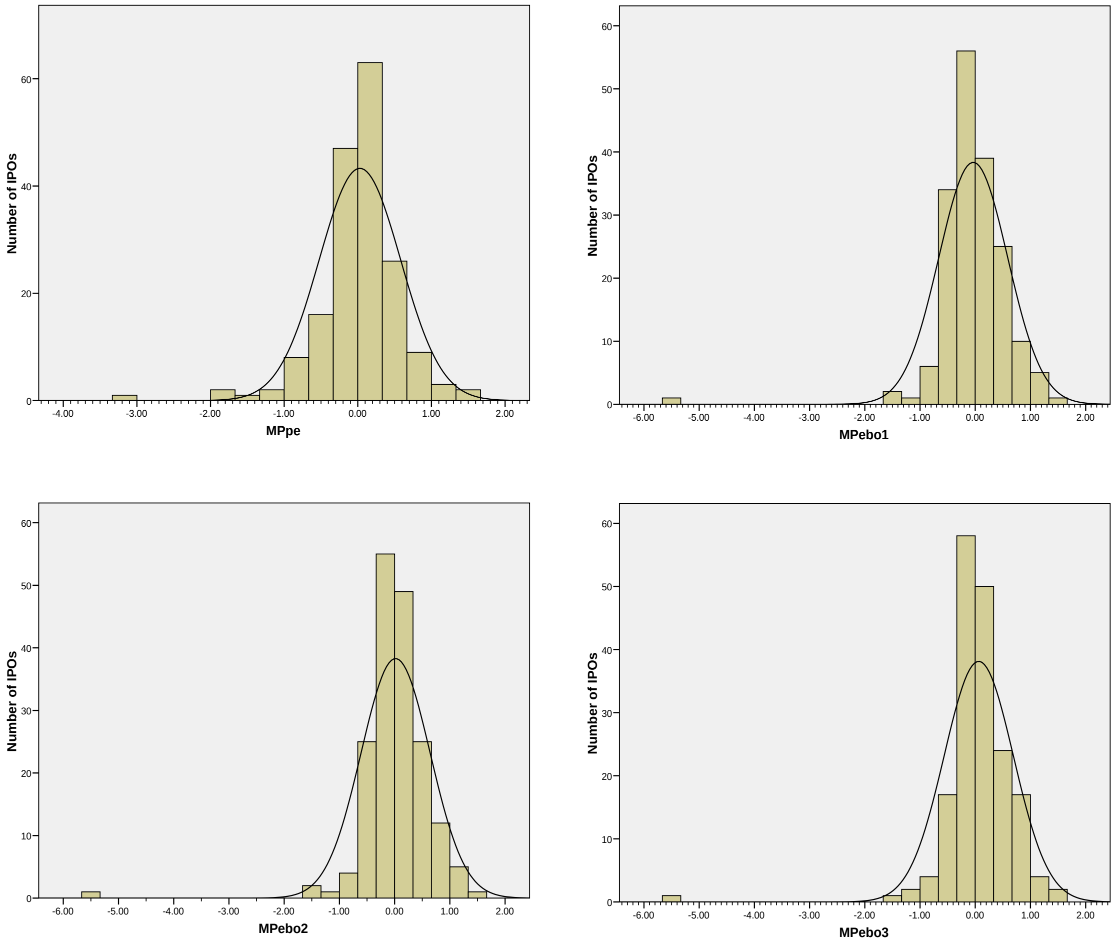
** Significant at <1% (two tailed)
t-statistics are White's heteroscedasticity adjusted
V_{PE} = comparable firms estimate of value. V_{EBO0} = EBO model value where r_0 is the discount rate. V_{EBO50} = EBO model value where r_{50} is the discount rate. V_{EBO100} = EBO model value where r_{100} is the discount rate.

when EBO models are used to estimate *V* as V_{EBO} ranges from -0.1452 to 6.36 (see table 5.4). While the lower range of V_{PE} is a near zero value (0.0049, see table 5.3), the exclusion of negative earnings forecasts and negative median industry PEs ensures that V_{PE} cannot take a zero or negative value. In this situation, the constant represents omitted variables (Gujarati, 2003). Highly significant RESET tests confirm that *V* is only one of a set of variables that explain *OP*.

6.3.2 Distributions and descriptive statistics for MP

Figure 6.2 shows the distributions of the MP_{PE}, MP_{EBO0}, MP_{EBO50} and MP_{EBO100} measures of *MP*. These distributions are constructed from the 180 observations that form the mispricing sample. The rationale for the final sample size is presented in section 6.6.

Figure 6.2 Distributions of *MP* for forecasting IPOs, 1997-2006



The distributions in figure 6.2 appear symmetric and centred close to a zero level of mispricing. Table 6.2 shows the proportions of positive and negative mispricing for each value proxy. Broadly speaking, about half the sample IPOs have positive levels of mispricing. The highest proportion of positive mispricing (56.91%) is identified with V_{PE} and the lowest (44.2%) occurs when V_{EBO100} is the value proxy.

The extreme outlier shown in figure 6.2 is Sterling Biofuels Ltd. This IPO floated in 2006 and reported the highest forecast *EPS* ($0.379) for the sample. In consequence of this high forecast, Sterling Biofuels has V_{PE} of $4.21 and V_{EBO} of $6.36.

Table 6.2 Proportions of positive and negative mispricing

	Positive *MP*	Negative *MP*
V_{PE}	56.91%	43.09%
V_{EBO0}	44.20%	55.80%
V_{EBO50}	50.83%	49.17%
V_{EBO100}	53.59%	46.41%

V_{PE} = comparable firms estimate of value. V_{EBO0} = EBO model value where r_0 is the discount rate. V_{EBO50} = EBO model value where r_{50} is the discount rate. V_{EBO100} = EBO model value where r_{100} is the discount rate.

Comparison of these values with the *OP* of $1 shows Sterling Biofuels has substantial negative mispricing. All measures of *MP* prior to the deletion of this observation are significantly non-normal and all follow a normal distribution when this observation is deleted from the sample (see table 6.3). Therefore, this observation is removed. Descriptive statistics for 179 sample IPOs with the four specifications of the dependent variable are presented in table 6.3.

Table 6.3 Descriptive statistics for *MP*, forecasting IPOs, 1997-2006

	Mean	Median	S.D.	Min	Max	K-S (*p*- value)	Skew	Kurtosis
MP_{PE}	0.0467	0.0429	0.4979	-1.84	1.63	1.219 (0.102)	-0.382	2.541
MP_{EBO0}	-0.0063	-0.0461	0.4816	-1.51	1.36	0.802 (0.540)	0.158	0.802
MP_{EBO50}	0.0477	0.0182	0.4793	-1.51	1.42	0.859 (0.452)	0.163	0.819
MP_{EBO100}	0.0942	0.0696	0.4800	-1.51	1.47	0.947 (0.332)	0.159	0.361

MP_{PE} = offer price minus the comparable firms estimate of value. MP_{EBO0} = offer price minus the EBO model value where r_0 is the discount rate. MP_{EBO50} = offer price minus the EBO model value where r_{50} is the discount rate. MP_{EBO100} = offer price minus the EBO model value where r_{100} is the discount rate.

The low means for *MP* suggest that issuers, on average, set price close to *V*. The standard deviation and maximum and minimum values show considerable variation in the sample, consistent with the normal distributions shown in figure 6.2. MP_{EBO0} shows a very small negative mean level of mispricing ($0.006) when it is assumed that imputation credits are not valued by the market. The highest mean level of *MP* ($0.09) is found when the return on equity used to calculate V_{EBO} is largest (i.e. when imputation credits are fully valued by the market). The minimum values for each MP_{EBO} measure are identical as the IPO generating these values did not pay dividends. The maximum values for MP_{EBO} show the impact of varying the value of imputation credits.

6.4 Institutional setting

Details of the Australian institutional setting and their implications for underpricing theories were provided in chapter 2. This section includes some further discussion of institutional features of particular relevance to *OP* and, therefore, mispricing. The capacity to incorporate demand into the *OP* when using the fixed-price mechanism is discussed. Differences in underwriter compensation mechanisms for Australia and the US are then addressed.

6.4.1 Incorporating demand into offer price

As discussed in chapter 2, bookbuild offers incorporate elements of demand into the setting of the final offer price via feedback received from institutional investors. Discussing the value-adding processes of professionals handling issues, Kim and Ritter (1999, p. 411) state

> … how much of this improvement in accuracy is due to superior fundamental analysis, and how much is due merely to canvassing market demand, is an open question.

By restricting the capacity of brokers and underwriters to assess demand formally prior to setting the offer price for fixed-price issues, testing for mispricing in the Australian institutional setting can shed light on this issue.

Section 736(1) of the *Corporations Act 2001* prohibits the 'hawking' of securities. This means that offers cannot be made as a result of unsolicited meetings or telephone calls and thus restricts the issuer's capacity to incorporate a formal assessment of the level of demand in setting the offer price. This prohibition of hawking does not, however, preclude the use of bookbuilding in Australia as it does not apply to offers made to sophisticated or professional investors (*Corporations Act 2001* s736(2)(a) and (b)). Relief from this prohibition is also extended to retail clients if the shares are offered over the telephone by a licensed securities dealer or to the licensed dealer's clients who have traded securities through the dealer in the twelve months prior to the offer (*Corporations Act 2001* s736(2) (c) and (d)).

Thus, it may be possible for Australian fixed-price issuers to engage in some informal price testing. However, Jenkinson and Ljungqvist (2001) consider that investors would be unlikely to reveal their costly information without some incentive. Further, an average of only 7.9 of the Top 20 shareholders in Australian fixed-price IPOs are institutional investors (see chapter 7). Combined with a lack of incentive to reveal information in the fixed-price setting, the relatively low levels of institutional investor activity in the Australian fixed-price IPO market suggest profound differences in these Australian data and the US bookbuild context. Given the Australian institutional setting, demand for a specific issue is expected to have little influence in setting *OP*. Therefore, the Australian fixed-price setting facilitates the assessment of issuer behaviour. In contrast, issuers can be expected to set *OP* relative to what the market will bear when demand can be formally assessed and incorporated into *OP*.

In addition to the constraints on incorporating issue-specific demand, the lag between setting *OP* and listing means there is less contemporaneity of market conditions at listing for Australian fixed-price issues compared to bookbuild issues. As shown in chapter 4, the mean (median) number of days from prospectus issue to listing is 54 (47). Thus, in contrast to bookbuild issues, fixed-price *OP* is set well in advance of listing. This institutional feature is relevant for the identification of any potential influence of hot IPO markets on establishing the offer price.

The main implication from the constraint on formally incorporating demand for the issue for modelling mispricing is that *OP* will be determined by reference to firm-specific characteristics rather than what the market is willing to pay for a share in the company. Thus, fixed-price *OP*s in the Australian context will be less influenced by investors' assessments of firm value or by investor sentiment than *OP*s established via bookbuilding.

6.4.2 Underwriting

The ‘stand-by’ arrangements of Australian underwriters were discussed in chapter 2. Here, the underwriter guarantees the number of underwritten shares that will be sold at the offer price. This approach is effectively ‘hard underwriting’ as issue proceeds are guaranteed. Hard underwriting is expected to result in deep discounting of the offer price relative to expected market price (Busaba, 2006). The results in chapter 4 confirm that underwritten issues are more underpriced.

A second institutional difference occurs in the pricing of underwriting services. As discussed in chapter 2, US underwriters purchase all offered shares from the issuer and sell them on to investors. The spread on the price paid to the underwriter is typically 7% of the issue size (Chen & Ritter, 2000). The spread includes underwriting fees, management fees and the selling concession paid to the underwriter (Ellis, Michaely & O’Hara, 2000). Chen and Ritter (2000) suggest that the underwriting spread also purchases analyst coverage post-listing from the issue management syndicate[79]. While the spread represents the primary source of compensation, profits are also generated from trading activities associated with acting as the market maker and using over-allotment options to manage inventory risk (Ellis, Michaely & O’Hara, 2000).

Australian issuers pay underwriters a fee for underwriting per se, a management fee for organising the issue and a brokerage fee (How & Yeo, 2000)[80]. Here, fees vary according to firm-specific variables including offer size, the length of time the offer is open and the level of retained ownership (How & Yeo, 2000). The average gross spread, 4.01% of issue proceeds, is substantially lower than that observed in the US (How & Yeo, 2000). Further profits from underwriting trading activities are not formally available as the Australian share trading system does not involve market makers and over-allotment options are not used for fixed-price offers.

[79] As previously discussed in chapter 5, analyst coverage for smaller Australian companies is negligible.

[80] A handling fee is paid to the ASX. This is paid directly to the ASX by the issuer or is paid to the underwriter who then passes it on to the ASX (How & Yeo, 2000).

Compared to the US firm commitment contracts, the use of the fixed-price setting mechanism and the relatively long time between price-setting and listing increase the risk of Australian underwriters holding shares after the offer [How & Yeo (2000); Suchard & Woo (2003)]. The inventory risk for Australian underwriters arises from the purchase of shares in undersubscribed issues, in contrast to the inventories of US underwriters which arise from post-listing market activities or over-allotment options. How and Yeo (2000) investigate this issue and conclude that the lower Australian underwriting fees either do not correctly price this higher inventory risk or the collusion in setting underpricing spreads in the US obscures the pricing of risk in the US spreads. In interviews, Australian brokers indicate that underwriting risk is reflected in the underwriting fee rather than the offer price (Hegarty, 1999). If the risk is not correctly priced by Australian underwriters, one would expect underwriters to exert a large influence on the setting of the offer price. This is not the case for Australian fixed-price offers (Cotter, Goyen & Hegarty, 2005).

The nature of the underwriting process used in Australia has two main implications for modelling mispricing. First, hard underwriting will constrain the underwriter's incentive to set offer price relative to expected market price. Australian underwriters, therefore, have less incentive to misprice issues than their US counterparts. Second, underwriters do not have access to over-allotment options in Australian fixed-price offers. This feature removes a potential incentive to misprice in order to profit from post-listing trading by the underwriter. Therefore, underwritten issues are not expected to exhibit systematic differences in mispricing[81]. However, the participation of the underwriter in the share allocation process (see section 6.5.3 below) is expected to be associated with mispricing.

6.5 The mispricing model

Hypothesised relationships for the factors affecting mispricing are developed in this section. While *MP* is determined by the divergence of *OP* from *V*, the mispricing model investigates factors that are predicted to either moderate or exacerbate the level of mispricing. These hypothesised relationships for mispricing are shown in HO_2.

[81] The potential for a signalling role for underwriters in misvaluation is investigated in chapter 7.

HO_2 *Mispricing in Australia is unrelated to the desired post-listing ownership structure, the wealth loss to owners, the disclosed share allocation policy and the state of the IPO market.*

The mispricing model expresses these hypothesised relationships in the following empirical model.

$$MP = \beta_0 - \beta_1 HOLDERS - \beta_2 PTN + \beta_3 DTN + \beta_4 ALLOC + \beta_5 HOTN + \beta_6 SIZE + \beta_7 GROWTH + \varepsilon \qquad \textbf{(\textit{MP} model)}$$

Table 6.4 contains a summary of independent variable measurement for the mispricing models.

Table 6.4 Variable measurement and predicted relationships for *MP*

Independent variable	Variable measurement	Predicted relationship
HOLDERS	represents the post-listing ownership structure. It is measured as the sum of the number of shares held by the top 20 shareholders less the number of shares retained by the vendors all scaled by the number of shares offered in the prospectus.	negative
PTN	is the participation rate of vendors in the issue. It is measured as the ratio of the number of secondary shares offered to the total number of original shares.	negative
DTN	is the dilution factor for vendors. It is measured as the ratio of the number of primary shares offered to the total number of original shares.	negative
ALLOC	proxies for the potential agency conflict arising when underwriters make the share allocation decision. The dichotomous variable is coded as one where the underwriter participates in the allocation process.	positive
HOTN	represents the state of the IPO market. *HOTN* is measured as by the number of industrial IPOs in the three months preceding the prospectus date. Hot markets are indicated by more listings.	positive
Control variables		
SIZE	measures the size of the firm post listing relative to industry median capitalisation for the year of listing. Firm size is measured as the total number of shares at listing multiplied by the offer price.	indeterminate
GROWTH	*GROWTH* is captured by 1-(book value of ordinary shareholders' equity / offer price).	positive

The rationale for including each of these independent variables is discussed in the following sub-sections.

6.5.1 Ownership structure (HOLDERS)

Deliberate negative mispricing (*OP* < *V*) may be used by issuers to achieve their desired post-listing ownership structure. Investors who are perceived to be long-term holders of shares receive favourable allocations in European IPOs (Jenkinson & Jones, 2004). Around 22% of Australian IPO shares are flipped[82] in the first three days of trading (Bayley, Lee & Walter, 2006), providing support for the notion that the majority of IPO shares are held for at least more than a few days.

There are distinct markets for controlling blocks and small dispersed shareholdings (Mello & Parsons, 1998). Booth and Chua (1996) argue higher underpricing is required to cover information costs of smaller investors. Pham, Kalev and Steen (2003) contend higher underpricing compensates smaller investors for adverse selection costs. As issuers are not expected to have a major influence on market price when listing occurs, the underpricing required to encourage a spread of ownership will be achieved by negative mispricing. In contrast to pricing with the bookbuild mechanism, private information is not incorporated into the offer price of fixed-price issues. Informed investors use their information in the after-market at the expense of uninformed investors (Ellul & Pagano, 2006). Therefore, IPO investors in fixed-price offers require the liquidity associated with a spread of ownership to dampen the impact of asymmetric information (Ellul & Pagano, 2006).

Large shareholders, on the other hand, have the informational advantage necessary to monitor management and monitoring will increase firm value (Stoughton & Zechner, 1998). Using an Australian sample of IPOs, Pham, Kalev and Steen (2003) find lower levels of underpricing when issuers pursue a concentrated post-listing ownership structure and higher underpricing with greater ownership dispersion[83]. Pham, Kalev and Steen's (2003) results are robust for different proxies for ownership

---

[82] 'Flipping' is the US term for selling IPO shares purchased from the prospectus on the first day of trading. This process is normally referred to as 'stagging' in Australia.
[83] The implicit assumption in Pham, Kalev and Steen is that issues are mispriced rather than misvalued (i.e. *P*=*V*). Therefore, higher underpricing by issuers to achieve sufficient shareholder diversity for liquidity will result from mispricing (*OP*<*V*) rather than misvaluation.

structure and after controlling for systematic differences between under- and overpriced issues[84].

Companies listing on the ASX are required to provide the names, and numbers of shares held by each, of the largest twenty shareholders upon completion of the allocation process. These 'Top 20' reports collected from the ASX form the basis of the ownership structure proxy HOLDERS:

$$HOLDERS = \frac{\sum_{k=1}^{20} TOP20SHARES_k - RETAINED}{OFFERSIZE} \qquad \textbf{(6.2)}$$

where $TOP20SHARES_k$ is the number of shares held by each of the top 20 investors. Following Pham, Kalev and Steen (2003), the number of shares retained by vendors is subtracted in the numerator to achieve a measure of outside interest. Scaling by OFFERSIZE provides a relative measure of outside interest.

Higher values for *HOLDERS* indicate outside shareholders own large parcels of shares and the resultant ownership structure is concentrated. Large outside shareholders will not require as much mispricing to induce them to purchase shares[85]. Conversely, lower values show the largest outside shareholders have relatively smaller share parcels and indicate a relatively more-dispersed ownership structure. As smaller investors will require $OP < V$, a negative association between mispricing and *HOLDERS* is expected. A negative relationship indicates issuers with a post-listing objective of control will misprice less than those with the objective of liquidity.

The numerator of the *HOLDERS* variable is Top 20 shares minus the number of retained shares. While it is reasonable to expect that vendors would remain amongst the largest 20 shareholders at listing, this is not always the case. Prospectuses were rechecked to ensure any negative value of the *HOLDERS* numerator was attributable

---

[84] Pham, Kalev & Steen test for the endogeneity of choice of ownership structure by regressing firm-specific characteristics (size, risk, leverage, growth and proxies for transparency) on each of their ownership-structure variables. They conclude ownership structure is unrelated to firm-specific characteristics.

[85] Large shareholders may even be willing to pay a premium above *V* that reflects the benefits of control.

to vendors with shareholdings outside the Top 20. Some issuers offer secondary shares as oversubscriptions but base their retained ownership prospectus figure on minimum subscription. Therefore, the retained ownership amount is adjusted in these cases to avoid overstatement if secondary shares are actually sold. Any shares issued to holders of convertible notes within three months of the prospectus date are not included in retained ownership.

OFFERSIZE is measured as the number of shares offered in the prospectus for fixed size issues. It is determined by reference to the company announcements made to the ASX at listing where the prospectus identifies a variable number of shares offered. OFFERSIZE is the maximum number of shares offered for those issues clearly identified as oversubscribed. Where IPOs offer a variable number of shares, OFFERSIZE is measured as the minimum number offered when the actual number of shares issued is closer to the minimum than it is to the maximum offered. Where the number of shares actually issued is closer to the maximum, OFFERSIZE is determined as the maximum disclosed in the prospectus. This approach is taken to minimise the impact of discrepancies between the ASX disclosures and the information contained in the prospectuses.

6.5.2 Wealth loss to owners (PTN and DTN)

The participation ratio and the dilution factor are included in the mispricing model to proxy for any impact that the wealth loss to owners may have on the divergence of *OP* from *V*. The extent to which issuers care about underpricing depends on the number of primary and secondary shares sold in the offer (Habib & Ljungqvist, 2001). Leung and Menyah (2006) confirm this result for fixed-price offers in Hong Kong.

Issuers may have the capacity to influence market price via the level of promotion costs expended on the issue[86], but the most direct impact they can have on underpricing is via the offer price. Loughran and Ritter (2002) and Zhang (2005) argue higher participation ratios and larger dilution factors provide incentives for

[86] Reputation and certification benefits, for example, are gained from the association of 'quality' investment bankers and auditors (Habib & Ljungqvist, 2001).

issuers to bargain harder with the underwriter for higher offer prices. Thus, these two variables associated with the wealth loss to owners are investigated in the mispricing model.

There are two sources of wealth loss to owners, the participation ratio and the dilution factor. Participation (*PTN*) results from the sale of secondary shares in the offer while dilution (*DTN*) results from the sale of primary shares (Habib & Ljungqvist, 2001). Table 6.5 demonstrates how wealth loss is determined by *PTN* and *DTN*. Assume that vendors own 1 000 shares at the time of setting *OP*. Each alternative offer structure results in 1 500 listed shares when the float is completed. The IPO has an *OP* = \$1 and lists at *P* = \$1.20.

Only new shares (N_p) are offered in scenario I. In this scenario, the wealth loss to owners is \$67. Twenty cents is lost on each new share sold (*OP* – *P*). The share of this belonging to the original owners is determined by the proportion of shares they retain in the post-listing capital structure (da Silva Rosa, Velayuthen & Walter, 2003).

Issuers in scenario II offer 250 of their own shares in addition to 500 new shares. The wealth loss on the sale of 250 secondary shares is \$50. The \$100 total wealth loss in scenario II demonstrates the higher relative wealth loss on secondary shares compared to primary shares.

Table 6.5 Owners' wealth losses from issuing primary and secondary shares

	Number of shares	Wealth loss
Scenario I		
Owners' retained	1 000	
Secondary	0	0
Primary	500	[(1.20 – 1) x 500 x 0.67] = 67
Total	1 500	67
Scenario II		
Owners' retained	750	
Secondary	250	[(1.20 – 1) x 250] = 50
Primary	500	[(1.20 – 1) x 500 x 0.5] = 50
Total	1 500	100

The higher the participation ratio, the more issuers are concerned about underpricing because wealth loss increases with the level of underpricing and the proportion of secondary shares sold by the issuers. *PTN* is included in the mispricing model to determine if issuers use *OP* to influence the level of underpricing. If they set *OP* relative to an expected market price (*E(P)*) which, in turn, has a low correlation with *V*, *PTN* will have an indeterminate relationship with *MP* because the divergence of *OP* from *V* will vary with *E(P)*. Conversely, if they set *OP* relative to *V*, and they anticipate a high correlation of *E(P)* with *V*, *MP* will have a negative relationship with *PTN*.

PTN, shown in equation 6.3, is the number of secondary shares sold (N_s) normalised by the total number of original shares (N_o).

$$PTN = N_s / N_o \qquad \textbf{(6.3)}$$

Higher dilution is associated with lower underpricing as the wealth loss from selling more new shares increases with the level of underpricing. The rationale for including *PTN*, outlined above, is also used for including *DTN* in the mispricing model. As shown in equation 6.4, *DTN* is the normalised number of primary shares sold (N_n).

$$DTN = N_n / N_o \qquad \textbf{(6.4)}$$

A negative relationship is expected for *DTN* and *MP*. Some negative correlation is expected between *PTN* and *DTN*. As shown in chapter 4, 75% of issuers do not offer secondary shares so *PTN* for these IPOs is zero. A combination of primary and secondary shares is offered by 21.5% of the chapter 4 sample IPOs. Further, the proportion of retained ownership is significantly lower for issuers offering secondary shares. The proportional amount of retained ownership affects the wealth loss to owners from both participation and dilution. Careful consideration of the correlation for *PTN* and *DTN* will be made to minimise the possibility of multicollinearity when determining the empirical model of *MP*.

6.5.3 Allocation method (ALLOC)

Reviewing relatively recent IPO literature, Ritter and Welch (2002) consider research into the allocation of shares as promising for understanding underpricing. The different institutional features for allocation methods in Australia and the US were discussed in chapter 2. Whilst the allocation policies of Australian issuers are not mandated, only two firms (0.06%) in the earnings-forecast sample indicate they use non-discretionary allocation. As there is insufficient variation in the sample to investigate the impact of the type of allocation process, the mispricing model includes an indicator variable to identify who makes the share allocation decisions.

Underwriters in the US bookbuild setting benefit the issuer by using share allocations to elicit information from informed investors [Benveniste & Wilhelm (1990); Ljungqvist & Wilhelm (2002)]. The more uncertain the issuer is about the value of the firm the more valuable the underwriter's advice. Hence, the issuer will delegate the pricing decision to the underwriter with the result of higher underpricing (Baron, 1982). In contrast, Sherman (2000) argues that underwriters allocate shares to regular uninformed investors to reduce the amount of underpricing. Providing some support for Baron's argument, the underpricing model in chapter 4 shows a higher level of underpricing associated with underwritten issues.

Agency conflict may arise in the Australian institutional setting where issuers delegate share allocation to underwriters and underwriters are unconstrained by any legal requirement to allocate shares in a specific manner. Underwriters can use selective allocation to keep favoured clients content, resulting in increased expected revenues from these clients [Benveniste & Spindt (1989); Sherman (2000); Ljungqvist & Wilhelm (2002); Loughran & Ritter (2002); Sherman & Titman (2002); Jenkinson & Jones (2006); Reuter (2006); Nimalendran, Ritter & Zhang (2007)]. Lee, Taylor and Walter (1996) contend that the non-public allocation procedures used for Australian IPOs increase the capacity of underwriters to allocate to favoured clients. Discretionary allocation generates an agency problem when underwriters act in their own best interests rather than the interests of the issuer.

In contrast to discretionary allocation in the US bookbuild setting, legal restrictions are placed on the allocation policies for fixed-price offers in the UK, Hong Kong, Malaysia (Chowdhry & Sherman, 1996) and Singapore (Lee, Taylor & Walter, 1999). Chowdhry and Sherman (1996) consider that such legal restrictions favouring small investors are in response to the regulator's desire for fairness. As underwriters are responsible for share allocations in the US bookbuilding setting and share allocation faces legal constraints in other fixed-price settings, the Australian institutional setting affords an unusual opportunity to investigate the participation of the share allocation process to an underwriter.

Australian underwriters participating in the allocation of shares have the capacity to act in their own (or their investing clients') best interests rather than those of the issuer. Given this potential agency conflict, a positive relationship is expected between underwriter participation in the allocation process (*ALLOC*) and mispricing (i.e. issues will have $OP < V$). The dichotomous variable is coded as one where the underwriter participates in the allocation process. Underwriters participate in the share allocation process for around 63% of underwritten issues in this sample.

6.5.4 Hot markets (HOTN)

The hot markets variable (*HOTN*) is included in the mispricing model to determine if issuers exploit their knowledge of the current state of the IPO market with higher mispricing. Prior research characterises hot markets as those with high underpricing at the start of the period followed by high IPO volume (Ritter, 1984a). The lag between underpricing and the volume of new issues is attributed to the administrative time required to float a company[87]. The speed of adjustment for volume is faster when social mood becomes pessimistic as issuers can withdraw their issues (Nofsinger, 2005).

High levels of optimism in society affect both investors and corporate managers. Optimism results in both groups overestimating the probability of success and underestimating the riskiness of their actions (Nofsinger, 2005). Thus, investor demand for IPOs increases with investor optimism. Consistent with firms taking advantage of overoptimism (Rajan & Servaes, 1997) and misvaluation (Jensen, 2005) in the market, potential issuers respond to higher observed levels of investor demand by taking their companies public and therefore increase IPO volume in hot markets (Helwege & Liang, 2004). French underwriters using the bookbuild mechanism set

[87] Brailsford, Heaney & Shi (2001) note that Australian institutional and regulatory requirements contribute to their finding that IPO volume does not adjust instantaneously in response to changed market conditions.

OP higher than *V* when individual investors are bullish (Derrien, 2005). US issuers also take advantage of investor optimism (Lowry, 2003). Underpricing in Australia leads volume by up to six months (Brailsford, Heaney & Shi, 2001). Further, both underpricing and volume are substantially higher in hot periods than they are in cold periods (Brailsford, Heaney & Shi, 2001).

The characterisation of hot markets in terms of high underpricing and volume and the empirical relationship of underpricing and volume suggest proxies for hot markets based on either of these measures. Using the number of prior IPOs to indicate a hot market is supported by the relationship between underpricing and IPO volume in the period from 1976 to 1997 in the Australian market (Brailsford, Heaney & Shi, 2001).

The number of unseasoned issues made in the three months prior to listing displays a highly significant association with raw underpricing in the Australian market (Sharpe & Woo, 2005). The relationship of interest in the mispricing model is the role of *HOTN* in setting the offer price, not on underpricing. The number of IPOs listing after the offer price has been set cannot influence mispricing. Therefore, the Sharpe and Woo (2005) measure is adapted to include the number of industrial IPOs occurring three months prior to prospectus date. Therefore, *HOTN* is measured as follows:

$$HOTN = \sum_{t=-3}^{0} IPO_i \qquad \textbf{(6.5)}$$

The count of IPOs for *HOTN* is based on the full sample described in chapter 3. If issuers take the state of the IPO market into consideration, a positive relationship between *HOTN* and mispricing is expected. That is, the greater the number of IPOs listing in the three months prior to the prospectus, the more *OP* will exceed *V*.

6.5.5 Control variables - relative size (SIZE) and growth prospects (GROWTH)

Alford (1992) considers that the ideal selection criteria for comparable firms are the variables that explain cross-sectional differences in PE multiples. Two frequently-used selection criteria for matching firms (in addition to industry) are size and growth [c.f. Alford (1992); Boatsman & Baskin (1981); Kim & Ritter (1999); Purnanandam & Swaminathan (2004); How, Lam & Yeo (2007); Zheng (2007)].

Although Alford (1992) does not find size important in the selection of comparable firms, Purnanandam and Swaminathan (2005) control for size in their investigation of IPO mispricing. A control for size is also included in this research. Cotter, Goyen and Hegarty (2005) report IPO size relative to industry median size is significant in the explanation of offer price for their Australian fixed-price sample. This relative measure of size is shown in equation 6.6.

$$SIZE = \frac{\textit{Number of shares at listing} \times OP}{\textit{Industry median market capitalisation}} \quad \textbf{(6.6)}$$

No theoretical justification for an association between size and mispricing in the fixed-price setting has been identified from the literature and none is posited here[88]. Therefore, no directional relationship is predicted for size and *MP*.

IPOs have higher growth opportunities than typical listed firms (Kim & Ritter, 1999). Further, the IPO's historic growth rate does not incorporate the incremental growth likely to be achieved with the larger post-float capital base. Zarowin (1990) finds longer-term growth is more important than short-term growth and risk in his investigation of the cross-sectional differences in the earnings-price ratio. Cotter, Goyen and Hegarty (2005) infer growth prospects from prospectus data and find their measure is significant in the explanation of offer price for Australian fixed-price offers.

Equation 6.7 shows the Cotter, Goyen and Hegarty (2005) measure of growth prospects. *GROWTH* is estimated as one minus the book value of ordinary shareholders' equity scaled by *OP*.

[88] Logue (1973) argues that the US underwriting market is monopsonistic and, as such, the relative bargaining powers of the parties (i.e. the underwriter and the issuer) determine the price paid by the monopsonist. Vendors of larger IPOs have greater bargaining power and use this to negotiate higher offer prices. The implication of this relationship for mispricing is unclear as issuers may wish to negotiate offer prices closer to expected market price rather than value.

$$GROWTH = 1 - \frac{BVE}{OP} \quad \textbf{(6.7)}$$

A positive relationship is expected between mispricing and *GROWTH* as high growth firms will be inherently more difficult to value. Having now concluded the discussion of model development, the following section specifies the sample data used to test the model and presents descriptive statistics and correlations for the variables.

6.6 Sample and descriptive statistics

Top 20 shareholder data, required for measuring *HOLDERS*, are either unavailable from the ASX or of poor quality for 28 sample firms[89]. Missing prospectus information about the allocation method result in three further exclusions. A total of 197 IPO data points for V_{PE}- and 238 for the V_{EBO}-based measures of mispricing are available after the exclusion of these companies.

An objective in this research is to ascertain if results from the mispricing model are sensitive to the method used to calculate *V*. Therefore, only those IPOs that have values calculated for both the PE and EBO methods are included in the analysis from this point forward. Following the deletion of the Sterling Biofuels outlier, there are 186 IPOs with measures for both V_{PE} and V_{EBO}.

6.6.1 Descriptive statistics for independent variables

Descriptive statistics for the dependent variables in the mispricing model were presented in section 6.3. Table 6.6 presents descriptive statistics for the independent variables included in the mispricing model. With the exception of *GROWTH*, the continuous independent variables have distributions that make highly significant departures from the normal distribution[90]. Therefore, median values provide the appropriate measure of central tendency.

---

[89] The Top 20 reports were screened for accuracy by comparing the disclosed number and proportion of shares in the Top 20 to the total number of shares listed on the ASX (including restricted securities) and to the total number of shares at the completion of the issue disclosed in the prospectus. The Top 20 data are considered to be poor quality where these figures diverge by more than 5% of issued shares.

[90] Kolmogorov-Smirnov statistics for tests of normality are significant at $p < 0.01$ for *HOLDERS, PTN, DTN, SIZE* and *HOTN*. *GROWTH* does not make a significant departure from the normal distribution at the conventional level ($p = 0.074$).

Table 6.6 Descriptive statistics for independent variables - 186 IPOs, 1997-2006

Panel A: Continuous measures

	Mean	Median	Standard deviation	Minimum	Maximum	Skew	Kurtosis
HOLDERS[a]	33.45	37.52	62.79	-320.90	334.51	-1.29	11.64
PTN %	14.08	0	23.52	0	100	2.04	3.933
DTN %	48.52	30.07	69.92	0	760.85	6.59	61.43
HOTN	17.72	15	11.13	0	48	0.69	-0.34
SIZE	1.78	1.05	2.24	0.004	13.75	2.89	10.13
GROWTH%	47.66	52.91	30.94	-56.45	94.60	-0.64	-0.18

Panel B: Dichotomous variable

	Proportion of 1s
ALLOC	0.46

HOLDERS = the sum of the number of shares held by the top 20 shareholders less the number of shares retained by the vendors all scaled by the number of shares offered in the prospectus. *PTN* = the ratio of the number of secondary shares offered to the total number of original shares. *DTN* = the ratio of the number of primary shares offered to the total number of original shares. *HOTN* = the number of industrial IPOs in the three months preceding the prospectus date. *SIZE* = market capitalisation of the IPO post listing relative to industry median capitalisation for the year of listing. *GROWTH* = 1-(book value of ordinary shareholders' equity / offer price). *ALLOC* = dichotomous variable coded as 'one' where the underwriter participates in the allocation process.
[a] Negative values are possible as the Top 20 is adjusted for the amount of retained ownership to obtain the measure of ownership dispersion.

The mean (median) of 33.45 (37.52) for *HOLDERS* indicates the level of ownership dispersion for the largest new shareholders participating in the issue. In their sample of Australian industrial IPOs listing between 1996 and 1999, Pham, Kalev and Steen (2003) report mean *HOLDERS* of 14.51% for issues with positive market-adjusted returns and 24.68% for issues with negative market-adjusted returns. Thus, this extended sample period indicates relatively-narrower ownership structures, on average, than those found in Pham, Kalev and Steen's shorter sample period[91].

As is the case for US IPOs (Habib & Ljungqvist, 2001), the median participation ratio (*PTN*) of zero confirms that most sample IPOs do not offer secondary shares in the prospectus. The mean of 14.08% is double that reported by Habib and Ljungqvist (2001). Median dilution (*DTN*), which indicates the wealth loss to owners from the sale of primary shares, is 30.07% for this sample. While mean dilution of 48.52% is

[91] 19% of IPOs in Pham, Kalev & Steen's sample have negative market-adjusted returns. The proportion in this sample is slightly larger at 23%. In this sample, mean *HOLDERS* is 30.25 for IPOs with negative market-adjusted returns and 34.37 for IPOs with positive market-adjusted returns. In contrast to the results of *t*-tests reported by Pham, Kalev & Steen, no significant difference is found for the two groups ($p = 0.3541$, one-tailed).

close to the 50% reported by Habib and Ljungqvist (2001), their median of 42% for *DTN* is substantially higher. The non-normal distribution of *DTN* constrains the ability to draw conclusions from comparisons between this sample and that of Habib and Ljungqvist (2001).

As shown in chapter 3, IPOs are about the same size as 'typical' companies already trading on the ASX. The finer measure, *SIZE*, (the IPO market capitalisation at listing compared to the median market capitalisation of listed companies in the same industry) confirms that earlier analysis. Median *SIZE* is 1.05, indicating that the sample IPOs have very similar market capitalisations to listed companies in the same industry. While '… unseasoned new issue firms are almost invariably small firms' (Finn & Higham, 1988, p. 347) care should be taken in the interpretation of this statement. Australian IPOs are small relative to the mean market capitalisation of all listed firms (see chapter 3) but they are marginally larger than the median firm in their respective industries. Mean and median *GROWTH* is substantially higher than that reported by Cotter, Goyen and Hegarty (2005)[92]. The median number of IPOs occurring in the three months prior to the prospectus date is 15.

As discussed in chapter 2, there are no legal requirements that specify the allocation method to be used by Australian issuers. Discretionary allocation was indicated for 23.9% of issuers in the earnings forecast sample. A further 71.7% of this sample identified their allocation policy as directors or underwriters (or both) reserving 'the right to accept or reject applications in full or in part'. In contrast to Ljungqvist and Wilhelm's (2002) assertion that pro rata allocations are the default in Australia, no prospectus stated that pro rata allocations of shares would be made[93].

Analysis of the 186 IPOs described in table 6.6 shows allocation is determined solely by the directors in 53.6% of issues, solely by the underwriter in 8.3% and jointly by

[92] Cotter, Goyen and Hegarty (2005) use the same measure of *GROWTH* and report a mean (median) of 30% (28%) for their 1995 to 1998 sample of Australian industrial IPOs.
[93] The allocation policies of three IPOs excluded from this sample are noteworthy. Arrow Pharmaceuticals indicated that shares would be allocated on a 'first-in' basis. The prospectus for Colorado Group indicated that shares would be allocated 'consistently' but with the right reserved to reject any application. Austbrokers Ltd made a fixed-price 'institutional offer' for a fraction of their shares and included a priority offer for their clients.

the underwriter and directors in 38.1% of issues. As noted earlier, the allocation methods of three firms could not be determined from the prospectus.

6.6.2 Correlations

Correlations for the mispricing model's dependent and independent variables are shown in table 6.7. Spearman coefficients are presented on the left-hand side of the table and Pearson coefficients are to the right. As noted in the previous section, the distributions for *HOLDERS, PTN, DTN, SIZE* and *HOTN* exhibit significant departures from the normal distribution. Thus, the following discussion focuses on Spearman correlations.

Consistent with the strong and highly significant correlations reported for the value measures in chapter 5, the four measures of *MP* are also highly correlated, with the highest correlations between the EBO measures. The number of IPOs listing in the quarter preceding the IPO (*HOTN*) has highly significant positive correlations with the mispricing measures. *HOTN* also exhibits a low (0.2) but highly significant correlation with *GROWTH*.

The measure of ownership dispersion (*HOLDERS*) is significantly correlated with the two MP_{EBO} estimates of mispricing that take the value of imputation credits into consideration and marginally correlated with the MP_{EBO0} measure. Combined with the lack of significant correlation for *HOLDERS* and MP_{PE}, these results suggest the V_{PE} measure incorporates the desired level of ownership dispersion via the annual industry median PE. An industry median PE that reflects issuers' target levels of ownership dispersion is consistent with industry-specific share ownership patterns.

The participation (*PTN*) and dilution (*DTN*) ratios show a highly significant and strong negative correlation (ρ = -0.515). Both have significant correlations with MP_{PE}, with *PTN* showing a positive relationship and *DTN* a negative one. Both variables capture components of wealth loss to owners and both were hypothesised to have negative relationships with *MP*. The expected negative relationship for *PTN* and *MP* may be masked by the relatively low proportion of sample issuers that sell

Table 6.7 Correlations for 186 IPOs, 1997-2006

	MP_{pe}	MP_{ebo0}	MP_{ebo50}	MP_{ebo100}	*HOLDERS*	*PTN*	*DTN*	*SIZE*	*GROWTH*	*HOTN*
MP_{pe}		0.708**	0.696**	0.684**	0.055	0.111	-0.134	0.429**	0.258**	0.215**
		(0.000)	(0.000)	(0.000)	(0.463)	(0.136)	(0.073)	(0.000)	(0.000)	(0.004)
MP_{ebo0}	0.635**		0.998**	0.992**	0.098	0.126	-0.147*	0.320**	0.063	0.182*
	(0.000)		(0.000)	(0.000)	(0.190)	(0.092)	(0.048)	(0.000)	(0.404)	(0.014)
MP_{ebo50}	0.613**	0.994**		0.998**	0.104	0.152*	-0.156*	0.331**	0.064	0.169*
	(0.000)	(0.000)		(0.000)	(0.166)	(0.042)	(0.036)	(0.000)	(0.390)	(0.024)
MP_{ebo100}	0.589**	0.981**	0.995**		0.108	0.173*	-0.163*	0.339**	0.066	0.156*
	(0.000)	(0.000)	(0.000)		(0.149)	(0.020)	(0.029)	(0.000)	(0.379)	(0.036)
HOLDERS	0.080	0.138	0.157*	0.155*		0.129	0.300**	0.131	0.209**	-0.033
	(0.289)	(0.065)	(0.035)	(0.035)		(0.085)	(0.000)	(0.081)	(0.005)	(0.664)
PTN	0.147*	0.127	0.146	0.148*	0.132		-0.238**	0.218**	0.207**	-0.068
	(0.050)	(0.090)	(0.051)	(0.044)	(0.077)		(0.001)	(0.003)	(0.005)	(0.368)
DTN	-0.170*	-0.103	-0.118	-.138	0.125	-0.515**		-0.174*	-0.194**	-0.122
	(0.022)	(0.169)	(0.113)	(0.065)	(0.097)	(0.000)		(0.020)	(0.009)	(0.102)
SIZE	0.565**	0.431**	0.443**	0.456**	0.267**	0.256**	-0.261**		0.297**	-0.044
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	0.001	(0.000)		(0.000)	(0.561)
GROWTH	0.339**	0.039	0.039	0.041	0.071	0.287**	-0.340**	0.330**		0.147*
	(0.000)	(0.600)	(0.600)	(0.582)	(0.345)	(0.000)	(0.000)	(0.000)		(0.049)
HOTN	0.194**	0.216**	0.205**	0.193**	-0.047	-0.037	-0.063	-0.035	0.200**	
	(0.009)	(0.004)	(0.006)	(0.009)	(0.528)	(0.619)	(0.399)	(0.642)	(0.007)	

Spearman's coefficients and associated probabilities are shown on the left-hand side of the table while Pearson's coefficients and probabilities are shown on the right-hand side.
** Correlation is significant at the 0.01 level (2-tailed)
* Correlation is significant at the 0.05 level (2-tailed)
MP_{PE} = offer price minus the comparable firms estimate of value. MP_{EBO0} = offer price minus the EBO model value where r_0 is the discount rate. MP_{EBO50} = offer price minus the EBO model value where r_{50} is the discount rate. MP_{EBO100} = offer price minus the EBO model value where r_{100} is the discount rate. *HOLDERS* = the sum of the number of shares held by the top 20 shareholders less the number of shares retained by the vendors all scaled by the number of shares offered in the prospectus. *PTN* = the ratio of the number of secondary shares offered to the total number of original shares. *DTN* = the ratio of the number of primary shares offered to the total number of original shares. *SIZE* = market capitalisation of the IPO post listing relative to industry median capitalisation for the year of listing. *GROWTH* = 1-(book value of ordinary shareholders' equity / offer price). *HOTN* = the number of industrial IPOs in the three months preceding the prospectus date.

secondary shares. The hypothesised relationship with *MP* is observed for *DTN* and dilution will be the only source of wealth loss for 92% of the sample IPOs. Further, as shown in the next section, *PTN* is associated with the participation of underwriters in the allocation process. Therefore, *PTN* is removed from the empirical mispricing model in order to minimise the effects of multicollinearity in the model.

Relative size (*SIZE*) shows highly significant and strong positive correlations with each measure of the dependent variable suggesting larger IPOs experience more mispricing. *SIZE* is positively correlated with *HOLDERS*, indicating that larger IPOs have more concentrated ownership structures with respect to outside shareholders. Issuers are less concerned about post-listing liquidity when the floating company is large relative to the median company in the same industry as the IPO. The positive correlation between *SIZE* and *PTN* suggests that more secondary shares are sold in larger IPOs. The significant and negative correlation for *SIZE* and *DTN* is suggestive of vendors in larger IPOs suffering relatively less wealth loss from the sale of primary shares. However, as *SIZE* is also positively correlated with *MP*, no firm conclusion on this matter can be drawn.

GROWTH shows a highly significant positive correlation with MP_{PE} while it is uncorrelated with the three EBO measures of mispricing. This result supports Ohlson's (1995) claim that growth is captured in the EBO model via the required return on equity.

6.6.3 Dichotomous independent variable associations

Panel A of table 6.8 presents Mann-Whitney U tests for differences in distributions where the data are categorised by underwriter participation in the allocation process. Issuers that choose to have underwriters participate in the allocation process do not experience significant differences in the level of mispricing. They do, however, have significantly higher (p = 0.000, one-tailed) participation levels, consistent with vendors of secondary shares being less concerned about the ownership structure post-listing. Issuers choosing to have the underwriter participate in the allocation process are also significantly larger (p = 0.000, one-tailed) and have higher levels of growth options (p = 0.040, one-tailed).

Table 6.8 Tests for differences where data are grouped by *ALLOC*

Panel A: Mann-Whitney U *tests for differences in distribution*

	MP_{PE}	MP_{EBO0}	MP_{EBO50}	MP_{EBO100}	*HOLDERS*	*PTN*	*DTN*	*HOTN*	*SIZE*	*GROWTH*
ALLOC median	0.123	-0.007	0.080	0.126	42.25	8.93	29.71	15	1.376	60.20
No *ALLOC* median	0.042	-0.051	0.015	0.066	33.44	0	34.03	15.5	0.850	46.11
U	3 377	3 501	3 470	3 408	3 454	2 578	3 462	3 939	2 820	3 140
Asymptotic sig. (2-tailed)	(0.086)	(0.175)	(0.148)	(0.104)	(0.136)	(0.000)	(0.141)	(0.930)	(0.001)	(0.016)
Median test (2-tailed)	(0.085)	(0.156)	(0.085)	(0.043)	(0.939)	(0.000)	(0.495)	(0.934)	(0.000)	(0.020)

Panel B: t-tests of means

	MP_{PE}	MP_{EBO0}	MP_{EBO50}	MP_{EBO100}
ALLOC mean	0.336	0.267	0.327	0.379
No *ALLOC* mean	0.211	0.189	0.239	0.282
t	-1.908	-1.184	-1.316	-1.423
Significance (2-tailed)	(0.058)	(0.238)	(0.190)	(0.157)

MP_{PE} = offer price minus the comparable firms estimate of value. MP_{EBO0} = offer price minus the EBO model value where r_0 is the discount rate. MP_{EBO50} = offer price minus the EBO model value where r_{50} is the discount rate. MP_{EBO100} = offer price minus the EBO model value where r_{100} is the discount rate. *HOLDERS* = the sum of the number of shares held by the top 20 shareholders less the number of shares retained by the vendors all scaled by the number of shares offered in the prospectus. *PTN* = the ratio of the number of secondary shares offered to the total number of original shares. *DTN* = the ratio of the number of primary shares offered to the total number of original shares. *HOTN* = the number of industrial IPOs in the three months preceding the prospectus date. *SIZE* = market capitalisation of the IPO post listing relative to industry median capitalisation for the year of listing. *GROWTH* = 1-(book value of ordinary shareholders' equity / offer price). *ALLOC* = dichotomous variable coded as 'one' where the underwriter participates in the allocation process.

Panel B presents *t*-statistics for difference in mean for the four normally distributed measures of mispricing. The lack of association between underwriter participation in the allocation process and mispricing shown in panel A is confirmed by the *t*-tests. With the data description and investigation of bivariate relationships now complete, the next section tests the mispricing model.

6.7 Testing the mispricing model

Table 6.9 reports the results for four versions of the mispricing model, each using a different specification of the dependent variable. Analysis of the residuals and Mahalanobis statistics from the first pass of the regressions reveals seven multivariate outliers[94]. Deletion of these multivariate outliers and the deletion of the Stirling Biofuels mispricing outlier results in a sample size of 179 observations for the regressions. The adjusted R-squared (AR^2) for the models range from 20.4% (MP_{EBO0}) to 25.3% (where MP_{PE} is the dependent variable). Although not directly comparable, these AR^2s generally higher than those reported in prior Australian underpricing research (see table 2.2) and *F* tests for the overall significance of the regressions are significant ($p < 0.001$).

With the exception of *SIZE*, theoretical foundations provide the basis for specifying directional relationships for all independent variables. As such, the *p*-values shown in table 6.9 are for one-tailed tests for all coefficients except for *SIZE* and the constant. The regression results show *SIZE* is the primary explanatory variable for *MP*. The coefficient on *SIZE* is highly significant and indicates a positive relationship with *MP* irrespective of the measure of the dependent variable. The number of IPOs listing in the three months prior to the prospectus date (*HOTN*) also makes significant contributions to the explanation of all measures of mispricing. As predicted, the greater the number of IPOs preceding the prospectus, the greater the level of mispricing. This results supports Loughran, Ritter and Rydqvist's (1994) contention that issuers take advantage of 'windows of opportunity' when making decisions

---

[94] The chi-squared critical value is determined as $p = 0.001$, d.f. = 6. The multivariate outliers, their listing dates and industries are as follows: Austaland (1997, developers and contractors); Australian International Carbon (1998, miscellaneous industrials); Strathfield Group (1998, retail); Austal (1998, engineering); Tox Free Solutions (2000, miscellaneous industrials); Infomedia (2000, miscellaneous industrials) and Cardno (2004, capital goods).

associated with their issue. One-tailed tests show *HOLDERS*, *DTN*, *GROWTH* and *ALLOC* do not have significant relationships with any of the measures of mispricing.

Table 6.9 Mispricing regression results for 179 IPOs, 1997-2006

		Dependent variable			
Independent variables		MP_{PE}	MP_{EBO0}	MP_{EBO50}	MP_{EBO100}
constant	coefficient	-0.444**	-0.279**	-0.213*	-0.156#
	t-stat	-4.872	-3.099	-2.387	-1.751
	p	(0.000)	(0.002)	(0.018)	(0.082)
HOLDERS	coefficient	-0.007	0.110	0.119	0.126
	t-stat	-0.115	1.656	1.890	1.926
	p	(1.000)	(0.199)	(0.144)	(0.112)
DTN	coefficient	0.007	-0.063	-0.074	-0.082
	t-stat	0.133	-1.244	-1.461	-1.636
	p	(1.000)	(0.430)	(0.292)	(0.207)
ALLOC	coefficient	0.0451	0.052	0.060	0.067
	t-stat	0.681	0.785	0.919	1.032
	p	(0.994)	(0.867)	(0.359)	(0.607)
HOTN	coefficient	0.009**	0.009**	0.008**	0.008*
	t-stat	3.243	3.198	2.897	2.617
	p	(0.003)	(0.007)	(0.009)	(0.019)
SIZE	coefficient	0.118**	0.104**	0.112**	0.117**
	t-stat	6.013	5.525	5.977	6.085
	p	(0.000)	(0.003)	(0.000)	(0.000)
GROWTH	coefficient	0.223	-0.219	-0.221	-0.222
	t-stat	1.843	-1.838	-1.871	-1.881
	p	(0.134)	(0.136)	(0.126)	(0.123)
AR^2		0.253**	0.204**	0.214**	0.221**
JB		47.824**	48.030**	55.976**	62.223**
	p	(0.000)	(0.000)	(0.000)	(0.000)
White's	*p*	(0.335)	(0.387)	(0.297)	(0.240)
DW		1.834	1.824	1.817	1.812
RESET	*F*	4.439*	1.486	1.332	1.194
	p	(0.013)	(0.229)	(0.240)	(0.258)

** Significant at <1% (two tailed for *SIZE* and one tailed for *HOLDERS*, *DTN*, *GROWTH*, *HOTN* and *ALLOC*)
* Significant at <5% (two tailed for *SIZE* and one tailed for *HOLDERS*, *DTN*, *GROWTH*, *HOTN* and *ALLOC*)
# Significant at <10% (two tailed for *SIZE* and one tailed for *HOLDERS*, *DTN*, *GROWTH*, *HOTN* and *ALLOC*)
MP_{PE} = offer price minus the comparable firms estimate of value. MP_{EBO0} = offer price minus the EBO model value where r_0 is the discount rate. MP_{EBO50} = offer price minus the EBO model value where r_{50} is the discount rate. MP_{EBO100} = offer price minus the EBO model value where r_{100} is the discount rate. *HOLDERS* = the sum of the number of shares held by the top 20 shareholders less the number of shares retained by the vendors all scaled by the number of shares offered in the prospectus. *DTN* = the ratio of the number of primary shares offered to the total number of original shares. *ALLOC* = dichotomous variable coded as 'one' where the underwriter participates in the allocation process. *HOTN* = the number of industrial IPOs in the three months preceding the prospectus date. *SIZE* = market capitalisation of the IPO post listing relative to industry median capitalisation for the year of listing. *GROWTH* = 1-(book value of ordinary shareholders' equity / offer price).

These multivariate results support those reported in the correlation analysis, where only *SIZE* and *HOTN* have significant relationships with *MP*. While *SIZE* has significant correlations with *HOLDERS, DTN*, *GROWTH* and *ALLOC*, the magnitude of these is low[95] and the AR^2s reported in table 6.9 are not high enough to suggest multicollinearity is an issue in these models. Endogeneity results in correlation between the independent variables and the error term (Brooks, 2002). While the correlation analysis in section 6.6 indicates that each of the continuous independent variables, except for *HOTN*, are partially determined by *SIZE*, no significant correlations are found for the independent variables and the residuals (results not reported). This provides evidence of the exogeneity of the independent variables.

The Jarque-Bera (JB) test statistics show residuals from the regressions of each measure of *MP* make significant departures from the normal distribution. While the residuals appear symmetric (none have significant skewness), significant kurtosis statistics indicate that they are leptokurtic. The probabilities for White's test demonstrate the absence of heteroscedasticity in the residuals.

The Durban-Watson (DW) statistic shows no significant autocorrelation of residuals when MP_{PE}, MP_{EBO0} and MP_{EBO50} are the dependent variables[96]. As the DW statistic for the MP_{EBO100} measure falls within the 'no decision' region for positive autocorrelation, a runs test for independence in the residuals was conducted. This showed no significant autocorrelation ($p > 0.09$)[97].

Model specification error is indicated by the Ramsey RESET test where the dependent variable is measured using MP_{PE} ($p < 0.02$) but not for the MP_{EBO} measures. The results of the RESET tests confirm those of the DW statistics for the MP_{EBO} measures. The change in the measure of *V* is the only difference between the correctly-specified models using MP_{EBO} as the dependent variable and that using MP_{PE} as the dependent variable.

As shown in table 6.6, the measures for the continuous variables *HOLDERS, PTN* and *DTN* exhibit significant skewness and kurtosis while *SIZE* is highly leptokurtic. These variables and *HOTN* make significant departures from the normal

[95] Gujarati (2003) provides a rule of thumb of ρ=0.5 to indicate comparatively low correlations in multicollinearity diagnostics.
[96] The critical level is determined as n = 180 and k = 6.
[97] No significant negative autocorrelation is observed in the residuals for any measure of *MP*.

distribution[98]. Logarithmic transformations produce normal distributions for *DTN*, *HOTN* and *SIZE*[99]. Although different transformations were trialled, the distributions for *HOLDERS* and *PTN* continue to make significant departures from the normal distribution.

The regressions in table 6.9 are re-estimated substituting the log values for *DTN*, *HOTN* and *SIZE*. Table C.1 of appendix C reports the results from regressing the four measures of mispricing on *HOLDERS*, *ALLOC* and *GROWTH*[100] and the log transformations of *DTN* (*lnDTN*), *HOTN* (*lnHOTN*) and *SIZE* (*lnSIZE*). The AR^2 for the model with MP_{PE} as the dependent variable exhibits largest increase, rising from 25.3% to 27.7% when transformed variables are included. While the coefficients *HOTN* with the MP_{EBO50} and MP_{EBO100} measures of mispricing are significant in table 6.9, the coefficients on *lnHOTN* are highly significant. Further, the coefficients on the constants are no longer significant with the MP_{EBO50} and MP_{EBO100} dependent variables.

The primary impact of the transformed variables, however, appears in the RESET tests. The significant specification error reported for the MP_{PE} measure of mispricing in table 6.9 is attributable to non-linearity in the *DTN*, *HOTN* and *SIZE* variables. Significant specification error is indicated by the RESET tests for the regressions of MP_{EBO} on the transformed dependent variables, indicating that the relationships between *DTN*, *HOTN*, *SIZE* and the MP_{EBO} measures of mispricing are linear. The DW statistics presented in C.1 all indicate the indecision area for autocorrelation, so are unable to shed further light on this issue.

6.8 Robustness testing

Alternative specifications of the mispricing measures and the empirical model are discussed in this section. Specifically, robustness tests assess the sensitivity of results to alternative wealth loss to owners' variables, alternative definitions of underwriter participation in the allocation process, the inclusion of an indicator variable for

---

[98] Kolmogorov-Smirnov tests reject the hypothesis of a normal distribution at $p < 0.001$.
[99] As *DTN*, *PTN* and *HOTN* have minimum values of zero (see table 6.6), each observed value is increased by unity prior to taking the logarithm. For ease of exposition, this transformation will simply be referred to as 'log transformation'.
[100] *ALLOC* is an indicator variable while *GROWTH* is normally distributed.

underwriter participation in the issue, the measurement of independent variables in levels and controlling for the number of shares issued. Given the non-linearity of the relationships for *PTN*, *HOTN* and *SIZE*, the logarithmic transformations of these variables are used in the following regressions where MP_{PE} is the dependent variable. Therefore, comparison of results for MP_{PE} relate to those reported in table C.1, while comparisons for MP_{EBO} relate to the results reported in table 6.9.

6.8.1 Measuring wealth loss to owners

The sensitivity of results to the inclusion of a single measure of wealth loss to owners (*DTN*) rather than both the *DTN* and *PTN* measures is investigated with the regressions presented in table C.2 of appendix C. The overall results are robust to the inclusion of *DTN* and *PTN*. Changes to the size of the coefficients and their levels of significance are trivial. The other change occurs where MP_{EBO100} is the dependent variable. Here, the constant loses its marginal significance while the strength of all other relationships is unchanged. The inclusion of *PTN* as an additional variable causes an increase of 1% to the AR^2 for the MP_{PE} dependent variable, while no change is identified to the AR^2 for the MP_{EBO} dependent variables.

The next sensitivity test relates to the selection of the particular measure of wealth loss to owners. The regressions with *PTN* substituted for *DTN* are presented in table C.3. These results are broadly consistent for the magnitude of all coefficients and their levels of significance. The only notable changes are to the now highly significant coefficients on the constants when *PTN* is the measure of wealth loss and MP_{EBO50} and MP_{EBO100} are the mispricing measures. Changes to the AR^2s are again minimal. Therefore, the results for the mispricing model are robust to the specification of the wealth loss to owners variable.

6.8.2 Measuring underwriter participation in the allocation process

Robustness to the selection of the particular measure of underwriter participation in the share allocation process is now examined. *ALLOC* is defined as underwriter participation for the mispricing model results reported in table 6.9. Here, the alternate measure (*ALLOC1*) is a dichotomous variable coded ‘one’ if the underwriter has complete discretion in the allocation process. For these issues, directors do not participate in the allocation of shares. The regressions reported in table C.4 of appendix C show the results are robust to the change in definition for *ALLOC*. The only change is to the coefficient on the constant with MP_{EBO100} as the dependent variable which loses significance.

6.8.3 Underwriter participation in the issue versus participation in allocation

It is argued in section 6.4.2 that underwriter participation in an issue will not be associated with mispricing. Given that *ALLOC* is not significant in the mispricing model, the sensitivity of results to the inclusion of *ALLOC* rather than an indicator variable for the association of an underwriter (*UW*) with the issue is examined. As a strong positive association is expected between dichotomous variables indicating the presence of an underwriter and the participation of the underwriter in the allocation process, an indicator variable for underwritten issues was not included in the mispricing model. To test the robustness of the results to this choice, the *UW* dichotomous variable discussed in chapter 4 is substituted for *ALLOC* in the empirical models. Results for these regressions are reported in table C.5 of appendix C.

The explanatory power of the model is little changed and the coefficient on *UW* is not significant. Therefore, it is concluded that neither the participation of the underwriter in the allocation process nor the underwriting of the issue per se is related to mispricing. The only change is where *GROWTH* gains marginal significance with the $MP_{EBO1000}$ dependent variable. The remaining results are consistent with those reported earlier.

6.8.4 Sensitivity to measures of mispricing

The regressions reported table 6.9 show the mispricing model is quite robust to changing the measure of mispricing from V_{PE} to V_{EBO} models. The sensitivity of results is tested here by scaling the measures of mispricing included as dependent variables in table 6.9. Two alternate measures of *MP*, the percentage of mispricing (relative to *OP*) and the ratio of *V* to *OP*, are examined in this section. As *OP* cannot be set below $0.20 in the Australian context, *OP* is chosen as the scalar for the relative measures of mispricing. In contrast, V_{EBO} can be equal to zero, providing the potential for an indeterminate ratio of *OP* to *V*[101]. Further, comparison of figures 5.2 and 5.3 (the distributions of the value measures) with figure 6.1 (the distribution of offer price) shows the former is relatively more symmetric. The lack of continuity observed for *OP*s is discussed in section 6.2. The empirical distribution of *OP* suggests it contains incremental information about issuers' pricing decisions. As such, *OP* is chosen as the scalar for *MP* and *V* in the alternate measures of underpricing.

Results for regressions with mispricing as a percentage of *OP* (*MP%*) and as the *VOP* ratio are reported in tables C.6 and C.7 of appendix C. In addition to the non-linear relationships of *DTN*, *HOTN* and *SIZE* with MP_{PE}, these independent variables are also related to the MP_{EBO} percentage and ratio measures in a non-linear fashion[102]. Therefore, *lnDTN*, *lnHOTN* and *lnSIZE* are the independent variables employed in tables C.6 and C.7.

Lower explanatory power is observed with the scaled *MP* dependent variables, with the lowest reported for the *V/OP* dependent variables. Coefficients on the significant variables change sign for the *V/OP* measures of mispricing as overpriced issues have a *V/OP* less than one[103]. *HOLDERS*, *DTN*, *ALLOC* and *GROWTH* continue to lack significance at the conventional level. The *t*-statistics decrease on *HOTN*, and this variable is now significant at the conventional level with the percentage measures of mispricing but not with the ratio measure. In contrast, the *t*-statistics on *GROWTH* increase with percentage and ratio measures of mispricing, but this variable is not significant at the conventional level.

lnSIZE is highly significant in all four regressions with the *V/OP* dependent variables and the $MP_{PE}\%$ dependent variable. As shown in section 6.6, *SIZE* has significant associations with all independent variables other than *HOTN*. Scale effects occur when variables in the model are influenced by the size of the firm's operations (Lo,

---

[101] The discounting process used in the estimation of V_{EBO} results in negative minimum values in the sample. See table 5.4 in chapter 5.

[102] Non-linearity is evidenced by the significant RESET tests for the regressions (unreported) of MP_{EBO} on the *DTN*, *HOTN* and *SIZE* dependent variables. No significant specification error is found when the transformed variables are substituted in the model.

[103] The values of *MP* and *MP%* become larger with the extent of overpricing. The coefficients change sign for *V/OP* because the value of this measure decreases as overpricing increases.

2005). Failure to control for scale effects results in coefficient bias [Barth & Clinch (2005); Lo & Lys (2000)], R^2 bias (Lo, 2005) and heteroscedasticity in the residuals (Easton & Sommers, 2003). Three alternatives for controlling for scale effects are the inclusion of a scale proxy as an independent variable (Barth & Kallapur, 1996), using a scale proxy to deflate scale-affected variables (Brown, Lo & Lys, 1999) or using weighted least squares to deflate each variable by market capitalisation (Easton & Sommers, 2003).

A natural control for scale is provided in the mispricing model as it contains *SIZE* as an independent variable. The highly significant coefficients on *SIZE* reported in table 6.9 could, therefore, indicate the presence of scale effects rather than indicate a role for *SIZE* in explaining mispricing. As returns regressions are free of scale effects (Easton & Sommers, 2003), the significance of *SIZE* to *MP%* provides complementary evidence on the role of size for explaining the level of mispricing. While the *t*-statistics on the *SIZE* coefficients decrease, they continue to be significant at the conventional level. Therefore, it can be concluded that *SIZE* does have high explanatory power for mispricing.

Significant model specification errors are indicated by the RESET tests only for the MP_{PE}% dependent variable. The DW statistics do not indicate autocorrelation in residuals. The results reported in tables C.6 and C.7 show the main results reported for the mispricing model are somewhat sensitive to changes in the measurement of *MP*.

6.8.5 Sensitivity to the number of shares offered

The observed preference for issuers to select the number of shares to achieve the desired offer price was discussed in section 6.2. To assess any potential impact of this behaviour on mispricing, regressions are re-estimated using the product of *MP* and the number of shares offered as the dependent variable. This approach results in all variables measured at the firm level with the dependent variable (*AMP*) indicating the aggregate level of mispricing.

The results for regressing *AMP* on the dependent variables are reported in table C.8 of appendix C. Highly significant model specification error is indicated by the RESET tests for the regressions when transformed dependent variables are used. Therefore, the untransformed versions of *DTN*, *HOTN* and *SIZE* are used. White's corrected *t*-statistics are reported for the AMP_{EBO} measures where significant heteroscedasticity is observed. While the coefficients on *SIZE* remain highly significant, the *t*-statistics on *HOTN* decrease and these coefficients are not significant. *HOLDERS, DTN, ALLOC* and *GROWTH* continue to lack significance.

Most notable of the changes from using the aggregate level of mispricing as the dependent variable are the significant RESET tests. As using transformed variables results in highly significant (rather than significant) indicators of model specification error, it is concluded that the specification error is attributable to missing variables rather than non-linearity with the *AMP* dependent variable. It is not, therefore, possible to draw firm conclusions about the impact of the issuer's selection of the number of shares to offer on mispricing.

6.9 Conclusions

Results from testing the mispricing model in this chapter show that IPOs with relatively larger market capitalisation than the industry median (*SIZE*) are more mispriced. In addition to the relative size effect, issuers appear to be aware of current IPO market conditions (*HOTN*) and opportunistically increase mispricing during hot markets. The hypothesised positive relationship of *GROWTH* and mispricing is not observed, suggesting issuers do not face greater difficulties valuing their own high growth IPO.

While Pham, Kalev and Steen (2003) report that underpriced IPOs have significantly lower levels of ownership dispersion (captured by *HOLDERS*), results in table 6.9 show this is not due to mispricing. In contrast to the hypothesised relationship to mispricing, wealth loss to owners from the sale of primary shares (*DTN*) bears no relationship to the level of mispricing. These results are robust to the substitution of the participation ratio (*PTN)* for *DTN* and to the inclusion of both *PTN* and *DTN* in the mispricing model. Issuers do not appear to utilise mispricing to minimise their wealth losses from the issue. Further, they do not appear to use mispricing to achieve their desired levels of dispersion for share ownership.

Underwriter involvement in the allocation process (*ALLOC*) is also unrelated to mispricing. This result may be attributable to the low proportion of underwriters given complete discretion over the allocation process as company directors provide a foil to the potential agency costs of complete discretion. However, re-estimating the mispricing regression and substituting a variable that indicates complete underwriter discretion in the allocation process for *ALLOC* again shows that underwriters do not exert a greater influence on mispricing when they can allocate shares to their preferred clients. Further, a dichotomous variable indicating the participation of an underwriter in the issue rather than *ALLOC* shows underwritten issues do not experience significantly different mispricing from those that are not underwritten.

While these results only provide indirect evidence, they suggest Australian underwriters of fixed-price issues do not influence mispricing in response to any informal testing of demand. As *ALLOC* is unrelated to mispricing, underwriters do not appear to be rewarding informed investors for costly information in this fixed-price setting. With the development and testing of the mispricing model now complete, the next chapter explores misvaluation.

CHAPTER 7
MISVALUATION OF AUSTRALIAN FIXED-PRICE IPOs

7.1 Introduction

The concept of fundamental analysis (or value investing) is predicated on identifying any divergence of market price (*P*) from value (*V)* (Greenwald et al., 2001). The disparity between *P* and *V* represents misvaluation (*MV*), the second component of the disaggregation of underpricing. Misvaluation is modelled in this chapter. This chapter addresses the third research sub-question: which investor-related factors determine the level of IPO misvaluation?

The relationship of *V* and *P* is explored further in the next section. The measurement of misvaluation is addressed in section 7.3 while institutional features of relevance to misvaluation in the Australian context are discussed in section 7.4. Potential factors associated with misvaluation are identified and models of misvaluation are developed in section 7.5. Section 7.6 describes the sample and presents descriptive statistics for the test sample of earnings forecasters. The misvaluation model is tested in section 7.7. The sensitivity of results to variable measurement is addressed in section 7.8 and conclusions are presented in the final section.

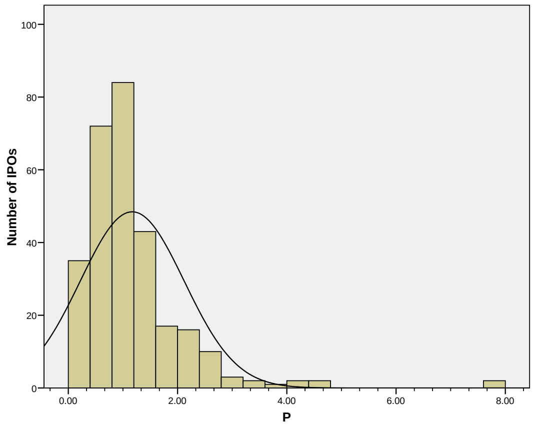
7.2 Market price and misvaluation

As misvaluation is defined as the divergence of *P* from *V*, the misvaluation model is developed by giving consideration to the factors posited to influence the market price of IPOs. Consistent with prior Australian underpricing research, the market price (*P*) is measured at the end of the first trading day for the IPO.

Although *V* is estimated from prospectus data, it is directly comparable with the non-contemporaneous *P*. As Lee (2001, p. 246) states 'fundamental value is concerned with measuring firm value regardless of market conditions'. Thus, while daily price variations of the shares of comparable firms would change the assessment of an IPO's *V* if it were measured on listing date, *V* does not have a short-term focus. The longer-term focus of *V* is reflected in the application of *median* PE multiples or the *perpetuity* of forecast earnings in the EBO measures.

Figure 7.1 shows the distribution of *P* for the earnings forecasting sample of 289 IPOs described in chapter 5. Sample prices range from \$0.14 to \$7.98 with a standard deviation of \$0.95. The mean (median) price is \$1.17 (\$1.01) and the distribution is significantly non-normal[104]. While the mean *P* is substantially higher than for *OP* (\$0.92) the medians for *P* and *OP* (\$1.00) are very similar. This highlights the fact that IPOs are underpriced *on average*.

Figure 7.1 Distribution of *P* for 289 forecasting IPOs, 1997-2006



While *P* does not display the same degree of 'stickiness' observed in *OP*, there is still some evidence of clustering around specific values[105]. Prices ending in a zero or five are observed for 32% of sample IPOs. The expected proportion in a continuous distribution of prices with the same range is 20%. Kandel, Sarig & Wohl (2001) provide a behavioural explanation for this phenomenon. They report that investors in Israeli IPO auctions prefer to bid using round numbers (i.e. prices ending in zero or five) and attribute this to investors' 'memory economising'.

Institutional features pertaining to market prices are examined in section 7.4. The next section discusses the measurement of the dependent variables for the misvaluation model developed in this chapter.

[104] Kolmogorov-Smirnov statistic = 3.097, $p = 0.000$. The distribution exhibits significant skewness (6.272) and kurtosis (20.919). The skewness is at least partially attributable to an outlier.
[105] There are 785 possible discrete *Ps* within this range (based on increments of \$0.01). Only 173 (or 22%) of these are observed in the sample.

7.3 Measuring misvaluation

Mirroring the measure of mispricing (*OP* – *V*) in chapter 6, misvaluation is measured as the difference between *P* and *V*. Four methods for estimating value were presented in chapter 5, and these four value estimates (V_{PE}, V_{EBO0}, V_{EBO50} and V_{EBO100}) are used to determine the dependent variables in the misvaluation model. Equation 7.1 shows how misvaluation is estimated.

$$MV_i = P_i - V_i \qquad \textbf{(7.1)}$$

where MV_i = per share level of misvaluation
P_i = per share market price
V_i = per share proxy for value

7.3.1 Relating value to market price

This section establishes the relationship between *P* and *V* and provides evidence on the nature and magnitude of this relationship. The results for regressions of the four measures of *V* on *P* are reported in table 7.1.

The results show *V* explains about 12-18% of the variation in *P*. As seen in chapter 6, *V* explains about 25-30% of *OP*. As no distribution is available for R^2, it is not possible to test the hypothesis that the R^2 of one model is significantly different from that of another model (Brooks, 2002). Taken together, the results presented in tables 6.1 and 7.1 suggest that *V* is more closely related to *OP* than to *P*. This implies the extent of misvaluation is greater than the extent of mispricing and provides justification for the investigation of misvaluation. As was the case with *OP* in chapter 6, the highly significant RESET tests confirm that *V* is only one of a set of variables that explain *P*.

Table 7.1 OLS estimation of the relationship of P and V

		Dependent variable			
		P (n = 222)	P (n = 269)	P (n = 269)	P (n = 269)
constant	coefficient	0.782**	0.592**	0.629**	0.665**
	t-stat	8.957	3.256	3.472	3.728
	p	(0.000)	(0.001)	(0.000)	(0.000)
V_{PE}	coefficient	0.417**			
	t-stat	5.924			
	p	(0.000)			
V_{EBO0}	coefficient		0.602**		
	t-stat		2.729		
	p		(0.007)		
V_{EBO50}	coefficient			0.594*	
	t-stat			2.552	
	p			(0.011)	
V_{EBO100}	coefficient				0.581*
	t-stat				2.412
	p				(0.017)
R^2		0.116**	0.179**	0.159**	0.143**
JB		6158**	5279**	5178**	5102**
	p	(0.000)	(0.000)	(0.000)	(0.000)
White's	*p*	(0.823)	(0.000)	(0.000)	(0.000)
DW		1.844	2.029	2.034	2.039
RESET	*F*	5.008**	8.869**	9.966**	10.510**
	p	(0.008)	(0.000)	(0.000)	(0.000)

** Significant at <1% (two-tailed)
* Significant at < 5% (two-tailed)
t-statistics are White's heteroscedasticity adjusted for the MP_{EBO} measures of misvaluation.
V_{PE} = comparable firms estimate of value. V_{EBO0} = EBO model value where r_0 is the discount rate. V_{EBO50} = EBO model value where r_{50} is the discount rate. V_{EBO100} = EBO model value where r_{100} is the discount rate.

7.3.2 Distributions and descriptive statistics for MV

Figure 7.2 shows the distributions of the MV_{PE}, MV_{EBO0}, MV_{EBO50} and MV_{EBO100} measures of misvaluation for the sample of 186 IPOs for which both MV_{PE} and MV_{EBO} measures are calculated. The extreme outlier on the left-hand side of the distribution is Stirling Biofuels Ltd. This firm exhibited severe negative mispricing and was deleted from the mispricing sample. It exhibits severe negative misvaluation and is also deleted from the misvaluation sample.

The extreme outlier on the right-hand side is Melbourne IT Ltd. Melbourne IT exhibits positive mispricing with an offer price of $2.20 and V_{PE} of $0.57. Comparing V_{PE} to the price at the end of listing day of $7.95 demonstrates severe positive misvaluation for this IPO. Although the measures of *MV* remain non-normal after the deletion of Stirling Biofuels and Melbourne IT (see table 7.3), Melbourne IT is deleted to remove its influence on the slope of the regression line. Comparing the distributions in figure 7.2 to those for mispricing shown in figure 6.2, misvaluation appears to be less symmetric with relatively more observations in the right-hand side of the distribution.

Figure 7.2 Distributions of *MV* for forecasting IPOs, 1997-2006

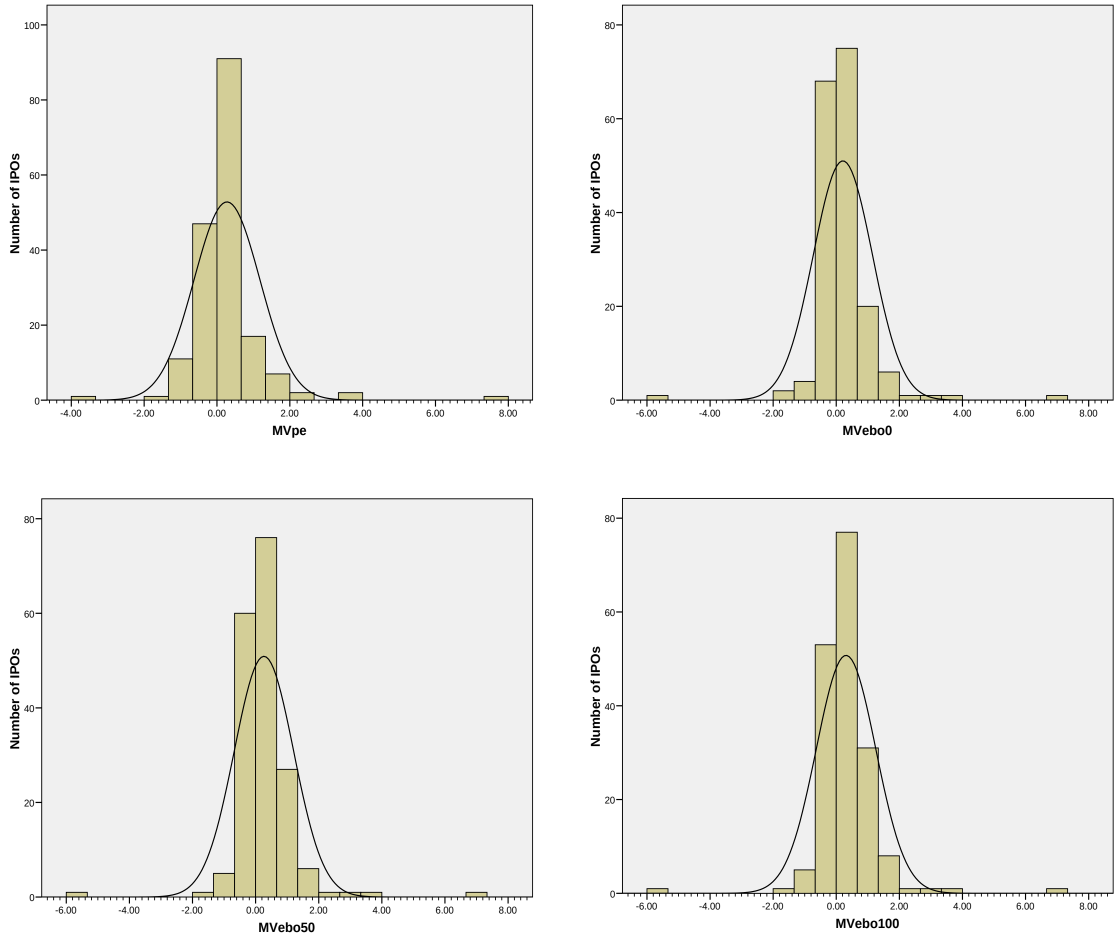


Table 7.2 shows the proportions of positive and negative misvaluation for each value proxy. Broadly speaking, about 60% the sample IPOs have positive levels of misvaluation. The highest proportion of overvaluation (66.85%) is identified with V_{PE} and V_{EBO100}, while the lowest (58.01%) occurs when V_{EBO0} is the value proxy.

Table 7.2 Proportions of positive and negative misvaluation

	Positive *MV*	Negative *MV*
V_{PE}	66.85%	33.15%
V_{EBO0}	58.01%	41.99%
V_{EBO50}	62.98%	37.02%
V_{EBO100}	66.85%	33.15%

MV_{PE} = price minus the comparable firms estimate of value. MV_{EBO0} = price minus the EBO model value where r_0 is the discount rate. MV_{EBO50} = price minus the EBO model value where r_{50} is the discount rate. MV_{EBO100} = price minus the EBO model value where r_{100} is the discount rate.

Descriptive statistics for 184 observations of the four specifications of the dependent variable are presented in table 7.3. Both mean and median values show the market tends to set *P* higher than *V*. The highest median level of misvaluation (20.59%) is found when the return on equity used to calculate V_{EBO} is largest (i.e. when imputation credits are fully valued by the market). The maximum and minimum values for MV_{EBO} are identical as the IPOs generating these values did not pay dividends. Using paired sample *t*-tests to compare the measures of mean *MV* (table 7.3) to mean *MP* (table 6.3), misvaluation is significantly higher than mispricing ($p < 0.001$)[106].

Table 7.3 Descriptive statistics for *MV*, forecasting IPOs, 1997-2006

	Mean	Median	S.D.	Min	Max	K-S (*p*- value)	Skew	Kurtosis
MV_{PE}	0.2256	0.1640	0.6860	-1.40	3.75	1.652 (0.009)	4.511	8.772
MV_{EBO0}	0.2035	0.1196	0.6615	-1.54	3.61	1.427 (0.034)	4.523	8.662
MV_{EBO50}	0.2574	0.1675	0.6615	-1.54	3.61	1.461 (0.028)	4.502	8.470
MV_{EBO100}	0.3039	0.2059	0.6634	-1.54	3.61	1.584 (0.013)	4.472	8.253

MV_{PE} = price minus the comparable firms estimate of value. MV_{EBO0} = price minus the EBO model value where r_0 is the discount rate. MV_{EBO50} = price minus the EBO model value where r_{50} is the discount rate. MV_{EBO100} = price minus the EBO model value where r_{100} is the discount rate.

7.4 Institutional setting

The applicability of underpricing theories, given Australian institutional features, was discussed in chapter 2. The potential impact of the Australian institutional setting on

[106] The mean of MV_{PE}, for example, is 0.2256 while the mean of MP_{PE} is 0.0467.

mispricing was described in chapter 6. This section includes some further discussion of institutional features of particular relevance to *P* and, therefore, misvaluation. The types of investors participating in the Australian IPO market are identified. Limits to arbitrage and restrictions on the sale of vendor shares in the Australian context are then discussed.

7.4.1 IPO investors

The first institutional feature of relevance to misvaluation is the composition of investors participating in the IPO. This section identifies some differences in the behaviours of institutional and individual investors[107], while the impact of the relative levels of participation of these investor groups on listing price is discussed in the following section.

Prospectuses should include information that is useful to both the 'unsophisticated investors and market professionals' (Law & Callum, 1997, p. 52) as both of these groups participate in the Australian IPO market. Following Shiller's (1984) nomenclature, market professionals are the 'smart money' who trade shares in response to news about fundamental value. While a few individual investors can be classified as 'smart money', this term is normally associated with institutional investors as these are expected to expend resources on the identification of which equities to include in their portfolios.

Unsophisticated individual investors are characterised as 'noise traders'. Noise traders are uninformed retail investors who are less than fully rational (Barber, Odean & Zhu, 2005). Their trading decisions are based on factors other than optimal responses to news about fundamentals (Lee, 2001). Assets become overvalued when individuals buy and undervalued when they sell [Brown & Cliff (2005); Barber, Odean & Zhu (2005)], providing opportunities for institutional investors to exploit.

Individual investors have greater influence of the prices of small-capitalisation stocks than they do on the market at large (Nofsinger & Sias, 1999). Further, the trades of

[107] Alternative nomenclatures for individual investors found in the literature include sentiment, retail and small investors. They are also known as noise traders.

individuals contribute to the explanation of returns in small-capitalisation firms with lower prices and relatively low levels of institutional ownership, especially if the shares are costly to arbitrage (Kumar & Lee, 2006). As seen in chapter 3, Australian fixed-price IPOs have about the same market capitalisation at listing as the median listed firm (approximately $35 million) but are much smaller than the mean listed firm (roughly $66 million for IPOs compared to $1 billion for listed companies). Therefore, IPO size suggests individual investors will exert influence on price at listing in the Australian context.

Institutional investors receive two to three times the number of shares as individual investors in France, Germany, the UK, the US (Ljungqvist & Wilhelm, 2002) and Australia (Bayley, Lee & Walter, 2006). They hold an average of 16.7% of shares for Australian companies that have been listed for one year (Balatbat, Taylor & Walter, 2004)[108]. The importance of the existence of both groups in the IPO market is demonstrated in the following section where constraints on arbitrage are discussed.

7.4.2 Arbitrage

Establishing that constraints on arbitrage exist in the Australian IPO setting is important in the explanation of why price deviates from value. Arbitrageurs are characterised as rational investors whose trades are based on fundamental value (Shleifer & Vishny, 1997). Individual investors (i.e. noise traders or sentiment investors) generate misvaluation when there is a systematic component to their trades. Jackson (2003) reports strong systematic patterns in the aggregate trading behaviour of Australian individual investors. Arbitrage is normally the preserve of institutions that trade to exploit misvaluation resulting from the trades of individuals. Arbitrage trading reduces the price of overvalued shares (Miller, 1977).

The simplest definition of arbitrage is the purchase of an asset in one market combined with the simultaneous sale of the same (or similar) asset in another market

[108] Using CHESS data, Bayley, Lee and Walter (2006) report about 25% of IPO shares are held by individuals on listing day, while institutions hold the remaining 75%. Some of this deviation from the Balatbat, Taylor and Walter (2004) proportion of institutional ownership is attributable to institutions flipping IPOs. Much, however, will be attributable to the different definitions of institutional investors employed in each study. The former defines institutional investors as non-individuals, while the latter uses a definition consistent with that presented in section 7.6.3.

to achieve a riskless profit by exploiting price differences (c.f. Brealey & Myers, 1996). Riskless arbitrage therefore requires the capacity to take a short position in a particular asset or a very close substitute for that asset.

Arbitrage on Australian equities can be achieved by short selling or by creating a synthetic short position. Synthetic short positions are created with low exercise price options (LEPOs) or short futures positions. ASX Listing Rule 19.7.1 allows short sales only on companies with more than 50 million shares issued and market capitalisation of more than $100 million[109]. Trade in the shares must also be deemed to have sufficient liquidity and the company must appear on the list of approved products for short sale. There were 345 shares and trust units on this list for September 2008 indicating that short selling can occur in the shares of less than 20 percent of listed companies[110]. IPO shares do not exist prior to allocation and cannot be sold short[111] (Rock, 1986). Shares on which short selling is allowed have large market capitalisations relative to fixed-price IPOs and do not represent close substitutes for IPO shares[112].

LEPOs were available on around 50 of the largest listed stocks in September 2008[113]. Given their capitalisation, none of the stocks covered by LEPOs are close substitutes for the fixed-price IPOs in this sample. Similarly, futures contracts for 37 listed firms were listed in March 2005 (SFE, 2005)[114]. Again, the large capitalisation companies covered by futures contracts are not close substitutes for the IPO sample firms. Arbitrage is risky when close substitutes are not available for the misvalued asset.

Even if close substitutes were available, selling futures would not constitute a riskless arbitrage for several reasons. First, futures contract dates are fixed and the actual date for listing is uncertain. This exposes the investor to basis risk as the prices of the substitute asset and the futures contract do not converge until the end of the contract

[109] As shown in Table 3.2, the median size of IPOs at listing is $35 041 000.
[110] The current (May, 2009) restriction on shorting financials does not affect the sample period for this research.
[111] As discussed in chapter 2, the over-allotment options that allow underwriters to short sell issues are not a feature of Australian fixed-price offers.
[112] US IPOs are subject to short selling constraints [Miller (1977) and Loughran (2002)].
[113] http://www.asx.com.au/products/options/lepos.htm Accessed 5/8/8. This data was collected prior to the October 2008 market downturn.
[114] The ASX and the SFE merged in 2006 and individual share futures are no longer traded.

period. Second, the number of shares covered by individual share price futures contracts is fixed (SFE, 2005) while IPO investors face uncertainty with respect to the size of their allocations. While investors can apply for a number of shares that matches the number in a futures position, an exposure to risk from the futures contract is created if the investor is allocated fewer shares than the application amount.

Given short selling constraints and the lack of availability of suitable derivatives, arbitrage activities are severely restricted for the majority of Australian equities. Most Australian IPOs will not meet the capitalisation criterion for short selling post-listing. Further, those of sufficient size do not have the required evidence of liquidity at listing. Synthetic short positions are unfeasible given the lack of close substitute assets for the IPO shares. Such limits to arbitrage result in an upward bias in IPO prices at listing (Miller, 1977).

7.4.3 Escrow of vendor shares

The final institutional feature relevant to misvaluation is the escrow of vendor shares. To protect the integrity of the market, the ASX listing rules place restrictions on securities held by vendors, seed capitalists (in some circumstances), promoters, professionals or consultants who are issued shares in return for services, shares from pre-listing employee incentive schemes and shares that would have been restricted securities if they had not been transferred prior to listing (ASX, 2002). Leyland and Pyle (1977) view retained ownership as a signal of the quality of the IPO on the basis that it represents a commitment by the vendors to the future of the firm. The security restrictions imposed by the ASX add '… weight to the "commitment" implied by retained ownership' (Lee, Taylor & Walter, 1996 p. 1193).

US regulators mandate a 'lockup' period of whereby shares retained by vendors cannot be traded for at least 90 days after listing (Jog & McConomy, 2003). US vendors sell primary shares in the IPO and sell their secondary shares at expiry of the lockup agreement (Aggarwal, Krigman & Womack, 2002). This preference for selling primary shares in the offer leads Gale and Stiglitz (1989) to conclude that retained ownership is not a reliable signal as vendors will sell down their ownership shortly after listing.

In addition to the mandatory lockup requirement, most US IPOs contain voluntary provisions as part of the underwriting agreement (Draho, 2004). These voluntary lockups are normally made in response to requests by influential buyers (Mohan & Chen, 2001). The usual lockup time is 180 days [Aggarwal, Krigman & Womack (2002); Zhang (2005)], with longer periods indicating greater uncertainty about the value of the firm (Mohan & Chen, 2001). Underpricing generates information momentum that allows the IPO vendors to receive more for the shares they sell after lockup expiration (Aggarwal, Krigman & Womack, 2002).

The company announcements section of the ASX website provides data on exchange-imposed and voluntary escrow arrangements for each listed company[115]. 49.5% of the sample described in chapter 3 was subject to ASX escrow[116]. The escrow period is either 12 or 24 months from the date of listing, depending on the ownership of the restricted securities (ASX, 2002)[117]. Therefore, Australian escrow periods are at least twice as long as the average US lockup period. Australian IPOs also have the capacity to enter voluntary escrow agreements that are disclosed in the prospectus. 16.7% of the sample described in chapter 3 disclosed that voluntary escrow agreements had been entered. In total, 64.1% IPOs had either imposed or voluntary escrow arrangements[118].

US lockup provisions are credited with an observed issuer preference for offering primary shares in the prospectus and subsequently selling secondary shares at the expiration of lockup (Gale & Stiglitz, 1989). Primary shares are offered by 96.4% of the fixed-price offer sample described in chapter 3 while only 24.3% offer secondary shares (with or without an offer of primary shares)[119]. While Australian issuers also

[115] Announcements relating to either initial escrow requirements or the dates on which escrow restrictions could not be identified for 31 of the 510 full sample firms. 30 of these IPOs listed prior to the second quarter of 1998, reflecting the higher level of electronic data availability from that time onward. The one remaining IPO for which data were not available occurred in 2002 and did not forecast earnings.

[116] ASX listing rule 9.1.3 indicates that these restrictions do not apply to companies admitted to the list under the profits test or to those that are deemed by the ASX to have sufficient profits or tangible assets (ASX, 2005).

[117] Australian escrow requirements are similar to those in Canada. Canadian vendor shares are released in tranches, with 10% typically released 9 months after listing and remaining shares released '… over the next several years on anniversaries of the IPO' (Jog & McConomy, 2003, p. 160)

[118] The total number of IPOs with escrow arrangements does not equal the sum of the percentages of voluntary and imposed arrangements as 2.1% of the sample had both types of escrow provisions.

[119] Only secondary shares are offered in the prospectuses of 3.6% of this sample.

display a preference for selling primary shares at the float, 64% of issuers cannot sell their secondary shares until at least one year after the float. This feature demonstrates the validity of retained ownership as a signal in the Australian setting.

To summarise, limits to arbitrage create conditions in which prices may be influenced by factors other than rational expectations, suggesting a role for sentiment-related variables in the misvaluation model. Post-listing restrictions on the sale of vendor shares strengthen the signal provided by the post-listing level of retained ownership. Having concluded the discussion of relevant institutional features, the misvaluation model is developed in the following section.

7.5 The misvaluation model

Hypothesised relationships for the factors affecting misvaluation are developed in this section. These hypothesised relationships for mispricing are shown in HO_3.

HO_3 *Misvaluation in Australia is unrelated to the demand for the issue, the speculative nature of the issue, the participation of institutional investors, the participation of an underwriter, the level of retained ownership, the level of IPO market sentiment and the level of mispricing.*

The hypothesised relationships are expressed in the empirical misvaluation model:

$$MV = \beta_0 + \beta_1 OS + \beta_2 SPEC - \beta_3 II + \beta_4 UW + \beta_5 OWN + \beta_6 HOTU + \beta_7 MP + \beta_8 SIZE + \beta_9 GROWTH + \varepsilon \qquad \textbf{(}\boldsymbol{MV}\textbf{ model)}$$

Table 7.4 contains a summary of independent variable measurement for the *MV* model. The rationale for inclusion of these independent variables is discussed in the following sub-sections.

7.5.1 Demand for the issue (OS)

Oversubscription (*OS*) occurs when there are more applications for shares than there are shares to be issued (Smullen & Hand, 2005). A rational explanation for high demand (indicated by *OS*) is that investors perceive the issue has negative mispricing (i.e. $OP < V$) and they expect to gain when the market prices at *V*. In this case, excess demand will be observed until *P* equals *V* in the aftermarket. Thus, a positive relationship is predicted for *OS* and *MV* until the equilibrium of *P* equal to *V* exists. An alternate explanation for high demand is that *OS* is a function of the level of individual investor interest in the issue. In this case, the demand generated by individual investors (behaving as noise traders) is a function of sentiment rather than a function of negative mispricing[120]. A positive relationship is again expected for *OS* and *MV*. However, any excess demand generated by individual investors will not dissipate when *P* equals *V* as this demand is not a function of fundamentals.

Table 7.4 Variable measurement and predicted relationships for misvaluation

Independent variable	Variable measurement	Predicted relationship
OS	Oversubscription is an indicator variable that proxies for excess demand. *OS* is equal to one if the issue is reported in the financial press as 'oversubscribed' or 'closed early'.	positive
SPEC	A speculative issue is defined as a dichotomous variable equal to one if the issuer identifies the offer as speculative in the prospectus.	positive
II	is the number of institutional investors identified from the top 20 shareholders disclosure.	positive
UW	indicates the participation of an underwriter in the issue. *UW* is defined as a dichotomous variable equal to one if the issue is underwritten.	positive
OWN	is the proportion of shares retained by vendors. It is measured as [(shares retained by pre-IPO owners / number of shares at listing) x 100].	negative
HOTU	indicates those issues made when the IPO market is hot. *HOTU* is measured by average underpricing for industrial IPOs in the three months preceding listing date.	positive
MP	is the level of mispricing measured as *OP* - *V*	positive
Control variables		
SIZE	measures the size of the firm post listing relative to industry median capitalisation for the year of listing. Firm size is measured as the total number of shares at listing multiplied by the *OP*.	positive
GROWTH	*GROWTH* is captured by [1-(book value of ordinary shareholders' equity / offer price)].	positive

Excess demand results in quantity rationing once the *OP* is set (Beatty & Ritter, 1986). Therefore, issuers and underwriters may require some level of

[120] Here, the IPO may not exhibit any mispricing or may display positive mispricing.

oversubscription to achieve their allocation objectives. If applications are only received for the number of shares offered, the issuer or underwriter does not have any discretion in the allocation process. Issuers will encourage oversubscription to ensure broad ownership at listing (Booth & Chua, 1996) or to reduce the size of new individual blockholders (Brennan & Franks, 1997). Underwriters will encourage oversubscription and use allocation and underpricing to reward loyal customers who pay for other services provided by the underwriter [Bae, Klein, & Bowyer (1999); Loughran & Ritter (2002)].

Lee, Taylor and Walter (1999) examine subscription and allocation data for IPOs in Singapore and find institutional investors make larger applications for underpriced IPOs. Using the number of times oversubscribed to measure demand, Jelic, Saadouni and Briston (2001) report a positive and highly significant relationship between oversubscription and underpricing in the Malaysian fixed-price setting. A high correlation for oversubscription and initial returns is also reported in the European bookbuild setting (Jenkinson & Jones, 2006).

Data on the rate of subscription for Australian IPOs are not available. Oversubscribed issues (*OS*) are identified from reports in the financial press. These reports sometimes disclose the level of oversubscription. Unfortunately, it is not possible to use these data to construct a continuous measure of excess demand as they are not routinely available. Australian issuers have the capacity to close an issue earlier than the stated closing date in the prospectus. Early-closing issues have sufficient applications for shares to fill the issue and meet any allocation objectives of the issuer or underwriter. Thus, even if numerical data were available for the level of oversubscription, the data for early-closing issues would be biased.

Given these data constraints, a dichotomous variable is included in the *MV* model to represent oversubscription. *OS* is coded one where the financial press indicates that an IPO was either oversubscribed or closed early. The limitations of this measure include inaccurate reporting and omitted reports. As such, *OS* is a fairly crude proxy for the measure of oversubscription compared to that examined by Lee, Taylor & Walter (1999). First-day returns have been used to proxy for oversubscription in a model of underpricing (Reuter, 2006) but this proxy will induce endogeneity in models of both misvaluation and underpricing.

7.5.2 Speculative issues (SPEC)

Speculative issues are expected to be associated with greater misvaluation because they have greater ex ante uncertainty with respect to their valuations. ASIC (2008) defines speculative as deliberately '… taking a big risk … in the hope of making an extraordinary gain'[121]. Similarly, Smullen and Hand (2005, p. 383) define a speculation as the '… purchase or sale of something for the sole purpose of making a capital gain'. In their 2004 prospectus, McMillan Shakespeare Ltd identifies their issue as speculative because the shares '…carry no guarantee with respect to payment of dividends, return of capital or market value'.

These definitions characterise speculative investments as high risk with a focus on shorter-term capital gains in stark contrast to the rational investor choices made with reference to the longer-term concept of value. By their nature, speculative issues will be more difficult for rational investors to value given the higher uncertainty of future earnings. Further, speculative issues are expected to attract bullish individual (sentiment) investors who will cause misvaluation.

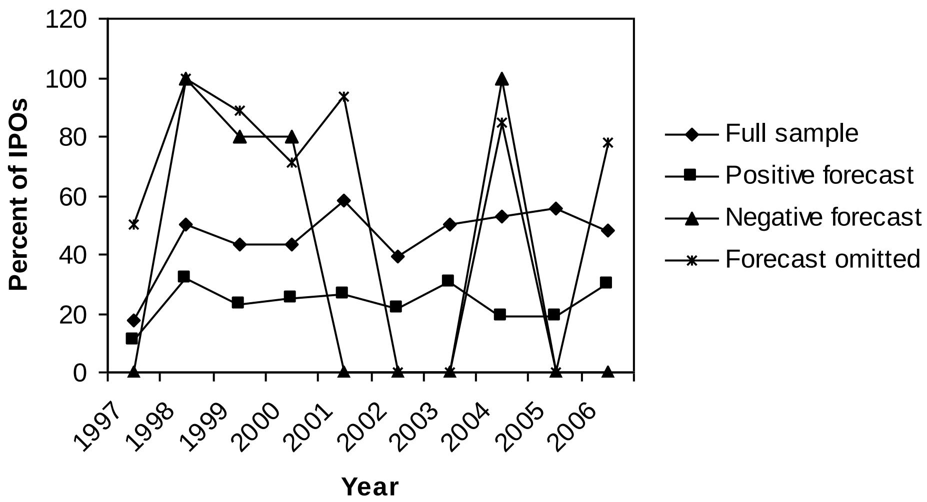
One proxy for the speculative nature of smaller start-up IPOs, issue proceeds, is used in several models of underpricing [Beatty & Ritter (1986); Tinic (1988)]. The number of risk factors disclosed in the prospectus [c.f. Beatty & Ritter (1986); Dalton, Certo & Daily (2003), Reber, Berry, & Toms (2005) and Chang et al. (2008)] is also used to identify speculative issues. Beatty and Ritter (1986) rationalise the number of disclosed uses of proceeds as a proxy because the Securities Exchange Commission requires greater disclosure in this area for speculative issues. Rather than proxy for the speculative nature of an issue, Jog and McConomy (2003) use Canadian data where clear identification of speculative issues is required by regulation[122]. They argue that this clear identification reduces the level of ex ante uncertainty and find a weak positive association for speculative issues and underpricing.

[121] The glossary of terms available on the ASX website does not include a definition for 'speculative'.
[122] This requirement is specified by the Ontario Securities Commission (Jog & McConomy, 2003).

Almost half (46%) of the issues included in the chapter 3 sample are labelled by the issuer as 'speculative', although no specific requirement to do so has been found[123]. It is, however, probable that investors and their advisors would reasonably require the identification of an issue as speculative to make an informed assessment of the offer[124]. More than three-quarters of Australian firms not providing earnings forecasts 'non-forecasters' (78.8%) are speculative issues. Consistent with the Canadian market (see Jog & McConomy, 2003), fewer Australian speculative issues contain earnings forecasts. Relatively fewer issuers with positive earnings forecasts (23.2%) are identified as speculative, while 70% of IPOs with negative forecasts identify their issues as speculative.

Figure 7.3 shows the percentage of speculative issues per year for the sample described in chapter 3. The percentage of speculative issues for IPOs with positive earnings forecasts remains relative stable over the sample period. In contrast, the annual percentage of speculative issues is highly volatile for IPOs with negative or omitted forecasts.

Figure 7.3 Speculative issues by year and forecast category



'Positive (negative) forecast' indicate issues that include a positive (negative) EPS forecast in the prospectus. No EPS forecast is disclosed in the 'forecast omitted' group.

---

[123] Electronic versions of the Corporations Act, ASIC regulations and the ASX Listing Rules were searched for the term 'speculative'. Further, ASIC was contacted by telephone to confirm that there is no specific requirement.

[124] Section 710 of the *Corporations Act 2001* identifies this general disclosure test for determining the contents of a prospectus.

A dichotomous variable (*SPEC*) is coded as one to indicate those issues identified as speculative in the prospectus. Given the above discussion on valuation difficulty and the likely participation of individuals behaving as noise traders in speculative issues, speculative issues are expected to be experience greater misvaluation.

7.5.3 Institutional investor participation (II)

Luplau (1998, p. 149) defines an institutional investor as:

> … an organisation whose primary purpose in investment markets is to invest its own assets or those held in trust by it for others.

Examples of institutional investors include superannuation funds, life companies, universities and banks (Luplau, 1998). Rock (1986, p. 187) defines informed investors as those '… whose information is superior to that of the firm as well as that of all other investors'. Compared to individual investors, institutions utilise more resources in their investment decisions (Barber & Odean, 2008). Lee, Taylor and Walter (1999) use Singaporean data to show large investors apply for relatively more shares in underpriced issues, indicating that they are better informed than small investors[125].

Institutional investors are associated with large IPO share trades (Aggarwal, 2003) and their trading behaviour should be broadly consistent with the fundamentals-based trading of Shiller's (1984) 'smart money'. Institutions participate in IPO markets to exploit sentiment (individual) investors (Ljungqvist, Nanda & Singh, 2006) and there is a negative association between average trade size and underpricing in the US (Cook, Kieschnick & Van Ness, 2006).

Institutional investors in the US sell about 47%of their IPO allocations when the company lists (Aggarwal, 2003) while individuals sell around 28%. Australian institutional investors (*II*) are also more likely to sell their IPO shares at listing than are individuals (Bayley, Lee & Walter, 2006). As only 100% of the offer can be allocated, there is, necessarily, a negative correlation between the level of institutional ownership and the proportion of shares held by small investors. It is reasonable to

[125] Not all large shareholders are institutional shareholders. Balatbat, Taylor & Walter (2004), for example, segregate large shareholders into 'institutional' and 'independent blockholders' categories.

expect that individuals purchase shares on the market when they have not received a full allocation in the IPO. Given the influence of sentiment on the trades of individuals, the participation of institutional (informed) investors in an IPO is expected to have a positive association with the level of *MV*.

Individuals receive lower allocations in Australian underpriced issues (Bayley, Lee & Walter, 2006)[126]. While institutional investors exhibit symptoms of rational and irrational sentiment (Verma, Baklaci & Soydemir, 2008), individuals trade more on sentiment and are expected to have a greater influence on *P* when there is unmet demand from investors in oversubscribed issues[127]. Australian CHESS-registered[128] individual investors are less likely to trade their IPO shares on listing (Bayley, Lee & Walter, 2006). While an average of 22% of IPO shares are traded in the first three days of seasoning, the average for individual investors is only 1.6% (or an average of 7.8% of CHESS registered shares held by individuals) (Bayley, Lee & Walter, 2006). These early trading patterns are consistent with the argument that institutions participate in IPOs to exploit individual (i.e. sentiment) investors. Therefore, the predicted relationship for the level of *II* and *MV* is positive, with larger numbers of institutional investors participating in the IPO when institutions expect to gain from selling to individuals in the after-market.

Equation 7.2 shows institutional investor participation (*II*) is measured as the number of institutional investors identified in the Top 20 at the completion of the allocation process.

$$II = \sum_{k=1}^{20} INSTITUTIONAL_k \qquad \textbf{(7.2)}$$

Data are collected from the Top 20 reports discussed in chapter 6. Insurance companies, banks, credit unions, listed investment companies, superannuation

[126] Bayley, Lee & Walter (2006) classify all categories other than individuals as institutional investors.
[127] This suggests an interaction variable including the proportion of shares held by individuals and oversubscription. This variable is not significant when included in the *MV* model (results unreported).
[128] During their 1995-2000 sample period, 59% of IPO shares were included in the CHESS database (Bayley, Lee & Walter, 2006). The CHESS data are an incomplete record of share ownership because share registration is at the option of the investor. The optional nature of the CHESS records may create a bias toward the inclusion of institutional and other large investors and an underreporting of individual shareholdings and trading activities.

funds[129] as well as custodial holders and nominees[130] are included in the measure of *II,* subject to the following screening process.

Searches were conducted in DatAnalysis to determine if listed corporate investors identified investing in equities as an operating objective of at the time of the IPO. This screen results in the removal of corporations making strategic investments in new IPOs or maintaining some investment in subsidiaries at listing. Further searches were conducted in Factiva to identify unlisted investment companies and funds that are potentially informed investors. This screen results in the identification of a number of offshore corporate investors and nominees that are included in *II*. The final screen was a Google search to identify investment companies that are no longer operating[131]. Details of the activities for some corporate investors and unlisted funds could not be located in either Factiva or DatAnalysis. These are included in *II* when they had invested in more than three non-extractive IPOs in the sample period[132]. As repeat IPO investors, these are assumed to be well-informed about the IPO market. Top 20 shareholdings of founders and venture capitalists or employee share funds associated with a particular IPO are not included in *II.*

An alternative proxy for the role of institutional investors is the proportion of Top 20 shares held by institutions. This proxy is less relevant for testing the hypothesised exploitation of individual investors. A high proportion of institutional ownership could be the result of a relatively low number of institutions holding relatively large blocks of shares. If institutions are ‘smart money’ one would expect, ceteris paribus, that many of them would form similar assessments of the probability of gaining from stagging their shares in the after-market. The proportion of institutional shareholdings is examined in robustness testing in section 7.8.1.

7.5.4 Underwriter participation (UW)

Literature reviewed in chapter 2 indicated mixed results for the role of underwriters and underpricing in Australia. Tests of the baseline model of underpricing in chapter

---

[129] Excluding self-managed superannuation funds.
[130] Excluding one nominee who specialised in acting for self-managed superannuation funds
[131] Adler Corporation Pty Ltd, for example, was operating as an investment company during part of the sample period.
[132] The cut-off point of 3 was determined by the maximum number of unique IPO investments made by a self-managed superannuation fund during the sample period.

4 show the participation of an underwriter has a positive and significant relationship to underpricing. It was argued in section 6.4.2 that Australian underwriting practices provide less incentive for underwriters to underprice fixed-price issues and results reported in section 6.8.3 confirm that underwriter participation is not associated with the level of mispricing.

UW is included in the misvaluation model to determine if the market views underwriter participation as a signal of quality for the issue. Chemmanur and Krishnan (2007) argue that high reputation underwriters work to increase market price, generating greater participation of 'higher quality market players' and obtaining more analyst coverage. They report that the activities of high reputation underwriters increase investor optimism and result in overvaluation at the end of the first trading day. Comparing the trading behaviour of institutional and individual Australian IPO investors, Bayley, Lee and Walter (2006) find results consistent with individual investors placing relatively more reliance on underwriters to signal issue quality[133].

The mixed results from the use of an underwriter reputation variable in the Australian setting are discussed in chapters 2. Therefore, the dichotomous variable used in chapter 4 is again employed here, with underwritten issues coded as unity. A positive association is predicted for *UW* and *MV*. More overvaluation is expected if underwritten issues are perceived to be of a higher quality than their non-underwritten counterparts or if the activities of underwriters result in higher levels of investor optimism about the issue.

7.5.5 Retained ownership signal (OWN)

The influence of owners' wealth loss on mispricing was investigated in chapter 6. The misvaluation model investigates the potential market response to the level of retained ownership (*OWN*). Retained ownership is relevant to the establishment of market prices in the IPO context [Downes & Heinkel (1982); Klein (1996)]. Ritter (1984b) attributes his evidence of a positive association between retained ownership and market price to an agency hypothesis. The positive relationship is observed

---

[133] This suggests an interaction variable including the proportion of shares held by individuals and the presence of an underwriter. This variable is not significant when included in the *MV* model (results unreported).

because lower levels of inside ownership provide incentives for managers to shirk, where shirking results in lower cash flows over time.

Signalling theories of asymmetric information posit that issuers convey their private information to outsiders by setting *OP* lower than expected market price (*E*(*P*)) and use the level of retained ownership to strengthen the underpricing signal [Grinblatt & Hwang (1989); Allen & Faulhaber (1989); Welch (1989)]. A larger proportion of retained shares in the post-listing ownership structure signals that the issuer is not misrepresenting the firm's circumstances (Downes & Heinkel, 1982). Credibility is added to the signal because issuers forego opportunities to diversify their personal risk when they retain a larger fraction of retained ownership (Jog & McConomy, 2003). Further, as Lee, Taylor and Walter (1996) suggest, the ASX's requirement for security restrictions enhances the reliability of retained ownership as a signal of the quality of the IPO. In the US context, Zheng, Ogden and Jen (2005) report a stronger relationship for retained ownership and underpricing for those IPOs with lockup provisions.

Based on the signalling literature, a negative association is predicted for the level of retained ownership and misvaluation. Higher levels of retained ownership give the market confidence in the *OP* by indicating that the issuers will share the consequences of any mispricing and reduce the valuation uncertainty for investors. Consistent with the measure used in the baseline model of underpricing, *OWN* is calculated as the proportion of shares held by the original owners at the completion of the issue.

7.5.6 Market sentiment (HOTU)

Investor sentiment becomes an important determinant of prices when there are limits to arbitrage (Shleifer & Summers, 1990). Lee (2001) develops an asset pricing model that includes noise trader (i.e. individual investor) demand and costly arbitrage. He shows that $P = V$ only when arbitrage cost is zero and that the extent of misvaluation is a function of both arbitrage costs and the level of noise trader demand.

Noise traders imitate each other when they observe high returns and create 'feedback loops' that result in prices shifting further from fundamentals (Shleifer & Summers, 1990). Investors consider past price changes as a factor in their IPO investment decisions (Shiller, 1990). Underpricing returns are highly correlated across time in the US (Ibbotson, Sindelar & Ritter, 1988) and Australia (Brailsford, Heaney & Shi, 2001). This correlation is consistent with investor use of publicly-available information about recent IPOs in their current investment decisions.

In a rational framework, information spillovers from recent IPOs facilitate the valuation of subsequent issues in hot markets by reducing the marginal cost of information acquisition (Merton, 1987). Alternately, a behavioural framework suggests investors use a representativeness heuristic in their current decisions based on recent IPO underpricing (Bayley, Lee & Walter, 2006) rather than taking advantage of incremental cost savings in information production. Highly significant first-order autocorrelation exists for initial returns in the US [Loughran & Ritter (2002); Lowry & Schwert (2004)]. Investigating the bids of institutional and individual investors in Taiwanese IPO auctions, Chiang, Qian and Sherman (2008) find that the returns on recent IPO auctions significantly influence individuals' decisions to bid. Share prices can be expected to diverge from value when investors emphasise recent returns and underweight other data (Offerman & Sonnemans, 2004).

The investor sentiment (*HOTU*) proxy used in the *MV* model is based on that of Loughran and Ritter (2002). The proxy is adapted from equally-weighted average first-day return per month preceding list date to returns per quarter, as the volume of Australian IPOs per month is substantially lower than that observed for the US. Raw returns, rather than market-adjusted returns, are used in the averages to capture sentiment better.

$$HOTU = \frac{\sum_{i=1}^{n} r_i}{n} \qquad \textbf{(7.3)}$$

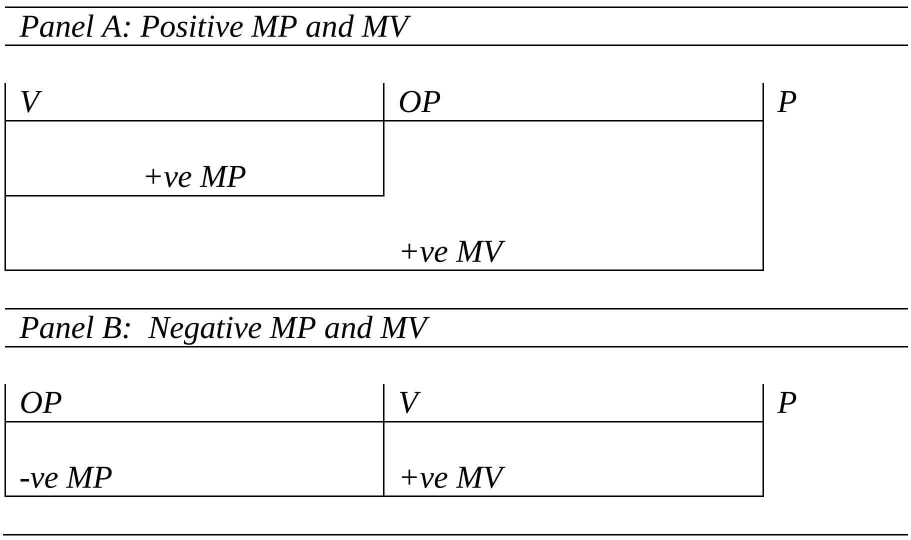
A positive relationship is predicted for *HOTU* and *MV*, with higher levels of *HOTU* associated with overvaluation of issues upon listing.

7.5.7 Mispricing (MP)

No relationship is expected between *MV* and *MP* if market price (*P*) is determined with reference only to intrinsic value (*V*). In this case, positive or negative mispricing will be ignored by the market. If, however, *P* is established using *OP* as the reference point, *MV* and *MP* will have a positive relationship for issues that experience positive mispricing. Figure 7.4 demonstrates this relationship in panel A.

The greater the extent of positive mispricing, the higher *OP* is relative to *V*. For issues with *P* > *OP*, issues with positive mispricing also have positive misvaluation. In the US setting, Purnanandam and Swaminathan (2004) find positive misvaluation in excess of the level of mispricing. Zheng (2007), however, argues that their result is attributable to methodological biases. After correcting for the omission of growth and matching on pre-listing firm characteristics, Zheng finds that US bookbuild issues do not exhibit significant mispricing[134]. However, the possible co-existence of positive *MP* and *MV* for an issue indicates that the model of misvaluation requires a control for the level of mispricing to isolate the individual effects.

Figure 7.4 Relationships of *MP* and *MV*

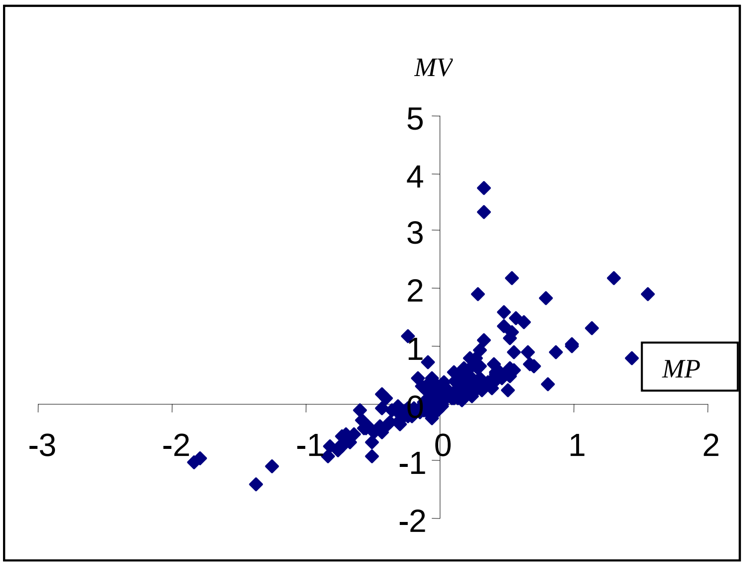


V = value. *OP* = offer price. *P* = market price. *MP* = *OP* minus *V*. *MV* = *P* minus *V*.

[134] Zheng's conclusion that US IPOs are underpriced in the offer price is based on estimates of *V* using the price to sales ratio, not the price to earnings ratio.

A clear positive relationship[135] between *MP* and *MV* is observed for 61% sample IPOs. Panel B of figure 7.4 shows a negative relationship for negative *MP* and positive *MV*. Such issues represent about 14% of the sample[136]. The remainder of the sample has either *OP* > *P* > *V* (7%) or *V* > *P* > *OP* (18%). While a positive relationship between *MP* and *MV* is not always observed in the sample data and the strength of the relationship is not necessarily monotonic, figure 7.5 shows that a positive relationship between *MP* and *MV* best describes the sample data.

Figure 7.5 <u>Empirical relationship of *MP* and *MV*</u>



Results in chapter 6 show that mean and median levels of *MP* are relatively low when compared to mean and median *OP*. These results confirm those of Cotter, Goyen and Hegarty (2005) who do not find systematic positive mispricing for Australian fixed-price IPOs[137]. As discussed in chapter 6, a ratio of *V* and *OP* is a relative measure of mispricing. Using both the comparable firms approach and the EBO model to estimate *V*, Cotter, Goyen and Hegarty (2005) find the ratio of *OP* to *V* makes a highly significant contribution to the explanation of underpricing. How, Lam and Yeo (2007) confirm the positive association between *MP* and underpricing using *OP*

[135] That is *P* > *OP* > *V*, *V* > *OP* > *P*, *OP* = *P* >*V* or *V* > *OP* = *P*.
[136] That is *P* > *V* > *OP* or *OP* > *V* > *P*.
[137] Their results are not subject to Zheng's criticism as *V* is estimated using forecast earnings and pro-forma balance sheets that reflect the IPO capital raising. They also partially control for growth in their *V* measure via the use of industry median PEs, although *GROWTH* provides incremental explanatory power in their model of *OP*.

to *V*, again with *V* based on Australian comparable firms' PEs[138]. Based on this prior research and the need to control for the level of mispricing when determining *MV*, *MP* is included as an independent variable. The four measures of *MP* described in chapter 6 are matched to the relevant measure of *MV* in the misvaluation model. A robustness test to determine if *OP* rather than *MP* influences misvaluation will be reported in section 7.8.5.

7.5.8 Control variables - relative size (SIZE) and growth prospects (GROWTH)

Consistent with the inclusion of *SIZE* and *GROWTH* as control variables in the mispricing model, the misvaluation model also includes these. The rationale for using the controls is, again, that they are frequently used as selection criteria for matching firms in the application of the PE comparable firms' approach. The measures of *SIZE* and *GROWTH* described in chapter 6 are also used in the empirical model of misvaluation.

SIZE is predicted to have a positive association with the level of misvaluation. Investors can only purchase shares in companies of which they are aware (Miller, 1977) and they will be more familiar with the operations of many larger IPO companies. Discussing why investors, on average, hold portfolios that are insufficiently diversified, Barberis and Thaler (2003) argue that investors find more familiar assets attractive than those of which they have no personal experience. Retail (i.e. individual) investors are attention-driven and purchase shares in response to news stories (Barber & Odean, 2008). Larger IPOs are more likely to attract a higher level of media attention, alerting potential investors already familiar with the company to the opportunity to participate in the IPO[139].

---

[138] How, Lam & Yeo match several comparable firms while Cotter, Goyen & Hegarty employ industry median PEs.

[139] A media exposure variable was considered for the misvaluation model. Investigation of Australian media reports relating to IPOs revealed that while bookbuild issues receive extensive media coverage, relatively little is reported for fixed-price issues. A simple count of the number of media reports prior to listing results in a confounded measure as a relatively high count is sometimes associated with problems relating to the issue (the issue of supplementary prospectuses, for example). A classification scheme based on 'positive' and 'negative' reports also raises validity concerns - many media reports consist of press releases that are essentially marketing for the IPO while very few contain independent analysis of prospects.

Individual investors, rather than professionals, will be attracted to an IPO on the basis of familiarity. As discussed previously, these noise traders have the capacity to influence the extent of misvaluation. If Jackson's (2003) evidence of strong systematic patterns in the aggregate trading behaviour of Australian individual investors holds in Australian IPO markets, greater misvaluation will be observed for larger issues. This predicted relationship is potentially confounded by the necessity for institutional investors to participate in IPOs large enough to accommodate the size of their investment without obtaining a controlling interest.

Given the inherent difficulty associated with valuing growth firms, a positive relationship is predicted for *GROWTH* and *MV*. *GROWTH* was also included in the mispricing model to capture valuation difficulties associated with growth prospects. The expected positive relationship for *GROWTH* and *MP* was not significant, suggesting vendors of high growth firms do not face greater valuation difficulty. The inclusion of *GROWTH* in the misvaluation model will ascertain if investors have more difficulty valuing firms with high growth prospects. Having now concluded the discussion of model development, the following section specifies the sample data used to test the model and presents descriptive statistics and correlations for the variables.

7.6 Sample and descriptive statistics

As shown in chapter 6, there are 186 sample firms with estimates of both V_{PE} and V_{EBO}. One company is deleted from the sample as it has an extreme level of mispricing and a second is deleted for an extreme observation on misvaluation (see section 7.3.2). No further exclusions are made on the basis of data constraints and the misvaluation sample includes 184 IPOs.

7.6.1 Descriptive statistics for independent variables

Descriptive statistics for the dependent variables in the misvaluation model were presented in section 7.3. Table 7.5 presents descriptive statistics for the independent variables included in the misvaluation model. Discussion of the descriptive statistics for *SIZE*, *GROWTH* and the *MP* measures was presented in chapter 6. As shown there, *SIZE* makes a significant departure from the normal distribution. The

Kolmogorov-Smirnov statistics in table 7.5 show the distribution of *HOTU* is significantly non-normal[140]. Therefore, median values provide the appropriate measure of central tendency for these variables.

Panel A of table 7.5 shows the mean number of institutional investors in the largest 20 shareholders (*II*) after the issue is 7.9. Ten percent of sample issues did not have any institutional investors identified in the Top 20 shareholder reports while 8.6% had more than 15 institutional issuers. The mean level of retained ownership (61.2%) is similar to that reported for the baseline sample of IPOs (including non-forecasters) in chapter 3 (62.25%). *HOTU* indicates the level of raw underpricing in the quarter prior to listing. While the average of 27.07% is close to that reported for the baseline sample in chapter 3 (25.57%), the median shown in table 7.6 (20.01%) is double that for the baseline sample (10%).

Table 7.5 Descriptive statistics for independent variables - 184 IPOs, 1997-2006

Panel A: Continuous measures

	Mean	Median	S.D.	Min	Max	K-S (*p*-value)	Skew	Kurtosis
II	7.90	8.00	5.05	0	19	0.799 (0.546)	0.17	-0.81
OWN	61.62	63.07	19.79	0	93.06	0.934 (0.348)	-1.05	1.24
HOTU	27.07	20.10	35.91	-74.29	370.00	2.308 (0.000)	5.12	45.41

Panel B: Dichotomous variables

	Proportion of 1s
OS	0.68
SPEC	0.18
UW	0.82

II = number of institutional investors identified from the top 20 shareholders disclosure. *OWN* = (shares retained by pre-IPO owners / shares offered) x 100. *HOTU* = average underpricing for industrial IPOs in the three months preceding listing date. *OS* = dichotomous variable coded as 'one' when the issue is reported in the financial press as 'oversubscribed' or 'closed early'. *SPEC* = dichotomous variable coded as 'one' when the issuer identifies the offer as speculative in the prospectus. *UW* = dichotomous variable coded 'one' if the issue is underwritten.

[140] Kolmogorov-Smirnov statistics for tests of normality show *II* (p = 0.453) and *OWN* (p = 0.269) do not make significant departures from the normal distribution at the conventional level. As shown in chapter 6, the *MP* measures and *GROWTH* are normally distributed.

Panel B of table 7.5 shows the proportions of oversubscribed (OS), speculative (SPEC) and underwritten issues (UW). While 68% of issues are oversubscribed, only 18% are classified as speculative by the issuer. Reflecting the higher incidence of earnings forecasts provided by underwritten issues, 82% of this earnings forecasting sample is underwritten compared to 68% for the baseline sample in chapter 3.

7.6.2 Correlations

Correlations for the continuous variables are shown in table 7.6. Spearman coefficients are presented on the left-hand side of the table and Pearson coefficients are to the right. There are only small differences in the magnitude of the correlations for the three MP_{EBO} measures with the dependent and other independent variables. Therefore, to facilitate the presentation of table 7.6, only the correlations for MP_{EBO50} are presented. As noted in the previous sections, the distributions for MV_{PE}, MV_{EBO0}, MV_{EBO50}, MV_{EBO100}, *HOTU* and *SIZE* exhibit significant departures from the normal distribution. Thus, the following discussion focuses on Spearman correlations.

Consistent with the strong and highly significant associations reported for the value measures in chapter 5 and the *MP* measures in chapter 6, the four measures of *MV* are highly correlated. The EBO measures again show the highest correlations. *MP* has the most substantial correlations of the independent variables and the four measures of the dependent variable. Each of the four *MP* proxies has the predicted positive coefficient and is highly significant. The largest of these is for MP_{PE} and MV_{PE} ($\rho = 0.867$) and the smallest is MP_{EBO100} and MV_{PE} ($\rho = 0.519$).

Relative size *(SIZE)* also exhibits highly significant positive correlations with each measure of *MV*. The positive correlations for *SIZE* and *MP* were identified in chapter 6. Taken together, these results show that relatively larger IPOs experience more positive mispricing, followed by relatively more positive misvaluation in the market. Size (measured as market capitalisation) is highly correlated with institutional ownership in the US (Gompers & Metrick, 2001). The moderate positive and highly significant correlation ($\rho = 0.387$) between *II* and *SIZE* in this sample is consistent with US results and is indicative of an institutional investor preference for larger

Table 7.6 Correlations for 184 IPOs, 1997-2006

	MV_{pe}	MV_{ebo0}	MV_{ebo50}	MV_{ebo100}	MP_{pe}	MP_{ebo50}	*II*	*OWN*	*HOTU*	*SIZE*	*GROWTH*
MV_{pe}		0.817**	0.810**	0.802**	0.741**	0.465**	0.200**	0.103	0.019	0.440**	0.352**
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.006)	(0.163)	(0.793)	(0.000)	(0.000)
MV_{ebo0}	0.731**		0.998**	0.993**	0.498**	0.742**	0.210**	0.059	0.022	0.363**	0.213**
	(0.000)		(0.000)	(0.000)	(0.000)	(0.000)	(0.004)	(0.426)	(0.763)	(0.000)	(0.000)
MV_{ebo50}	0.719**	0.996**		0.998**	0.484**	0.737**	0.229**	0.043	0.010	0.376**	0.215**
	(0.000)	(0.000)		(0.000)	(0.000)	(0.000)	(0.000)	(0.562)	(0.894)	(0.000)	(0.003)
MV_{ebo100}	0.708**	0.987**	0.997**		0.470**	0.737**	0.245**	0.029	0.000	0.386**	0.216**
	(0.000)	(0.000)	(0.000)		(0.000)	(0.000)	(0.001)	(0.695)	(0.990)	(0.000)	(0.003)
MP_{pe}	0.867**	0.619**	0.598**	0.579**		0.584**	0.199**	0.049	-0.040	0.370**	0.291**
	(0.000)	(0.000)	(0.000)	(0.000)		(0.000)	(0.007)	(0.512)	(0.591)	(0.000)	(0.000)
MP_{ebo50}	0.535**	0.861**	0.858**	0.850**	0.606**		0.257**	-0.056	-0.055	0.262**	0.094
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)		(0.000)	(0.452)	(0.456)	(0.000)	(0.201)
II	0.205**	0.255**	0.275**	0.294**	0.202**	0.251**		-0.430**	-0.030	0.319**	0.120
	(0.005)	(0.000)	(0.000)	(0.000)	(0.006)	(0.001)		(0.000)	(0.681)	(0.000)	(0.104)
OWN	0.108	0.029	0.014	0.003	0.090	-0.051	-0.407**		0.109	0.056	0.085
	(0.144)	(0.698)	(0.850)	(0.963)	(0.221)	(0.495)	(0.000)		(0.141)	(0.451)	(0.252)
HOTU	0.121	0.051	0.039	0.028	0.147*	0.036	0.003	0.172*		-0.015	0.195**
	(0.101)	(0.490)	(0.598)	(0.701)	(0.046)	(0.626)	(0.969)	(0.019)		(0.838)	(0.008)
SIZE	0.592**	0.482**	0.491**	0.503**	0.547**	0.401**	0.387**	0.055	0.077		0.280**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.459)	(0.299)		(0.000)
GROWTH	0.376**	0.139	0.136	0.140	0.343**	0.031	0.132	0.084	0.236**	0.337**	
	(0.000)	(0.060)	(0.065)	(0.057)	(0.000)	(0.671)	(0.073)	(0.254)	(0.001)	(0.000)	

Spearman's coefficients and associated probabilities are shown on the left-hand side of the table while Pearson's coefficients and probabilities are shown on the right-hand side.
** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed)
MV_{PE} = price minus the comparable firms estimate of value. MV_{EBO0} = price minus the EBO model value where r_0 is the discount rate. MV_{EBO50} = price minus the EBO model value where r_{50} is the discount rate. MV_{EBO100} = price minus the EBO model value where r_{100} is the discount rate. *II* = number of institutional investors identified from the top 20 shareholders disclosure. *OWN* = (shares retained by pre-IPO owners / shares offered) x 100. *HOTU* = average underpricing for industrial IPOs in the three months preceding listing date. MP_{PE} = offer price minus the comparable firms estimate of value. MP_{EBO50} = offer price minus the EBO model value where r_{50} is the discount rate. *SIZE* = market capitalisation of the IPO post listing relative to industry median capitalisation for the year of listing. *GROWTH* = 1-(book value of ordinary shareholders' equity / offer price).

companies. It is, therefore, unsurprising that *II* and the level of retained ownership (*OWN*) are negatively correlated.

While the expected positive relationship for *II* and *MV* is observed, none is reported for *OWN* and *MV*. Contrary to the expectation that greater positive misvaluation would be observed after high levels of underpricing for recent IPOs, the measures of *MV* are uncorrelated with *HOTU*. However, *HOTU* has a significant positive correlation with *OWN*. *II* and *HOTU* are uncorrelated, suggesting that the higher levels of *OWN* observed when market sentiment is high are not determined by a change in the number of participating institutional investors.

Consistent with the relationship reported for *GROWTH* and *HOTN* in chapter 6, a positive association is identified for *GROWTH* and *HOTU*. While significant positive correlations were reported for *HOTN* and the four measures of *MP* in chapter 6, *HOTU* is uncorrelated with the EBO measures of mispricing. Spearman's coefficients show *GROWTH* has a highly significant and positive correlation with MV_{PE}. Consistent with the lack of correlation for *GROWTH* and EBO-based measures of mispricing reported in chapter 6, *GROWTH* is uncorrelated with MV_{EBO}[141].

7.6.3 Dichotomous independent variable associations

Table 7.7 presents Mann-Whitney U tests for differences in distributions and median tests where the data are categorised by *OS*, *SPEC* and *UW*. Consistent with media-reported oversubscription indicating higher demand, *OS* issues experience significantly more positive misvaluation. In contrast to the rational explanation for high demand (i.e. $OP < V$), *OS* issues exhibit significantly higher levels of mispricing. In the fixed-price setting, demand for a specific IPO is not reflected in its *OP*. Therefore, the positive association of *OS* and *MP* is consistent with issuers being cognisant of hot markets when determining *OP* and, thus, the explanatory power of *HOTN* in the mispricing model reported in chapter 6. These results provide support for the alternate behavioural explanation of excess demand (see section 7.5.1), where individual investor demand is a function of sentiment rather than fundamentals.

[141] Pearson coefficients show significant positive correlations for *GROWTH* and each measure of *MV*. Given the non-normal distributions for the *MV* measures, Spearman correlations are the more appropriate test.

Table 7.7 Differences in distribution where data are grouped by *OS*, *SPEC* and *UW*

	MV_{PE}	MV_{EBO0}	MV_{EBO50}	MV_{EBO100}	MP_{PE}	MP_{EBO0}	MP_{EBO50}	MP_{EBO100}	*II*	*OWN*	*HOTU*	*SIZE*	*GROWTH*
OS median	0.283	0.167	0.228	0.286	0.102	-0.005	0.068	0.099	8	65.714	20.601	1.143	0.581
Not *OS* median	0.052	-0.081	-0.033	0.015	-0.021	-0.238	-0.175	-0.098	7	61.136	18.263	0.960	0.445
U	2 470	2 532	2 507	2 503	2 692	2 864	2 868	2 849	3 416	3 628	3 206	3 170	2 912
Asym sig. (2-tail)	(0.001)	(0.002)	(0.001)	(0.001)	(0.007)	(0.032)	(0.033)	(0.028)	(0.325)	(0.720)	(0.111)	(0.089)	(0.014)
Median test (2-tailed)	(0.001)	(0.011)	(0.004)	(0.004)	(0.026)	(0.057)	(0.112)	(0.112)	(0.900)	(0.525)	(0.403)	(0.153)	(0.153)
SPEC median	0.058	-0.024	0.003	0.035	0.012	-0.037	-0.005	0.005	5.5	66.215	17.820	0.490	0.435
Not *SPEC* median	0.204	0.129	0.181	0.236	0.048	-0.069	-0.009	0.053	8	63.336	20.381	1.143	0.557
U	1 947	2 045	1 902	1 808	2 349	2 294	2 412	2 266	1 685	2 437	2 467	1 576	2 179
Asym sig. (2-tail)	(0.077)	(0.160)	(0.058)	(0.022)	(0.777)	(0.627)	(0.960)	(0.555)	(0.002)	(0.645)	(0.723)	(0.000)	(0.169)
Median test (2-tailed)	(0.178)	(0.178)	(0.083)	(0.034)	(0.563)	(0.563)	(0.563)	(0.847)	(0.012)	(0.335)	(0.847)	(0.034)	(0.178)
UW median	0.237	0.159	0.225	0.271	0.075	-0.039	0.040	0.094	9	66.447	20.241	1.210	0.566
No *UW* median	0.048	-0.058	-0.019	0.003	-0.400	-0.178	-0.152	-0.093	2	77.273	18.390	0.453	0.440
U	1 793	1 666	1 602	1 559	1 975	1 976	1 880	1 797	828	1 245	2 397	1 430	1 750
Asym sig. (2-tail)	(0.019)	(0.005)	(0.002)	(0.001)	(0.096)	(0.097)	(0.044)	(0.020)	(0.000)	(0.000)	(0.691)	(0.000)	(0.007)
Median test (2-tailed)	(0.012)	(0.000)	(0.000)	(0.000)	(0.034)	(0.335)	(0.083)	(0.034)	(0.000)	(0.000)	(0.847)	(0.000)	(0.083)

MV_{PE} = price minus the comparable firms estimate of value. MV_{EBO0} = price minus the EBO model value where r_0 is the discount rate. MV_{EBO50} = price minus the EBO model value where r_{50} is the discount rate. MV_{EBO100} = price minus the EBO model value where r_{100} is the discount rate. *OS* = dichotomous variable coded as 'one' when the issue is reported in the financial press as 'oversubscribed' or 'closed early'. *SPEC* = dichotomous variable coded as 'one' when the issuer identifies the offer as speculative in the prospectus. *II* = number of institutional investors identified from the top 20 shareholders disclosure. *UW* = dichotomous variable coded 'one' if the issue is underwritten. *OWN* = (shares retained by pre-IPO owners / shares offered) x 100. *HOTU* = average underpricing for industrial IPOs in the three months preceding listing date. *MP* = offer price minus the relevant estimate of value. *SIZE* = market capitalisation of the IPO post listing relative to industry median capitalisation for the year of listing. *GROWTH* = 1-(book value of ordinary shareholders' equity / offer price).

This conclusion is, however, somewhat equivocal as there may be a systematic bias in *V* that affects some types of IPOs where these companies are also more likely to be oversubscribed. The distributions of *GROWTH* for oversubscribed and not oversubscribed issues are significantly different, suggesting *GROWTH* is a factor in the determination of investor demand for IPO shares. There is, however, no significant difference in median *GROWTH* for the two groups. *GROWTH* is frequently identified in the literature as a problematic variable for valuation and, therefore, presents a likely candidate for valuation bias. While V_{PE} incorporates industry growth rates via the price multiple, no adjustment has been made for the expected higher growth rates of sample IPOs. Thus, the one-period ahead earnings are effectively assumed to continue. This same assumption employed in the two-period expansion of the Edwards-Bell-Ohlsen model (used to estimate V_{EBO}) where the earnings forecast is discounted in the terminal value perpetuity.

If *GROWTH* is associated with a systematic bias in the measures of *V*, one would expect significant relationships for *GROWTH* and *MP* and *GROWTH* and *MV*. *GROWTH* is not significant in the *MP* regressions presented in chapter 6. This issue is investigated further in section 7.9.

It would be reasonable to expect that speculative issues are more difficult for the market to value. Results in table 7.7 do not support this expectation. Although the distributions of MP_{PE} are different, the difference in medians for speculative and non-speculative issues is not significant at the conventional level. No significant differences are found for the *EBO* mispricing measures. Taken together, these results suggest that neither issuers of speculative offers nor investors purchasing speculative issues experience greater difficulties establishing value. Significantly fewer *II*s (p = 0.024, one-tailed) participate in speculative issues, consistent with the expectation that these are more attractive to individual investors. This result is, however, equivocal as the distributions of *SIZE* for *SPEC* issues are different (p = 0.000, one-tailed) from those for non-speculative issues. There is weak evidence that *SPEC* issues are smaller (p = 0.068, one-tailed) and, as shown in table 7.6, the correlation of *II* and *SIZE* is low (ρ = 0.387) but highly significant.

As expected, underwritten issues display significantly higher misvaluation than do non-underwritten issues. The median level of *MV* for issues made without an underwriter is close to zero (MV_{PE} = 0.048 and MV_{EBO100} = 0.003) or negative (MV_{EBO0} = -0.058 and MV_{EBO50} = -0.019). These results suggest market participants are willing to pay a premium for underwritten issues (p = 0.012, one-tailed, for MV_{PE} and $p < 0.001$ for MV_{EBO}).

Underwritten issues are significantly larger and have around four times the number of institutional investors participating and have lower levels of retained ownership. While the distributions of *GROWTH* are significantly different for underwritten issues and those issues that are not underwritten, there is no significant difference in median *GROWTH* for the two groups. In contrast to the differences observed for misvaluation, *UW* issues do not exhibit significantly higher median mispricing at the conventional level. Therefore, while underwriters attract a higher number of institutional investors to an issue, they do not appear to compensate institutions for their participation with lower levels of mispricing. Given the discretionary share allocation process used by Australian issuers, higher market prices for underwritten issues (evidenced by positive misvaluation) may be a function of unmet demand from individual investors. This assertion is consistent with Bayley, Lee and Walter's (2006) evidence that institutional investors flip relatively more of their allocations at listing.

Cramér's V is used to identify associations between the nominal variables *UW*, *OS* and *SPEC*. The results show that engaging an underwriter in the Australian fixed-price setting is not associated with a significant difference in the incidence of oversubscription[142]. However, significantly fewer speculative issues are oversubscribed[143] and fewer speculative issues are underwritten[144]. With the data description and investigation of bivariate relationships now complete, the next section tests the misvaluation model.

---

[142] Cramér's V = 0.128, p = 0.086
[143] Cramér's V = 0.159, p = 0.033
[144] Cramér's V = 0.184, p = 0.014

7.7 Testing the misvaluation model

Table 7.8 reports the results for four versions of the misvaluation model, each using a different specification of the dependent variable. Analysis of the residuals and Mahalanobis statistics from the first pass of the regressions revealed four multivariate outliers[145]. Deletion of these multivariate outliers results in a sample size of 180 observations for the regressions. The AR^2s for the models are relatively high at about 58-60% and *F* tests are significant ($p < 0.001$). Directional relationships, based on theoretical foundations, are specified so the *p*-values shown in table 7.8 are for one-tailed tests except for the coefficient on the constant.

The regression results show *MP* is the primary explanatory variable for *MV*. The coefficient on *MP* is highly significant for each of the measures and exhibits the expected positive relationship with *MV* irrespective of the measure of the dependent variable. *SIZE* also makes a significant contribution to the explanation *MV*. The larger the IPO firm relative to the industry median listed firm, the greater the extent of misvaluation. The relationship between *SIZE* and *MV* is not as strong as that shown for *SIZE* and *MP* in chapter 6. As *SIZE* is highly significant for the explanation of *MP* and *MP* is included as an independent variable, it is to be expected that some of the effect of *SIZE* is captured by *MP* in the *MV* model.

The presence of excess demand (*OS*), the speculative nature of the IPO (*SPEC*), the number of institutional investors (*II*), underwriting (UW), mean underpricing in the quarter prior to listing (*HOTU*) and the level of retained ownership (*OWN*) are not significant. The multivariate results are largely supportive of those reported in the bivariate analysis, where *MP* and *SIZE* have the strongest significant relationships with *MV*. The low but significant correlations for *II* and *MV* are not reflected in multivariate testing.

Section 7.6.3 suggests *GROWTH* as a potential source of bias in the measures of valuation. The lack of a significant relationship for *GROWTH* and *MV* (table 7.8) and

[145] The chi-squared critical value is determined as $p = 0.001$, d.f. = 9. The multivariate outliers, their listing dates and industries are as follows: Scanbox (1997, media); Australian International Carbon (1998, miscellaneous industrials); Aspermont (2000, media); and Infomedia (2000, miscellaneous industrials).

Table 7.8 Misvaluation regression results for 180 IPOs, 1997-2006

		Dependent variable			
Independent variables		MV_{PE}	MV_{EBO0}	MV_{EBO50}	MV_{EBO100}
constant	coefficient	-0.261	-0.254	-0.250	-0.246
	t-stat	-1.452	-1.416	-1.401	-1.383
	p	(0.148)	(0.159)	(0.163)	(0.168)
OS	coefficient	0.098	0.100	0.100	0.100
	t-stat	1.398	1.414	1.414	1.412
	p	(0.328)	(0.319)	(0.318)	(0.319)
SPEC	coefficient	-0.155	-0.152	-0.154	-0.156
	t-stat	-1.804	-1.751	-1.782	-1.810
	p	(0.146)	(0.163)	(0.153)	(0.144)
II	coefficient	-0.001	-0.001	-0.001	-0.001
	t-stat	-0.135	-0.134	-0.124	-0.116
	p	(1.000)	(1.000)	(1.000)	(1.000)
UW	coefficient	0.097	0.101	0.102	0.102
	t-stat	1.545	1.058	1.065	1.070
	p	(0.248)	(0.583)	(0.577)	(0.572)
OWN	coefficient	0.003	0.003	0.003	0.003
	t-stat	1.014	1.473	1.462	1.450
	p	(0.624)	(0.285)	(0.291)	(0.298)
HOTU	coefficient	0.001	0.002	0.002	0.002
	t-stat	1.197	1.163	1.150	1.137
	p	(0.466)	(0.493)	(0.504)	(0.514)
MP	coefficient	0.925**	0.937**	0.933**	0.931**
	t-stat	12.484	12.956	12.708	12.559
	p	(0.000)	(0.000)	(0.000)	(0.000)
SIZE	coefficient	0.043*	0.041*	0.041*	0.042*
	t-stat	2.424	2.367	2.380	2.389
	p	(0.033)	(0.038)	(0.037)	(0.036)
GROWTH	coefficient	0.172	0.149	0.150	0.150
	t-stat	1.496	1.321	1.327	1.331
	p	(0.273)	(0.376)	(0.373)	(0.369)
AR^2		0.609**	0.580**	0.578**	0.579**
JB		3 177**	3 193**	3 179**	3 166**
	p	(0.000)	(0.000)	(0.000)	(0.000)
White's	*p*	(0.458)	(0.320)	(0.291)	(0.267)
DW		1.517	1.520	1.519	1.519
RESET	*F*	2.050	0.832	0.8512	1.519
	p	(0.132)	(0.437)	(0.429)	(0.340)

** Significant at <1% (one-tailed). * Significant at <5% (one-tailed). # Significant at <10% (one-tailed).
MV_{PE} = price minus the comparable firms estimate of value. MV_{EBO0} = price minus the EBO model value where r_0 is the discount rate. MV_{EBO50} = price minus the EBO model value where r_{50} is the discount rate. MV_{EBO100} = price minus the EBO model value where r_{100} is the discount rate. *OS* = dichotomous variable coded as 'one' when the issue is reported in the financial press as 'oversubscribed' or 'closed early'. *SPEC* = dichotomous variable coded as 'one' when the issuer identifies the offer as speculative in the prospectus. *II* = number of institutional investors identified from the top 20 shareholders disclosure. *UW* = dichotomous variable coded 'one' if the issue is underwritten. *OWN* = (shares retained by pre-IPO owners / shares offered) x 100. *HOTU* = average underpricing for industrial IPOs in the three months preceding listing date. *MP* = offer price minus the relevant estimate of value. *SIZE* = market capitalisation of the IPO post listing relative to industry median capitalisation for the year of listing. *GROWTH* = 1-(book value of ordinary shareholders' equity / offer price).

for *GROWTH* and *MP* (table 6.9) does not support this suggestion. Thus, if V_{PE} and V_{EBO} suffer some systematic bias, it is unlikely to be directly associated with growth prospects as measured in this research.

While *SIZE* has significant correlations with *MP* and *II*, and *II* is also correlated with *MP* and *OWN*, the magnitude of these is low. High pair-wise correlations between individual variables are a sufficient (but not necessary) condition for multicollinearity, which may exist even when correlations are comparatively low[146] (Gujarati, 2003). AR^2s in excess of 90%, combined with several coefficients that individually lack statistical significance are indicative of multicollinearity (Gujarati, 2003). While the AR^2s in table 7.8 fall well short of 90% and few of the correlations among independent variables are 'high', variance inflation factors (VIFs) are calculated. The VIF indicates the extent to which each independent variable is explained by the remaining independent variables in the model (Hair et al., 1998). The largest VIF (unreported) for any coefficient from the regressions in table 7.8 is 1.685, well below the 10 suggested by Hair et al. (1998) to be indicative of problematic multicollinearity.

The Jarque-Bera (JB) test statistics show residuals from the regressions of each measure of *MV* make significant departures from the normal distribution. Significant kurtosis statistics indicate that they are leptokurtic. The probabilities for White's test demonstrate the absence of heteroscedasticity in the residuals. The Durban-Watson (DW) statistic shows significant positive autocorrelation of residuals[147]. Model specification error, however, is not indicated by the Ramsey RESET tests.

Sensitivity testing is conducted to determine if the results reported in table 7.8 are biased by the linear inclusion of non-normal variables. As reported in table 7.5, the Kolmogorov-Smirnov test rejects the assumption of normal distributions for *HOTU* and *SIZE* (see chapter 6). The logarithmic transformation of *SIZE* (*lnSIZE*) is normally distributed (p = 0.062). While a number of transformations for *HOTU* were trialled, none result in a normal distribution for the transformed variable. In contrast to the non-normal distribution of *OWN* reported in chapter 4 for the full sample of

[146] Gujarati considers $\rho = 0.5$ as a comparatively low correlation.
[147] The critical level is determined as n = 180 and k = 9.

IPOs, *OWN* for the earnings forecasters in this sub-sample takes a normal distribution. The *II* and *MP* variables do not make significant departures from the normal distribution. Re-estimation of the regressions with the transformed variable *lnSIZE* (results unreported) does not affect the results presented in table 7.8. *MP* and *lnSIZE* remain the only significant variables. The AR^2s do not differ by more than 0.05%, the residuals remain non-normal and the RESET tests again indicate there is no model misspecification.

7.8 Robustness testing

This section discusses robustness tests that assess the sensitivity of results to alternate measures of institutional-investor participation and market sentiment. The sensitivity of results to alternate measures of misvaluation is also discussed. The misvaluation model is also re-estimated with *OP* substituted for *MP*.

7.8.1 Measure of institutional investors (II)

As described in section 7.5.3, *II* is measured as the number of institutional investors identified in the Top 20 shareholder reports. Here, the proportion of shares held by institutional investors is substituted to determine if the result is sensitive to the measure of institutional participation. This alternate measure protects the variable from any potential bias induced via relatively few institutional investors holding abnormally large blocks of shares in a given IPO.

$$II\% = \frac{\sum_{k=1}^{20} INSTITUTIONAL_k}{\sum_{n=1}^{20} TOP20} \times 100 \qquad \textbf{(7.4)}$$

The *MV* model is retested with *II%* and the results are reported in table D.1 of appendix D. The *t*-statistics on the *II*% measure of institutional investor participation increase substantially and the coefficients are now marginally ($p < 0.06$) significant. Comparison of the AR^2s from table 7.8 to those in table D.1 shows a slight increase (by around 1%) in the explanatory power of the model. *SIZE* and *MP* continue to have significant explanatory power where *II%* is an independent variable. Results are unchanged when logarithmic transformations are applied to *II%* and *SIZE*.

Although not significant at the conventional level, *t*-stats for the percentage of shares held by institutional investors in the Top 20 report (*II%*) indicate this is a more informative measure of institutional-investor participation than the number of participating institutional investors (*II*). These results suggest that the exploitation of individual investors is not the motivating factor for institutional ownership in Australian fixed-price IPOs. If it were, the number of participating institutions would have a significant association with *MV*. Rather, the results for *II%* provide weak evidence that some institutional investors successfully identify issues that will be misvalued and receive relatively large allocations of shares in these issues.

An alternate explanation of the results is that underwriters allocate more shares to their preferred institutional clients, thus increasing the proportion of shares held while reducing the number of institutions receiving share allocations. While the data collected for this dissertation do not permit a direct test of this explanation, the opportunity for an indirect test is afforded by allocation process data. Consistent with higher institutional-investor participation in underwritten issues, a *t*-test shows that the mean number of institutional investors (9.64) allocated shares in issues where underwriters participate in the allocation process is significantly higher ($p < 0.000$) than for issues without underwriter participation in the allocation process (6.46). A Mann-Whitney U test is used to determine if the non-normal *II%* variable is drawn from the same distribution. There is also a significant difference[148] in the proportion of Top 20 shares held by institutions for these groups. Median *II%* for the underwriter participation in allocation group is 17.13 which is substantially higher than the 7.25 for issues where underwriters do not participate in allocation. As these indirect tests show underwriter participation results in greater institutional participation and higher proportions of shares issued to institutions, they do not shed light on why higher explanatory power is observed for *II%*.

7.8.2 Measure of market sentiment

Average underpricing in the quarter preceding an IPO (*HOTU*) is included in the *MV* model as a proxy for market sentiment. The sensitivity of results presented in table 7.8 to the market sentiment proxy are analysed in this section. The number of IPOs in

[148]Mann-Whitney U = 890.5 and $p < 0.000$)

the quarter preceding prospectus date (*HOTN*), an indicator variable for issues made in bull markets (*BULL*) and return on the All Ordinaries index for two and four months prior to listing are investigated as alternatives to *HOTU*.

As discussed in chapter 6, *HOTN* proxies for the state of the IPO market. Table D.2, included in appendix D, presents the results for the misvaluation model with *HOTN* substituted for *HOTU* as the proxy for the state of the IPO market. The AR^2s are highly similar to those in table 7.8. Neither *HOTU* nor *HOTN* is significant for the explanation of *MV* and the *t*-statistics for *HOTN* are smaller than those for *HOTU*. Again, *SIZE* is significant at the conventional level, the RESET tests show no significant model specification error and a logarithmic transformation of *SIZE* does not change the results. As shown in chapter 6, *HOTN* is a significant explanatory variable in the mispricing model. With *MP* included as an independent variable in the misvaluation model, a plausible explanation for the lack of significance of both *HOTN* and *HOTU* is that any effect attributable to the state of the IPO market at listing is captured by *MP*. These results suggest that the state of the IPO market is priced by issuers when they establish *OP* and any incremental impact of the state of the IPO market on investors is insignificant.

Rather than measure IPO market sentiment, *BULL* is a dichotomous variable coded as unity when the sharemarket is considered to be in a bull-market phase. Indicator variables for market condition have equivocal success in the explanation of underpricing in Australia [c.f. How, Izan & Monroe (1995); How (1996)]. These prior studies classify market phases by visual inspection of returns on the All Ordinaries index.

In this dissertation, *BULL* is determined by reference to the media. Keyword searches were undertaken in the Factiva database to identify newspaper articles that identify the Australian market in a ‘bull’ or a ‘bear’ phase during the sample period. Articles were analysed to determine the general view of the market. While relatively few articles disagreed on the state of the market for any given period, a minimum hurdle of six articles (with different authors) was imposed to classify each market phase.

This approach results in three phases over the sample period. The first, a bull market, runs from the start of the sample until March 2000. The subsequent bear market continues until March 2003. The new bull market continues throughout the remainder of the sample. In total, 84 months (74%) of the sample are classified as bulls and the remaining 36 months are identified as bears. Bull market issues represent 76.4% of this sample.

Table D.3 reports the results for the *MV* model where *HOTU* is replaced by *BULL* as the proxy for market sentiment[149]. The AR^2 is increased by around 2% for each of the *MV* measures. *BULL* has a highly significant ($p < 0.008$) positive relationship with each measure of *MV*. The *t*-stats on *SIZE* decrease when *BULL* is included in the models and the variable now lacks significance. As *BULL* apparently captures the *SIZE* effect, this result suggests larger issues are associated with bull market phases[150]. *GROWTH* now shows the predicted positive relationship with *MV* but the relationship is weak. Contrary to the predicted negative relationship, *OWN* shows a marginally significant positive relationship with *MV*. The constants become highly significant with each measure of the dependent variable when *BULL* is the market sentiment proxy. The RESET test is marginally significant when MV_{PE} is the dependent variable[151] but not with the MV_{EBO} dependent variables

Two further proxies for sharemarket sentiment are based on market returns preceding listing date. Brailsford, Heaney and Shi investigate the time series behaviour of the US IPO market and provide evidence that underpricing increases when there is a 'surge in the stock market' (2004 p. 131). The level of value-weighted underpricing in Australia is associated with the performance of the stock market four and six months prior to listing (Shi, 2003). The results of this prior research suggest returns on the All Ordinaries index for the four months prior to the listing date (*RM4*) as a proxy for market sentiment. Table D.4 reports the results for the *MV* model where *HOTU* is replaced by *RM4* as the proxy for market sentiment. As is the case for the *HOTU* and *HOTN* proxies for market sentiment, *RM4* lacks significance for each

[149] As *HOTU* is a proxy for the state of the IPO market and *BULL* is a proxy for sharemarket sentiment, a theoretical model could include both variables. As shown in table 7.8, *HOTU* is not significant in the explanation of MV so it is not included in the table D.3 regressions.
[150] The median test, however, rejects this hypothesis ($p = 1.000$).
[151] The RESET test indicates significant (p = 0.045) model specification error for MV_{PE} when the model is re-estimated with *lnSIZE*.

measure of *MV*. *SIZE* again demonstrates significant relationships with each measure of the dependent variable.

As discussed in chapter 4, market-adjusted returns are typically used to measure underpricing in the Australian context to control for the component of return attributable to the change in the market from the prospectus date to the date of listing. Return on the market index over the delay period has a positive and significant relationship with raw underpricing in the Australian context (Dimovski & Brooks, 2004). As this time period is roughly two months, the second market return proxy for sentiment (*RM2*) is the return on the All Ordinaries Index for the two months prior to the listing date. Results are presented in table D.5.

The re-estimated regressions that include *RM2* as the sentiment proxy are quite similar to those reported for *BULL* in table D.3. Again, AR^2s have increased by around 2% and highly significant positive relationships are observed for *RM2* and *MV*. While the *t*-stats on the *SIZE* coefficients again decrease, they show marginal significance with *RM2*. The *t*-stats on the constants increase, but only to marginal significance with *RM2* compared to being highly significant with *BULL*. As was the case for the *BULL* proxy, the RESET test for the MV_{PE} dependent variable shows marginal model specification error[152]. In contrast to the *BULL* proxy results in table D.3, *GROWTH* and *OWN* do not show any relationship with *MV*.

The results in table 7.8 are robust to a change in the proxy for hot IPO markets. While Shi (2003) reports sharemarket returns in the quarter prior to listing contribute to the explanation of underpricing, they do not contribute to the explanation of misvaluation. However, market returns for the two months prior to listing are significant for explaining misvaluation. This relationship is masked in Australian research using market-adjusted underpricing as the dependent variable.

The *BULL* and *RM2* results suggest that IPOs with large market capitalisations relative to the industry median choose to list when market sentiment is positive. The coefficients on *SIZE*, *GROWTH* and *OWN* are somewhat sensitive to choice of proxy

[152] RESET for this dependent variable and *lnSIZE* indicates that the model specification error is not a function of the non-linear relationship of *SIZE* and MV_{PE} (F = 3.189, p = 0.044).

for general market sentiment, with *GROWTH* and *OWN* showing marginal significance only with the *BULL* proxy. Overall, results from these sensitivity tests suggest that any 'hot IPO markets' phenomenon in Australia over the sample period is distinct from proxies based on broad sharemarket returns.

7.8.3 Sensitivity to measures of misvaluation

The regressions reported table 7.8 show the misvaluation model is robust to changing the measure of misvaluation. Although regressing MV_{PE} on the independent variables results in a marginally higher AR^2, the same variables are significant for all measures of *MV*.

Consistent with the approach used in chapter 6, the sensitivity of results is tested here by scaling the *MV* dependent variables. Two alternate measures of *MV*, the percentage of misvaluation and the ratio of *V* to *P*, are examined in this section. Results for regressions with misvaluation as a percentage of *P* (*MV%*) and as *V/P* are reported in tables D.6 and D.7 of appendix D. Highly significant heteroscedasticity of residuals is indicated by White's test for regressions of all measures of the dependent variable. Therefore, *t*-statistics and associated *p*-values are adjusted for heteroscedasticity in both table D.6 and D.7. Models using these scaled dependent variables exhibit substantially higher AR^2s than those reported in table 7.8. Here, AR^2s range from 84.3% to 87.8% for the *MV*% dependent variables and from 84.4% to 87.8% for the *V/P* regressions.

MP remains highly significant for both *MV*% and *V/P* dependent variables. *SPEC* is marginally significant for the MV_{EBO}% and V_{EBO}/P dependent variables. Relative size (*SIZE* or *lnSIZE*) loses significance when the scaled measures are modelled. Significant coefficients on *SIZE* in table 7.8 may, therefore, indicate the presence of scale effects. As discussed in chapter 6, the inclusion of *SIZE* as an independent variable provides a natural control for scale effects in the levels regressions. *SIZE* is significant in the mispricing model, even after controlling for potential scale effects. The lack of significance for *SIZE* in the returns regressions is consistent with a scale effect in the misvaluation model, suggesting *SIZE* does not have explanatory power for misvaluation[153].

Residual diagnostics, however, indicate that this evidence is not unequivocal. In addition to the heteroscedasticity noted earlier, RESET tests indicate model specification error for all *MV%* (table D.6) and *V/P* (table D.7) dependent variables. While the AR^2s are high and the number of significant coefficients is small, the VIFs do not indicate the existence of multicollinearity. Re-estimation of the regressions using *lnSIZE* produces the same results, indicating that the model misspecification errors are not attributable to non-linearities in this variable. Therefore, the results reported in tables D.6 and D.7 are less reliable than the main regressions reported in table 7.8. The latter do not have significant heteroscedasticity and, according to the RESET tests, do not exhibit specification errors.

7.8.4 Sensitivity to the number of shares offered

Consistent with the analysis undertaken in chapter 6, this section investigates the robustness of results to the issuer's selection of the number of offer shares. The potential impact of this issuer choice is addressed by re-estimating the regressions with the product of *MV* and the number of shares offered (*AMV*) as the dependent variable. The results for regressing *AMV* on the dependent variables are reported in table D.8 of appendix D. The mispricing variable is measured as the aggregate level of mispricing (*AMP*) corresponding to the value proxy used to determine the dependent variable. Highly significant heteroscedasticity is reported for all measures of misvaluation so White's correction is applied to the t-statistics. Consistent with the results in table 7.8, *AMP* and *SIZE* are highly significant for the explanation of aggregate misvaluation (*AMV*) for all measures of *MV* dependent variable.

The RESET tests show marginally significant model specification error in the AMV_{PE} regression while indicating the AMV_{EBO} models are correctly specified. The regressions with *AMV* show the results presented in table 7.8 for MV_{EBO} measures are not influenced by the issuer's selection of the number of shares offered. Given the

---

[153] As was the case for the IPO market sentiment proxy (*HOTN*), some of the influence of *SIZE* could be captured via the inclusion of *MP* in the misvaluation model. However, if this were the explanation, one would expect *SIZE* to also lack significance in the regression results of table 7.8.

outcome from analysis of the residuals, it is not possible to draw firm conclusions for the AMV_{PE} specification of the dependent variable.

7.8.5 The potential relationship of offer price (OP) and misvaluation (MV)

A positive relationship between *MP* and *MV* was predicted in section 7.5.7 and this predicted relationship is observed in table 7.8. Subtracting the common factor *V* from *OP* and *P* to obtain *MP* and *MV* respectively will not change any underlying relationship. However, if market prices anchor on *OP* rather than *V*, the strong relationship between *MV* and *MP* would really be attributable to the underlying relationship of *MV* and *OP*. In this case, issues with larger *OP*s would be expected to experience higher levels of *MV*, given that the average issue has $P > OP$. Table 7.6 shows the highly significant and large correlations (around 0.86) between *MV* and *MP* measures. *OP* has highly significant ($p < 0.001$) but more moderately sized correlations ($\rho = 0.357$ to 0.505) with the measures of *MV*. Table D.9 presents regressions that include *OP* rather than *MP* as an independent variable to investigate the potential relationship between *OP* and *MV*.

The regressions in table D.9 show that *OP* has a highly significant positive relationship with the MV_{EBO} measures, but not with the MV_{PE} measure of the dependent variable. Oversubscribed issues (*OS*) have significantly ($p < 0.01$) higher misvaluation for the MV_{EBO} dependent variables and *OS* is marginally significant with the MV_{PE} measure of misvaluation. *GROWTH* is highly significant with the MV_{PE} dependent variable but lacks significance with the MV_{EBO} dependent variables. *OWN* is marginally significant for the MV_{EBO50} and MV_{EBO100} dependent variables. Therefore, the results for the model including *OP* are not robust across estimates of *MV*. In contrast to the results reported in table 7.8, *SIZE* is not significant and the AR^2s are about one-third the size of those reported earlier.

The coefficients on the constants become highly significant, consistent with variable omission from the *MV* model. The RESET tests confirm that the model including *OP* rather than *MP* has omitted variables[154]. Given the *MV* model with *OP* rather than

[154] These model specification errors are not attributable to non-linearities in the *SIZE* variable. Results from re-estimating the regressions with *lnSIZE* (not reported) show the same significant variables, marginally higher AR^2s and no improvement in the RESET statistics.

MP as the independent variable is a poor statistical model, it is concluded that *MP* is the relevant explanatory variable for misvaluation. In addition to not being robust to changing from the MV_{PE} to MV_{EBO} measures of misvaluation, *OP* is not significant when the dependent variable is either *MV%* or *V/P* and RESET tests indicate highly significant model specification errors in these regressions (results unreported).

7.9 Conclusions

Results from testing the misvaluation model in this chapter show the level of mispricing is the primary factor for explaining the misvaluation of forecasting IPOs. This result is robust to changes in the measurement of the dependent and independent variables. Although somewhat equivocal, the results also suggest that IPOs with relatively larger market capitalisation than the industry median (*SIZE*) are more misvalued.

The state of the IPO market (proxied by *HOTU* and *HOTN*) does not exert a significant influence on misvaluation. The lack of incremental explanatory power the IPO market state variables can be interpreted in two ways. First, investors do not respond to the state of the IPO market when establishing market price (*P*). Second, the result could indicate that issuers exhibit a high degree of accuracy when factoring the state of the IPO market into offer price. However, given the relatively small amount of *MP* for the typical issue, this effect is unlikely to be economically significant. In contrast, the prevailing condition of the sharemarket does have a significant impact on the level of misvaluation. Robustness tests reveal that misvaluation is greater in bull market phases (*BULL*) and, consistent with this result, *MV* varies with the return on the market for the two months (*RM2*) preceding an issue. Thus, while the state of the IPO market has a significant relationship with mispricing, it is general market sentiment that has incremental explanatory power for the extent of misvaluation.

While the number of institutional investors participating in an issue (*II*) is unrelated to *MV*, robustness tests show larger *t*-statistics for the percentage of shares held by institutional investors (*II%*) and *MV*. The weak negative relationship indicates lower misvaluation for issues with high levels of institutional ownership at listing, suggesting that institutional investors do not participate in issues in order to exploit individual investors in the aftermarket. Holding the proportion of retained ownership constant, higher *II%* is necessarily accompanied by lower levels of individual investor share ownership. Therefore, the weak negative relationship for *II%* and *MV* provides an indication of higher levels of misvaluation for issues where individuals hold relatively more shares[155].

In contrast to the prediction that speculative issues (*SPEC*) will attract bullish individual investors, these issues only have lower levels of misvaluation for the scaled MV_{EBO} dependent variables. However, this relationship is not unequivocal as the regression results presented in tables D.6 and D.7 exhibit highly significant specification errors.

Bivariate analysis shows that media-reported demand for an issue (*OS*) has significant negative relationships with mispricing and misvaluation. This negative relationship is contrary to that predicted. However, in the multivariate context, results for *OS* are sensitive to the measure of value used to calculate *MV* and to the inclusion of *BULL* as the market-sentiment proxy. The coefficient on *OS* is negative (supporting the bivariate results) but it is only marginally significant and only for the MV_{EBO} dependent variables. When *OP* rather than *MP* is the independent variable in the *MV* model, *OS* is highly significant and in the expected positive direction with the MV_{EBO} dependent variables and marginally significant with the MV_{PE} dependent variable. These results suggest that *MP* captures the effect of *OS*. As shown in table 7.7, Mann-Whitney tests indicate that the median level of *MP* is significantly higher for oversubscribed issues for all measures of *MP*.

Based on signalling literature, a negative relationship for the level of retained ownership at listing (*OWN*) and *MV* was predicted. While the escrow requirements of the ASX would strengthen any signal implicit in *OWN*, no relationship is found in the bivariate results or in the multivariate *MV* model. Underwriting (*UW*) was also hypothesised as a signal of IPO quality in the Australian institutional setting where

[155] It is possible that for some IPOs, lower levels of *II%* indicate higher levels of *OWN* rather than higher levels of individual investor participation. This issue is investigated by re-estimating the table D.1 regressions omitting the *II%* independent variable. While the *t*-statistics on *OWN, UW* and the constant increase, they continue to lack significance.

underwriters have fewer opportunities to earn profits from trading in IPO shares. While significantly higher median *MV* is observed in the bivariate tests reported in table 7.7, no significant relationship is identified in the multivariate tests. The hypothesised positive relationship of growth prospects (*GROWTH)* and misvaluation is not observed, suggesting investors do not face greater difficulties pricing high-growth IPOs. *GROWTH* is highly significant with the MV_{PE} dependent variable when *OP* rather than *MP* is an independent variable. While this result comes from a model with specification errors, it does suggest some further support for Ohlson's (1995) claim that growth is captured in the EBO model. The absence of the hypothesised relationships for *OWN*, *UW* and *GROWTH* with *MV* is generally confirmed by the sensitivity tests.

The disaggregation of underpricing into mispricing and misvaluation components is now complete. In the next chapter, insights gleaned from modelling *MP* and *MV* are incorporated into the baseline model of underpricing developed in chapter 2.

CHAPTER 8
MISPRICING, MISVALUATION AND UNDERPRICING

8.1 Introduction

The previous two chapters modelled the mispricing and misvaluation of Australian fixed-price industrial IPOs. Results from these models are incorporated into the baseline model of underpricing which was developed in chapter 2 and tested in chapter 4. This chapter addresses the fourth research sub-question: to what extent do issuer-related mispricing and investor-related misvaluation factors contribute to the explanation of underpricing? The following hypothesis is tested:

HO_4 *The explanatory power of the baseline model of underpricing is not increased when mispricing and misvaluation factors are added.*

Sections 8.2 and 8.3 discuss theoretical relationships between mispricing, misvaluation and underpricing. As the mispricing and misvaluation sample include only companies which forecast earnings, the baseline model of underpricing (chapter 4) is re-estimated for this sample prior to testing HO_4. Section 8.4 reports these results that then provide an appropriate comparison for the extended models of underpricing.

The incremental explanatory power of mispricing is determined by adding the *MP* variable to the baseline model. Similarly, *MV* is tested in the multivariate context via inclusion in the baseline model. These two models form the basis for two further extended models of underpricing developed in section 8.5 and tested in section 8.6. Robustness tests are discussed in section 8.7. The explanatory power of the extended models of underpricing is then compared to that of prior research in section 8.8. Conclusions are presented in the final section.

8.2 Underpricing and mispricing

Much of the prior IPO research cited in this dissertation concentrates on underpricing rather than mispricing or misvaluation. Defined as the proportional difference between market price and offer price, underpricing can be viewed as compensation required for obtaining information from informed investors in the bookbuild process

(Benveniste & Spindt, 1989). Sherman and Titman (2002) argue underpricing is required to encourage information production[156]. Similarly, Habib and Ljungqvist (2001) assume that *OP* is set relative to expected market price on listing to ensure uninformed investors break even. In contrast, Derrien (2005) suggests that issuers are not upset about leaving money on the table because they view their returns relative to *V* rather than what the market would be willing to pay.

Mispricing is equivalent to underpricing in theories relying on the assumption that market price at listing is the appropriate measure of IPO value. This assumption avoids the difficulties associated with estimating an unobservable *V*. While it provides a readily observable proxy for *V*, the cost of using *P* is the uncritical acceptance of the tenets of market efficiency, even when (as demonstrated in chapter 7) arbitrage is not possible in the Australian IPO context[157]. If the market for IPOs is efficient, a clear directional relationship cannot be specified for mispricing and underpricing. A negative relationship is expected when issuers set offer price higher than value while the market is expected to set price close to value and, therefore, lower than offer price. Conversely, where offer price is set lower than value, mispricing and underpricing will have a positive relationship as the market price is close to value in an efficient market.

In the US IPO context, Purnanandam and Swaminathan (2004) and Zheng (2007) investigate estimates of *V* that are independent of the market price of an IPO but utilise the market prices of comparable firms. Purnanandam and Swaminathan (2004) report positive mispricing, on average. They find a positive association between the log of *OP/V* and initial returns, indicating that issues with the highest levels of positive mispricing also tend to have the highest levels of underpricing. In contrast, Zheng makes corrections to the Purnanandam and Swaminathan methodology and finds no evidence of positive mispricing. As previously discussed, results from these studies are limited by their reliance on pre-IPO accounting data.

---

[156] Sherman & Titman consider that the level of underpricing required to encourage information production will be sufficient to elicit truthful responses from participants in the bookbuild process.
[157] For discussion of *P* as a proxy for *V*, see chapter 5, for limits to arbitrage, see chapter 7.

Asymmetric information theories of underpricing predict a negative relationship between mispricing and underpricing, where the IPOs with lower positive (or those with negative) mispricing experience the highest levels of underpricing (Purnanandam & Swaminathan, 2004). Cotter, Goyen and Hegarty (2005) and How, Lam and Yeo (2007) report a negative relationship for *OP*/*V* and underpricing using forecast earnings and pro-forma accounting data that reflect post-listing capital structures. How, Lam and Yeo (2007) argue that *P* should approximate V_{PE} when the market uses the comparable firms PE approach, and when *OP* is high relative to *V* (i.e. positive mispricing) the issue will be overpriced rather than underpriced. Consistent with asymmetric information theories, Australian data show issues with less positive (or with negative) mispricing tend to have the highest levels of underpricing. Thus, theory and prior IPO research indicate a negative relationship for *MP* and underpricing in the Australian fixed-price setting.

8.3 Underpricing and misvaluation

Results in chapter 6 show issuers, on average, set *OP* higher than *V*. The measures of *V* identified in chapter 5 are not dependent on the market's assessment of the IPO. Therefore, consistent with contemporary behavioural literature [Purnanandam & Swaminathan (2004); Derrien (2005); Ljungqvist, Nanda & Singh (2006)] misvaluation is viewed here as a component of underpricing.

Miller (1977) argues IPOs will be underpriced even when issuers set *OP* relative to an *E*(*P*) based on the prices of comparable seasoned firms. He reasons that investors purchasing IPO shares on listing date are more optimistic than typical investors and this optimism will cause *P* to exceed *E*(*P*). The typical investor may be pessimistic about a particular share and will not make a purchase. As discussed in section 7.5.2, limits to arbitrage prevent the typical investor from profiting by his or her expectations. Pessimistic investors do not hold shares in the IPO, so they have none to sell and they are unable to reflect their pessimism by short selling. Therefore, *P* is determined by a minority of optimistic investors, resulting in overvaluation.

Researchers have uncovered evidence of misvaluation in many equity markets and in many time periods. Frankel and Lee (1998), for example, find the *V* to *P* ratio is a good predictor of cross-sectional returns for US listed firms. While the long-run behaviour of stock prices is consistent with fundamentals, behavioural factors such as market sentiment affect the short-run evolution of prices (Coakley & Fuertes, 2006). Research in behavioural finance attributes these short-run departures from market efficiency to a number of sources including the cognitive biases of investors (Barberis, Sheifer & Vishny, 1998), overconfidence in private information (Daniel, Hirshleifer & Subrahmanyam, 1998) and interactions between fundamental and noise traders [Shiller (1984); Shefrin & Statman (1994); Lee (2001)]. Investor sentiment does not influence prices in an efficient market because profitable trades by arbitrageurs promptly eliminate any sentiment-induced price bias (Shleifer & Summers, 1990).

After analysing their US bookbuild IPO data, Purnanandam and Swaminathan (2004) conclude that the observed coexistence of mispricing and misvaluation is consistent with behavioural theories. They argue that investors' bids for IPO shares reflect overconfidence in their private information and this overconfidence affects the *OP* in the bookbuild process. After listing, misvaluation in the market persists as investors underreact to subsequent news. For his French bookbuild IPO sample, Derrien (2005) reports *OPs* higher than *V* when individual investors are bullish and, in these circumstances, *P* is higher than *OP* on listing[158]. Ljungqvist, Nanda and Singh (2006) develop their theory of underpricing based on the premise that institutional investors hold IPO shares in hot markets to exploit the presence of irrationally-exuberant investors after listing. Thus, theory and prior research (albeit limited) indicate a positive relationship for *MV* and underpricing.

8.4 Re-estimating the baseline model

This section presents the results for the re-estimation of the baseline model using the reduced sample of earnings forecasters. As discussed in chapter 5, management earnings forecasts are required to operationalise the two value proxies (V_{PE} and V_{EBO}) used in this research. The sample used to test the extended models of underpricing necessarily excludes those IPOs without management earnings forecasts. Therefore,

[158] Derrien uses bids submitted by institutional investors in the bookbuild process as a proxy for intrinsic value.

results for the baseline model presented in chapter 4 are not directly comparable to those for including *MP* and *MV* as independent variables. The empirical baseline model developed in chapter 2 is as follows:

$UP = \beta_0 + \beta_1 DELAY + \beta_2 OWN + \beta_3 SIGMA + \beta_4 UW + \beta_5 OPT + \varepsilon$ **baseline model**

Three alternate measures of underpricing (*RUP*, *MAUP* and *PUP*) are used as the dependent variable. As defined in chapter 4, raw underpricing (*RUP*) is the change from offer price to closing price at the end of day 1 trading divided by the offer price. Market-adjusted underpricing (*MAUP*) is calculated by subtracting the return on the market index (from prospectus date to listing date) from the raw return. The return on packaged issues (*PUP*) includes the return on attaching options.

As shown in table 2.3, the number of days from prospectus date to listing date, the proxy for informed demand (*DELAY*), was predicted to have a negative relationship with *UP*. The standard deviation of daily returns (*SIGMA*), the proxy for ex ante uncertainty, was predicted to have a positive relationship with underpricing. No directional relationships were predicted for the proportion of retained ownership (*OWN*), underwriting (*UW*) or for the inclusion of attaching options with the issue (*OPT*). Measurement details for each of these independent variables, initially provided in table 2.3, are reiterated in table 8.5.

8.4.1 Re-estimation sample, descriptive statistics and correlations

As noted above, the sample used to re-estimate the baseline model is restricted to earnings forecasters. Data requirements for V_{PE} and V_{EBO} (used to measure *MP* and *MV*), discussed in chapter 5, restrict the sample further. The inclusion of the institutional investors percentage variable (*II%*) in an extended underpricing model imposes another restriction[159] relating to data availability. After these exclusions, the sample for re-estimating the baseline model consists of the 180 IPOs used in chapter 7 to test the misvaluation model.

[159] See chapter 7 for discussion of exclusions attributable to poor or unavailable Top 20 shareholder disclosure data.

Table 8.1 presents descriptive statistics for the baseline model's dependent and independent variables in this re-estimation sample. Comparing these descriptives to those presented for the full sample in tables 4.1 and 4.5 reveals some interesting differences between the two samples.

Table 8.1 Descriptive statistics for variables - 180 IPOs, 1997-2006

Panel A: Continuous measures

	Mean	Median	S.D.	Min	Max	K-S (*p*-value)	Skew	Kurtosis
RUP	25.620	10.330	51.142	-46.000	342.000	(0.000)	3.354	14.729
MAUP	25.287	12.601	50.371	-33.253	335.374	(0.000)	3.437	15.085
PUP	25.462	12.609	50.259	-33.253	335.374	(0.000)	3.454	15.191
DELAY	49.888	46.000	18.247	26	203	(0.000)	3.960	27.637
OWN%	61.531	63.683	19.488	0.000	93.061	(0.348)	-1.046	1.323
SIGMA	3.856	3.206	2.568	0.407	16.306	(0.000)	1.819	4.286

Panel B: Dichotomous variables

	Proportion of 1s
UW	0.82
OPT	0.03

RUP = raw underpricing = [(Market price - offer price) / offer price] x 100. *MAUP* = market-adjusted underpricing = *RUP* – return on the market index. *PUP* = packaged underpricing = market-adjusted underpricing including the return on any attaching options. *DELAY* = number of days from prospectus registration to listing on the exchange. *OWN* = shares retained by pre-IPO owners / number of shares at listing. *SIGMA* = standard deviation of the first 20 daily returns (excluding the day one return). *UW* = dichotomous variable coded as 'one' when an issue is underwritten *OPT* = dichotomous variable coded as 'one' when the issue is packaged with options.

Median market-adjusted underpricing (*MAUP*) is higher for the re-estimation sample (12.6%) than that observed for the full sample (10.5%). Median market-adjusted underpricing including the return on attaching options (*PUP*) is equal to median *MAUP* and is also higher for the re-estimation sample (12.6% compared to 11.7%). This result is driven by higher median *MAUP* for the re-estimation sample combined with the very low proportion of earnings forecasts that include attaching options with their issues. While 14.3% of the baseline sample issued attaching options, only 3% of the re-estimation sample did so. Therefore, 97% of the observations on *OPT* take a zero value. In effect, the very small number of packaged issues (five) are outliers and inclusion of this type of independent variable may have undue influence on the ordinary least squares estimates (Brooks, 2002). Therefore, the independent variable *OPT* is excluded from the re-estimation of the baseline model. Correspondingly, the *PUP* measure of underpricing is not investigated further.

Next, the distribution of *OWN*, which is significantly non-normal for the baseline sample, is normally distributed in the forecasting re-estimation sample. This result suggests greater homogeneity, with respect to the proportion of retained ownership, for earnings forecasters. The median level of *OWN* is less for earnings forecasters (63.7% compared to 64.7%)[160]. Lower median *DELAY* suggests that earnings forecasters take less time to list. Lower median *SIGMA* is consistent with investors facing less ex ante uncertainty when evaluating earnings forecasters[161]. Finally, a higher proportion of earnings forecasters are underwritten[162].

Correlations for the dependent and independent variables in the re-estimation sample are presented in table 8.2. Spearman's correlations and *p*-values are presented on the left side with Pearson's coefficients presented on the right. Correlations are not reported for *lnSIGMA* and *SIGMA* as only one of these variables is included in the model. Similarly, as either *lnDELAY* or *DELAY* is included in the model, correlations between these variables are not reported.

The correlations in table 8.2 are very similar to those reported for the baseline sample in chapter 4. *RUP* and *MAUP* make significant departures from the normal distribution[163], so Spearman's correlations are the focus of discussion for these variables. *DELAY* again displays negative and highly significant correlations with *RUP* and *MAUP*. *SIGMA* and *OWN* are not significantly correlated with the dependent variables while displaying low but highly significant correlations with each other. *DELAY* exhibits highly significant but low correlations with both *OWN* and *SIGMA*.

---

[160] A dichotomous variable used to differentiate earnings forecasts from non-forecasters is applied in the full baseline sample described in chapter 3 to conduct median tests. The median level of *OWN* is significantly lower for forecasters ($p = 0.018$).

[161] Median tests on the full baseline sample confirm forecaster median *DELAY* ($p = 0.001$) and *SIGMA* ($p = 0.000$) are significantly smaller than those for non-forecasters

[162] Utilising data included in the baseline sample, Cramér's V shows more earnings forecasters are underwritten ($p = 0.000$).

[163] For *RUP*, K-S = 2.647 and $p = 0.000$. For *MAUP*, K-S = 2.759 and $p = 0.000$.

Table 8.2 Correlations for 180 IPOs, 1997-2006

	RUP	*MAUP*	*DELAY*	*OWN*	*SIGMA*	*lnDELAY*	*lnSIGMA*
RUP		0.994**	-0.192*	-0.110	0.251**	-0.206**	0.230**
		(0.000)	(0.010)	(0.143)	(0.001)	(0.006)	(0.002)
MAUP	0.957**		-0.201**	0.108	0.252**	-0.208**	0.229**
	(0.000)		(0.007)	(0.150)	(0.001)	(0.005)	(0.002)
DELAY	-0.233**	-0.230**		0.240**	0.250**	n.a.	n.a.
	(0.002)	(0.002)		(0.001)	(0.001)	n.a.	n.a.
OWN	0.070	0.044	0.202**		0.189*	0.254**	0.197**
	(0.349)	(0.561)	(0.006)		(0.011)	(0.001)	(0.009)
SIGMA	0.090	0.063	0.128**	0.210**		n.a.	n.a.
	(0.229)	(0.398)	(0.006)	(0.005)		n.a.	n.a.
lnDELAY	-0.233**	-0.230**	n.a.	0.202**	n.a.		0.144
	(0.002)	(0.002)	n.a.	(0.006)	n.a.		(0.057)
lnSIGMA	0.093	0.072	n.a.	0.122	n.a.	0.112	
	(0.221)	(0.340)	n.a.	(0.138)	n.a.	(0.138)	

Spearman's coefficients and associated probabilities are shown on the left-hand side of the table while Pearson's coefficients and probabilities are shown on the right-hand side.
** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed).
[n.a.] No correlations are presented for *lnSIGMA* and *lnDELAY* with *SIGMA* or *DELAY* as these are not included in the same model.
RUP = [(Market price - offer price) / offer price] x 100. *MAUP* = *RUP* – return on the market index. *DELAY* = days from prospectus date to listing date. *lnDELAY* = log of *DELAY*. *OWN* = (shares retained by pre-IPO owners / minimum shares offered) x 100. *SIGMA* = standard deviation of 20 daily returns from listing date. *lnSIGMA* = log of *SIGMA*.

Table 8.3 presents Mann-Whitney U tests for differences in distributions and median tests where the data are categorised by *UW*. Consistent with the results for the full sample presented in table 4.8, there are significant differences in the distributions for *DELAY*, *OWN* and *SIGMA* when earning forecasters are categorised by underwriter participation.

Table 8.3 Differences in distribution where data are grouped by *UW*

	RUP	*MAUP*	*DELAY*	*OWN*	*SIGMA*
UW median	12.000	13.093	45	61.213	3.045
Not *UW* median	7.500	5.772	51	77.273	4.894
U	2 147	2 015	1 854*	1 170**	1 452**
Asym sig. (2-tail)	(0.302)	(0.129)	(0.034)	(0.000)	(0.000)
Median test (2-tailed)	(0.563)	(0.563)	(0.150)	(0.000)	(0.007)

RUP = [(Market price - offer price) / offer price] x 100. *MAUP* = *RUP* – return on the market index. *DELAY* = days from prospectus date to listing date. *SIGMA* = standard deviation of 20 daily returns from listing date. *OWN* = (shares retained by pre-IPO owners / minimum shares offered) x 100. *SIGMA* = standard deviation of 20 daily returns from listing date. *UW* = dichotomous variable equal to one if the issue is underwritten.

Again consistent with the results in table 4.8, median tests confirm differences in location of the distributions of *OWN* and *SIGMA.* In contrast to the median test for the full sample, there is no significant difference for *DELAY*. Therefore, it is concluded that the underwritten issues of earnings forecasters have significantly lower levels of retained ownership and lower post-listing volatility than are observed for issues that are not underwritten. While the distribution of *DELAY* is different for underwritten issues, the distributions have the same location. Having concluded the descriptive and bivariate analysis of the sample, the following section presents results for the re-estimation of the baseline model.

8.4.2 Re-estimation results

Table 8.4 presents the results for the re-estimation of the baseline model. These results will be used to assess the incremental contribution of the significant *MP* and *MV* variables to the baseline underpricing model (section 8.7). As *DELAY* and *SIGMA* make significant departures from the normal distribution, table 8.4 reports results for the regressions with and without logarithmic transformations.

Consistent with the results of the baseline model reported in chapter 4, the positive coefficient on *SIGMA* is highly significant. Results for *UW* are also consistent with those shown in chapter 4, displaying a significant positive relationship (one-tailed). While *DELAY* was marginally significant in the larger sample, it is highly significant in the forecaster re-estimation sample. This result indicates a stronger relationship for underpricing and *DELAY* when issuers provide earnings forecasts. Similarly, *OWN* lacked significance in the larger sample but is significant at the conventional level in this earnings forecaster sample[164].

The adjusted AR^2s are substantially higher than those reported in chapter 4, indicating that the independent variables provide greater explanatory power for earnings forecasters than they do for the extended sample. In contrast to the larger sample, White's test fails to reject the hypothesis of no heteroscedasticity in the re- estimation sample. While significant positive autocorrelation of residuals is identified in the

[164] A median test on the full baseline sample shows earnings forecasters have significantly ($p = 0.028$) lower median *OWN* of 62.6% compared to non-forecasters (68.5%).

baseline model, the Durban-Watson statistic indicates the indecision area for the re-estimation sample. The residuals, however, remain significantly non-normal.

RESET tests indicate significant model specification error in the regressions reported in chapter 4 and indicate highly significant specification error in the re-estimated regressions. To determine if the larger *F*-statistics on the RESET tests for the re-estimation are attributable to the omission of *OPT*, the table 8.4 regressions are re-estimated including this independent variable (results unreported). The coefficient on *OPT* is significant (as one would expect if this variable is having an undue influence on the estimates) and the *F*-statistics are higher than those reported in table 8.4. Therefore, *OPT* is not a candidate for an omitted variable. RESET tests do not improve when *DELAY* and *SIGMA* are replaced with *lnDELAY* and *lnSIGMA* as independent variables[165].

Comparison of the descriptive statistics, bivariate analyses and re-estimation of the baseline model on this smaller sample of earnings forecasters reveals some interesting differences from the results presented in chapter 4. First, earnings forecasters are much less likely to choose packaged issues, suggesting a trade-off between the provision of forecast information and the issue of 'free' options. This conclusion is not unequivocal as chapter 4 results revealed that underwritten issues are less likely to include options and the proportion of underwritten earnings forecasters is substantially higher than that shown for the larger sample.

Second, compared to the full sample, relatively more homogeneity is observed in the distribution of retained ownership (*OWN*) for the forecasting sample as the former is not normally distributed while the latter is. Again, this result may be a function of the relatively high proportion of underwritten earnings forecasters. As shown in table 4.8, the distributions and medians of *OWN* are significantly different for issues with and without underwriter participation.

[165] *lnSIGMA* follows a normal distribution (K-S statistic = 0.547, $p = 0.926$). *lnDELAY* continues to make a significant departure from the normal distribution (K-S statistic = 1.511, $p = 0.021$). As reported in table *RUP* and *MAUP* are highly leptokurtic and follow distributions that are significantly non-normal.

Table 8.4 Baseline regression results for 180 IPOs, 1997-2006

		Dependent variable			
Independent variables		*RUP*	*MAUP*	*RUP*	*MAUP*
constant	coefficient	-6.979	-8.187	129.374**	125.346**
	t-stat	-0.361	-0.432	3.276	3.209
	p	(0.719)	(0.666)	(0.001)	(0.002)
DELAY	coefficient	-0.764**	-0.774**		
	t-stat	-3.715	-3.844		
	p	(0.000)	(0.000)		
OWN	coefficient	0.438*	0.439*	0.451*	0.451*
	t-stat	2.256	2.311	2.412	2.457
	p	(0.025)	(0.022)	(0.017)	(0.015)
SIGMA	coefficient	6.577**	6.598**		
	t-stat	4.533	4.645		
	p	(0.000)	(0.000)		
UW	coefficient	22.527*	24.009*	23.198*	24.743**
	t-stat	2.280	2.482	2.551	2.807
	p	(0.024)	(0.014)	(0.012)	(0.006)
lnDELAY	coefficient			-45.928**	-45.214**
	t-stat			-3.928	-3.877
	p			(0.000)	(0.002)
lnSIGMA	coefficient			23.198**	22.980*
	t-stat			2.945	2.807
	p			(0.007)	(0.011)
AR^2		0.152**	0.162 **	0.133 **	0.138 **
JB		1 351**	1 425**	1 356**	1 292**
	p	(0.000)	(0.000)	(0.000)	(0.000)
White's	*p*	(0.074)	(0.072)	(0.049)	(0.047)
DW		1.714	1.756	1.712	1.745
RESET	*F*	6.829**	6.445**	9.959**	9.146**
	p	(0.001)	(0.002)	(0.000)	(0.000)
SIC		10.658	10.616	10.680	10.645

** Significant at <1% (two-tailed for *OWN* and *UW* and one-tailed for *DELAY, SIGMA lnDELAY* and *lnSIGMA*)
* Significant at <5% (two-tailed for *OWN* and *UW* and one-tailed for *DELAY, SIGMA lnDELAY* and *lnSIGMA*)
# Significant at <10% (two-tailed for *OWN* and *UW* and one-tailed for *DELAY, SIGMA lnDELAY* and *lnSIGMA*)
t-statistics are White's heteroscedasticity adjusted for the regressions including *lnDELAY* and *lnSIGMA*.
RUP = [(Market price - offer price) / offer price] x 100. *MAUP* = *RUP* – return on the market index. *DELAY* = days from prospectus date to listing date. *lnDELAY* = log of *DELAY*. *SIGMA* = standard deviation of 20 daily returns from listing date. *lnSIGMA* = log of sigma. *OWN* = (shares retained by pre-IPO owners / minimum shares offered) x 100. *UW* = dichotomous variable equal to one if the issue is underwritten.

Third, a median test on the full baseline sample described in chapter 4 (results unreported) indicates that earnings forecasters have significantly lower median

DELAY of 46 days compared to the non-forecasting issues (52 days). This result suggests the demand (informed or otherwise) for IPO shares is higher when forecasts are disclosed.

Fourth, results for the baseline model in table 8.4 show higher AR^2s than are observed in the larger sample, indicating that the baseline variables provide higher explanatory power for the underpricing of earnings forecasters[166]. Compared to the results for the full sample in table 4.9, *t*-statistics for the coefficients on both *DELAY* and *OWN* are substantially higher for the earnings-forecasting sample. While *DELAY* shows marginal significance for the larger sample, it is highly significant in the explanation of underpricing for earnings forecasters. *OWN* lacked significance in table 4.9 but is significant at the conventional level in table 8.4, suggesting any signal provided to the market by the level of retained ownership is confirmed by the provision of an earnings forecast. As is the case for the full sample, the coefficient on *SIGMA* is highly significant while *UW* is significant at the conventional level.

These differences in multivariate associations highlight the importance of re-estimating the baseline model for the sample of earnings forecasters. They demonstrate that tests of the extended models of underpricing presented in the following sections are not directly comparable to the results for the estimation of the baseline model on a sample that includes issues that do not disclose earnings forecasts. Therefore, the results for the extended models of underpricing will be compared to those in table 8.4 rather than to those for the larger sample presented in table 4.9. Having now completed the re-estimation of the baseline model, the following section explores potential relationships and describes empirical relationships between mispricing, misvaluation and underpricing. These observed relationships are then used to make directional predictions for mispricing in the extended underpricing models.

8.5 The extended underpricing models

In this section, the baseline model of underpricing is extended by including mispricing and misvaluation and variables found to be associated with them. The

---

[166] Higher AR^2s are not attributable to the omission of *OPT* from the baseline model.

inclusion of both *MP* and *MV* as independent variables in a model of underpricing is tautological[167]. Further, the results from the inclusion of both *MP* and *MV* in a model of underpricing could be driven by high correlations (see table 8.6) between *MP* and *MV* for these IPOs. Therefore, two separate models are developed to isolate the effects of mispricing and misvaluation on underpricing.

As a first step, *MP* is included in the baseline model to identify any incremental explanatory power for underpricing. Model 8.1 is used to assess the relationship of *MP* and underpricing, controlling for the significant variables identified from the re-estimation of the baseline model. As was the case for the re-estimation of the baseline model, raw underpricing (*RUP*) and market-adjusted underpricing (*MAUP*) are the dependent variables.

$$UP = \beta_0 + \beta_1 DELAY + \beta_2 OWN + \beta_3 SIGMA + \beta_4 UW + \beta_5 MP + \varepsilon \quad \textbf{(model 8.1)}$$

Next, to investigate the role of *MV* in underpricing, model 8.2 shows the predicted relationship of *MV* and underpricing. As with model 8.1, the baseline underpricing independent variables are controlled.

$$UP = \beta_0 + \beta_1 DELAY + \beta_2 OWN + \beta_3 SIGMA + \beta_4 UW + \beta_5 MV + \varepsilon \quad \textbf{(model 8.2)}$$

Given the aforementioned tautology of including both *MP* and *MV* in one model of underpricing, the approach adopted here is to develop two further models of underpricing that extend models 8.1 and 8.2. Model 8.3 extends model 8.1 (baseline with *MP*) by representing the effects of misvaluation with the proportion of institutional investor participation and the level of general market sentiment. Thus, misvaluation is indirectly represented by the independent variables that contribute to the explanation of misvaluation.

$$UP = \beta_0 + \beta_1 DELAY + \beta_2 OWN + \beta_3 SIGMA + \beta_4 UW + \beta_5 MP + \beta_6 II\% + \beta_7 BULL + \varepsilon \quad \textbf{(model 8.3)}$$

[167] As $MP = OP - V$, $MV = P - V$ and $UP = OP - P$, the dependent variable in the underpricing model will be fully explained by *MP* and *MV*.

Neither *II%* nor *BULL* were included in the original specification of the *MV* model. Both of these variables were identified from the robustness tests conducted in chapter 7. While *SIZE* was included as a control variable in the original *MV* model, the chapter 7 sensitivity tests indicated that the significance for this variable shown in table 7.8 can be attributed to scale effects. Therefore, *SIZE* is not included in model 8.3.

Model 8.4 extends model 8.2 (baseline with *MV*) by representing the effects of mispricing with the level of IPO market sentiment (*HOTN*) and the size of the listing firm (*SIZE*). Thus, mispricing is indirectly represented by the independent variables that make a significant contribute to the explanation of mispricing. Robustness testing in chapter 6 indicates that the significant relationship for *SIZE* and *MP* is not attributable to scale effects.

$$UP = \beta_0 + \beta_1 DELAY + \beta_2 OWN + \beta_3 SIGMA + \beta_4 UW + \beta_5 MV + \beta_6 HOTN + \beta_7 SIZE + \varepsilon \qquad \textbf{(model 8.4)}$$

The dependent variables used in the primary tests of the *MV* and *MP* models in chapters 6 and 7 were the dollar amounts of mispricing and misvaluation. Dollar measures for these independent variables are also used here with robustness tests for scaled *MP* and *MV* measures presented in section 8.7.

Chapters 6 and 7 reported results for *MP* and *MV* based on V_{PE}, V_{EBO0}, V_{EBO50} and V_{EBO100}. In the interest of parsimony, only the results for the V_{PE} (the primary value proxy) and V_{EBO50} (the alternate proxy) measures of the *MP* and *MV* independent variables will be reported in this chapter. The remaining independent variables have been defined in chapters 2, 6 and 7. Table 8.4 summarises their measurement and identifies the direction of the predicted relationship with underpricing.

As discussed in chapter 2, results for retained ownership (*OWN*) in prior Australian research are mixed so no directional relationship was predicted for the baseline model. *OWN* did not exhibit a significant relationship with underpricing in the baseline model but results reported in table 8.4 show *OWN* has a positive significant relationship with *RUP* and *MAUP* in the earnings forecasting sample. Therefore, *OWN* is predicted to have a positive relationship with underpricing in the extended models. Similarly, no directional prediction was made for the relationship between *UW* and underpricing in the baseline model. The empirical results presented in chapter 4 and section 8.4 show this relationship to be positive, supporting Logue's (1973) rationale of underpricing as a mechanism to minimise the underwriter's costs and risks. Therefore, the predicted relationship for *UW* and underpricing is positive.

Table 8.5 Variable measurement and predicted relationships for underpricing

Independent variables	Variable measurement	Predicted relationship
DELAY	proxies for the level of informed demand. *DELAY* is captured by the number of days from prospectus date to listing date.	negative
OWN	is the level of retained ownership. *OWN* is measured by (shares retained by pre-IPO owners / number of shares at listing) x 100.	positive
SIGMA	proxies for the level of ex ante uncertainty. *SIGMA* is defined as the standard deviation of daily returns for days 2 to 20 from listing date.	positive
UW	indicates the participation of an underwriter in the issue. *UW* is defined as a dichotomous variable equal to one if the issue is underwritten.	positive
MP	is the level of mispricing. *MP* is measured as *OP-V*.	negative
MV	is the level of misvaluation. *MV* is measured as *P-V*.	positive
II%	is the proportion of 'Top 20' shares held by institutional investors.	positive
BULL	is the proxy for market sentiment. *BULL* is defined as a dichotomous variable equal to one if the issue is listed during a period identified as a bull market from media reports.	positive
HOTN	represents the state of the IPO market. *HOTN* is measured as by the number of industrial IPOs in the three months preceding the prospectus date. Hot markets are indicated by more listings.	positive
SIZE	measures the size of the firm post listing relative to industry median capitalisation for the year of listing. Firm size is measured as the total number of shares at listing multiplied by the offer price.	positive

Robustness testing in chapter 7 identified the percentage of institutional investors (*II%*) identified in the Top 20 shareholder disclosure as marginally significant

($p < 0.06$) in the explanation of misvaluation. Using an Australian sample, Bayley, Lee and Walter (2006) find institutional investors receive significantly larger allocations in underpriced issues[168]. As reported in chapter 7, institutional investors tend to be allocated a relatively larger proportion of shares in issues with listing prices in excess of value (i.e. issuers with positive misvaluation) in this sample. Therefore, a positive relationship is predicted for *II%* and underpricing in model 8.3.

The general market sentiment variable (*BULL*) was found to be highly significant for explaining misvaluation. *BULL*, determined by reference to the media, has a positive and highly significant relationship with misvaluation. *BULL* is included in model 8.3 and a positive relationship with underpricing is predicted. Issues with higher positive misvaluation are expected to have relatively higher prices at listing and are, therefore, likely to have greater levels of underpricing.

The proxy for the state of the IPO market (*HOTN*) is included in model 8.4. *HOTN* displays a positive and highly significant relationship with mispricing (see section 6.7) and is not associated with misvaluation (see section 7.8.2). Based on prior research [c.f. Ritter (1984); Sharpe & Woo (2005)], a positive relationship is predicted for *HOTN* and underpricing.

IPO market capitalisation relative to industry median (*SIZE*) displays a positive and highly significant relationship with mispricing (see section 6.7), so is included in model 8.4. Robustness tests show *SIZE* remains highly significant in the explanation of mispricing after controlling for scale effects. Prior Australian research (discussed in chapter 2) reports mixed evidence on a relationship for various measures of size (issue size, total assets and market capitalisation at listing) and underpricing. Where significant relationships are identified in prior Australian research, the measure of size has a positive coefficient [How, Izan & Monroe (1995); How & Howe (2001); Cotter, Goyen & Hegarty (2005)]. A positive relationship is predicted for *SIZE* and underpricing. This concludes the development of the extended underpricing models. Tests of the models are presented in the following section.

---

[168] As discussed in chapter 7, the Bayley, Lee and Walter definition of institutional investors is broader than that used in this research.

8.6 Testing the extended underpricing models

The sample used to re-estimate the baseline model (see section 8.1) is used here to test the extended underpricing models. The first sub-section provides descriptive statistics for the independent variables. Bivariate associations are analysed and regression results are then presented.

8.6.1 Descriptive statistics and correlations

Table 8.3 presented descriptive statistics for the dependent variables (*RUP* and *MAUP*) and for the independent variables from the baseline model (*DELAY*, *SIGMA*, *OWN* and *UW*). Descriptive statistics for *MP* (table 6.3), *HOTN* and *SIZE* (table 6.6), *MV* (table 7.3) have been presented and discussed in previous chapters. As discussed in chapter 7, around 77% of issues listed during the two bull market phases observed in the sample. As it was identified from the chapter 7 robustness tests, *II%* is the sole remaining variable that requires description. The mean (median) percentage of shares held by institutional investors identified from the Top 20 shareholder disclosures is 16.58% (12.97%). The minimum level of *II%* is zero, while the maximum is 78.22%. Although the skewness and kurtosis statistics for *II%* are not significant, the distribution has a large standard deviation and is significantly non-normal.

Table 8.6 presents correlations for dependent and independent variables. Spearman's coefficients are presented on the left-hand side of the table while the Pearson's coefficients are shown on the right. Given the non-normality of variable distributions, the discussion focuses on Spearman's *rho* and associated *p*-values. Correlations for the baseline independent variables and underpricing were discussed in section 5.2, so discussion in this section relates to the additional independent variables for the extended models of underpricing. As expected, correlations between the *MP* and *MV* measures are positive, large and highly significant.

Table 8.6 <u>Correlations for 180 IPOs, 1997-2006</u>

	RUP	*MAUP*	*DELAY*	*SIGMA*	*OWN*	*SIZE*	*II%*	*HOTN*	MP_{PE}	MP_{EBO50}	MV_{PE}	MV_{EBO50}
RUP		0.994**	-0.192*	0.251**	0.110	0.113	-0.137	0.075	0.001	-0.051	0.575**	0.560**
		(0.000)	(0.010)	(0.001)	(0.143)	(0.132)	(0.066)	(0.317)	(0.987)	(0.499)	(0.000)	(0.000)
MAUP	0.957**		-0.201**	0.252**	0.108	0.108	-0.129	0.091	0.003	-0.038	0.573**	0.565**
	(0.000)		(0.007)	(0.001)	(0.150)	(0.148)	(0.084)	(0.222)	(0.967)	(0.609)	(0.000)	(0.000)
DELAY	-0.233**	-0.230**		0.250**	0.240**	-0.236**	-0.306**	0.009	-0.224**	-0.267**	-0.290**	-0.327**
	(0.002)	(0.002)		(0.001)	(0.001)	(0.001)	(0.000)	(0.903)	(0.002)	(0.000)	(0.000)	(0.000)
SIGMA	0.090	0.063	0.128		0.189*	-0.195**	-0.251**	0.171*	0.000	-0.131	0.087	-0.002
	(0.229)	(0.398)	(0.087)		(0.011)	(0.009)	(0.001)	(0.021)	(0.995)	(0.080)	(0.244)	(0.978)
OWN	0.070	0.044	0.202**	0.210**		0.030	-0.490**	0.191*	0.026	-0.053	0.093	0.040
	(0.349)	(0.561)	(0.006)	(0.005)		(0.688)	(0.000)	(0.010)	(0.733)	(0.478)	(0.214)	(0.593)
SIZE	0.103	0.125	-0.354**	-0.241**	0.038		0.148*	-0.124	0.354**	0.281**	0.419**	0.376**
	(0.168)	(0.093)	(0.000)	(0.001)	(0.610)		(0.048)	(0.097)	(0.000)	(0.000)	(0.000)	(0.000)
II%	-0.103	-0.073	-0.366**	-0.325**	-0.490**	0.194**		-0.093	0.112	0.174*	-0.002	0.040
	(0.167)	(0.331)	(0.000)	(0.000)	(0.000)	(0.009)		(0.213)	(0.136)	(0.019)	(0.981)	(0.592)
HOTN	0.070	-0.043	-0.033	0.176*	0.159*	-0.091	-0.049		0.182*	0.166*	0.153*	0.143
	(0.070)	(0.565)	(0.661)	(0.018)	(0.033)	(0.224)	(0.515)		(0.015)	(0.026)	(0.041)	(0.055)
MP_{PE}	0.011	0.026	-0.142	0.060	0.070	0.527**	0.099	0.182*		0.650**	0.752**	0.510**
	(0.882)	(0.731)	(0.057)	(0.422)	(0.348)	(0.000)	(0.187)	(0.015)		(0.000)	(0.000)	(0.000)
MP_{EBO50}	-0.102	-0.079	-0.267**	-0.116	-0.036	0.409**	0.195**	0.209**	0.650**		0.475**	0.728**
	(0.175)	(0.290)	(0.000)	(0.122)	(0.630)	(0.000)	(0.009)	(0.005)	(0.000)		(0.000)	(0.000)
MV_{PE}	0.384**	0.391**	-0.254**	0.066	0.098	0.573**	0.041	0.144	0.880**	0.544**		0.825**
	(0.000)	(0.000)	(0.001)	(0.378)	(0.193)	(0.000)	(0.584)	(0.055)	(0.000)	(0.000)		(0.000)
MV_{EBO50}	0.336**	0.350**	-0.323**	-0.092	0.021	0.490**	0.139	0.170*	0.630**	0.847**	0.732**	
	(0.000)	(0.000)	(0.000)	(0.220)	(0.778)	(0.000)	(0.064)	(0.023)	(0.000)	(0.000)	(0.000)	

Spearman's coefficients and associated probabilities are shown on the left-hand side of the table while Pearson's coefficients and probabilities are shown on the right-hand side.
** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed)
RUP = [(Market price - offer price) / offer price] x 100. *MAUP* = *RUP* – return on the market index. *DELAY* = days from prospectus date to listing date. *SIGMA* = standard deviation of 20 daily returns from listing date. *OWN* = (shares retained by pre-IPO owners / minimum shares offered) x 100. *SIZE* = size of the firm post listing relative to industry median capitalisation for the year of listing. *II%* = the proportion of 'top 20' shares held by institutional investors. *HOTN* = number of industrial IPOs in the three months preceding the prospectus date. MP_{PE} = offer price minus the comparable firms estimate of value. MP_{EBO50} = offer price minus the EBO model value where r_{50} is the discount rate. MV_{PE} = price minus the comparable firms estimate of value. MV_{EBO50} = price minus the EBO model value where r_{50} is the discount rate.

A negative relationship for mispricing and underpricing was predicted but the Spearman's correlations show no significant relationship for either measure of mispricing. Both measures of misvaluation have moderately-sized (i.e. between 0.336 and 0.391) positive and highly significant correlations with the measures of underpricing as predicted. This result is interesting in view of the lack of correlation between the mispricing measures and underpricing. Taken together, these results suggest investor-related factors (misvaluation) are more important for the explanation of underpricing than are issuer-related factors (mispricing). Further, the correlation of *MV* with underpricing highlights the deficiency of price as a proxy for value. When it is assumed that *P* equals *V*, *MV* is necessarily zero. The bivariate relationship of *MV* and underpricing suggests important information about *MV* is lost when it is assumed to be zero.

DELAY is the only other independent variable that displays a significant association with underpricing. Market capitalisation relative to industry median (*SIZE*) was predicted to have a positive association with underpricing but no significant relationship is observed. *DELAY* exhibits highly significant negative correlations with *SIZE* and the proportion of institutional investors (*II%*). Thus, consistent with Miller's (1977) visibility hypothesis, the larger the IPO relative to its relevant industry median market capitalisation, the more interest the issue attracts. The association of *DELAY* with the proportion of institutional investors identified in the Top 20 shareholder disclosure provides support for the notion that this variable captures the level of informed demand and that institutional investors appear to behave as 'smart money'. The significant positive association of *DELAY* and *OWN* indicates issuers with higher retained ownership take longer to list.

Mispricing, measured with the EBO model, exhibits a low negative but highly significant correlation with *DELAY*[169]. Contrary to a rational argument for purchasing IPOs where issue price is close to value, this relationship suggests that issues with greater positive mispricing take less time to fill. *DELAY* has negative and significant correlations with both measures of *MV*, indicating that issues taking longer to list are less misvalued.

[169] The size of the correlation for mispricing measured with V_{PE} is smaller and only has marginal significance.

There are at least three possible explanations for this result. The first is that longer *DELAY* facilitates the incorporation of more information about the listing firm, resulting in lower misvaluation. The second is that positive market sentiment results in a shorter time to listing and higher prices for listing firms as demand for shares is high. This explanation is not supported by the comparison of distributions of *MV* variables in bull and bear markets. As shown in table 8.7 (below) *MV* does not take a different distribution during bull markets. However, the significant positive correlation for *HOTN* and MV_{EBO} and the weak relationship with MV_{PE} indicates that IPO market sentiment (rather than general market sentiment proxied by *BULL*) influences misvaluation. The third potential explanation for the negative correlation of *MV* and *DELAY* is that, as a proxy for informed demand, *DELAY* has a strong negative correlation with *II%*. This explanation is consistent with the Ljungqvist, Nanda and Singh (2006) view that institutional investors participate in issues to exploit expected misvaluation generated by individual investors. This third explanation is not supported as *II%* and the measures of MV_{PE} are uncorrelated, while the relationship between *II%* and MV_{EBO} is positive and weak.

As is the case for *DELAY,* the proxy for the level of ex-ante uncertainty (*SIGMA*) also has highly significant negative correlations with *SIZE* and *II%*. As discussed in chapter 7, *SIZE* and *II%* have low but highly significant correlations supporting the argument that institutional investors are constrained, to some extent, by the size of IPOs in their investment decisions. These results indicate lower levels of ex ante uncertainty for larger IPOs as the market has access to more information about these firms. Further, ex ante uncertainty is lower for IPOs where institutional investors hold relatively more shares and are, presumably, more active in the aftermarket. This result, however, is not unequivocal as the association between *SIZE* and *II%* may be attributable to endogeneity[170].

The number of IPOs listing in the preceding quarter (*HOTN*) also has a low but highly significant correlation with *SIGMA*. This positive association is unexpected as the market should have relatively lower search costs when the number of listings prior to

[170] Only *SIZE* or *II%* is included in models 8.3 and 8.4.

the IPO is higher. The positive association for *SIGMA* and *OWN* indicates higher levels of ex ante uncertainty for issues with greater retained ownership.

Correlations in table 7.6 include the number of institutional investors identified in the Top 20 shareholder disclosures rather than the *II%* measure reported in table 8.6. Consistent with the relationship for the number of institutional investors and *OWN*, *II%* and *OWN* show a moderate negative (ρ = -0.490) and highly significant correlation. Highly significant positive correlations with mispricing and the number of institutional investors are shown in table 7.6. In contrast, table 8.6 shows no relationship with *II%* for the V_{PE} measure of mispricing.

Table 7.6 includes mean underpricing in the three months prior to listing (*HOTU*) while table 8.6 reports the number of IPOs listing in the three months preceding the prospectus date (*HOTN*). Comparison of these results reveals that both *HOTN* and *HOTU* have low positive significant associations with *OWN*. Further, both *HOTN* and *HOTU* have significant relationships with the mispricing proxies.

Table 8.7 presents results for tests of differences in distributions and median tests with data grouped by the dichotomous variables, underwritten issues (*UW*) and general market sentiment (*BULL*). Cramér's V test for nominal variables indicates that no significant association exists for *BULL* and *UW*[171].

Tests for distribution and differences in medians for the baseline model variables were presented in table 8.3 and will not be discussed again here. Differences in distributions and medians for *MP*, *MV* and *SIZE* where issues are grouped by the participation of an underwriter were presented and discussed in chapter 7. The results for *II%* confirm those for the number of institutional investors (reported in table 7.7), with underwritten issues having significantly more shares in the Top 20 shareholders disclosures held by institutions. As reported for the *HOTU* measure in table 7.7, issuers do not appear to vary their decisions to engage underwriters in response to the state of the IPO market (*HOTN*).

[171] Cramér's V = 0.051, p = 0.496

Table 8.7 <u>Differences in distribution where data are grouped by *UW* and *BULL*</u>

	RUP	*MAUP*	*DELAY*	*OWN*	*SIGMA*	*HOTN*	*SIZE*	*II%*	MP_{PE}	MP_{EBO50}	MV_{PE}	MV_{EBO50}
UW median						15		15.850				
Not *UW* median						14		1.360				
U						2 393		891				
Asym sig. (2-tail)						(0.903)		(0.000)				
Median test (2-tailed)						(0.985)		(0.000)				
BULL median	15.000	15.234	46	61.356	3.079	29	1.055	14.457	0.011	0.009	0.150	0.156
BEAR median	3.000	5.500	44	67.401	3.786	12	1.046	9.660	0.215	0.173	0.252	0.181
U	1 695	1 960	2 652	2 109	2 053	559	2 730	2 569	2 118	2 013	2 640	2 650
Asym sig. (2-tail)	(0.000)	(0.002)	(0.500)	(0.012)	(0.007)	(0.000)	(0.684)	(0.338)	(0.013)	(0.004)	(0.475)	(0.496)
Median test (2-tailed)	(0.000)	(0.021)	(0.572)	(0.008)	(0.110)	(0.000)	(0.859)	(0.110)	(0.021)	(0.213)	(0.374)	(0.594)

UW = dichotomous variable coded ‘one’ if the issue is underwritten. *BULL* = dichotomous variable coded as ‘one’ when listing date occurs during a bull market. *RUP* = [(Market price - offer price) / offer price] x 100. *MAUP* = *RUP* – return on the market index. *DELAY* = days from prospectus date to listing date. *OWN* = (shares retained by pre-IPO owners / minimum shares offered) x 100. *SIGMA* = standard deviation of 20 daily returns from listing date. MP_{PE} = offer price minus the comparable firms estimate of value. MP_{EBO50} = offer price minus the EBO model value where r_{50} is the discount rate. *II%* = the proportion of ‘top 20’ shares held by institutional investors. *HOTN* = number of industrial IPOs in the three months preceding the prospectus date. *SIZE* = size of the firm post listing relative to industry median capitalisation for the year of listing. MV_{PE} = price minus the comparable firms estimate of value. MV_{EBO50} = price minus the EBO model value where r_{50} is the discount rate.

RUP and *MAUP* follow significantly different distributions in *BULL* and bear (i.e. not *BULL*) markets, with significantly higher median underpricing during bull market phases even after initial returns are market-adjusted. As one would expect, *HOTN* is distributed differently and is significantly higher during bull markets. Results from testing the mispricing model in chapter 6 show *HOTN* is a significant factor in the explanation of *MP*. The difference in distributions for *MP* during *BULL* and bear markets is consistent with this relationship. In contrast, there are no significant differences in the distributions or medians of the *MV* measures during bull market phases. This result is surprising as the level of general market sentiment would reasonably be expected to influence the level of misvaluation.

Pre-floatation owners retain a significantly smaller proportion of shares in the company (*OWN*) when choosing to list into a bull market. This result is consistent with Ritter's (1991) argument that issuers take advantage of windows of opportunity. There is, however, no significant difference in the distributions of *DELAY* during bull markets suggesting that any investor over-optimism does not translate into shorter listing times. The distributions for *II%* do not differ during bull and bear market phases. While the distributions for *SIGMA* are significantly different in bull markets, lack of difference in the median level of *SIGMA* indicates the location of the distribution is stable. With the presentation and discussion of descriptive statistics and bivariate analyses now complete, the following sections test the extended underpricing models.

8.6.2 Mispricing and the baseline model

Model 8.1 extends the empirical baseline model via the inclusion of *MP* as an independent variable. *RUP* and *MAUP* are the dependent variables, with MP_{PE} and MP_{EBO50} included as alternate measures of mispricing. Results for these regressions are presented in table 8.8.

Coefficients for all independent variables display the predicted sign. Mispricing, in contrast to results reported by Cotter, Goyen and Hegarty (2005) and How, Lam and Yeo (2007), is not significant for the explanation of underpricing. Prior research uses scaled (rather than dollar) mispricing which suggests the results are sensitive to the changes in the specification of the *MP* variable. This issue is investigated with sensitivity testing in section 8.7.

Table 8.8 Model 8.1 regression results for 180 IPOs, 1997-2006

		Dependent variables			
Independent variables		*RUP*	*MAUP*	*RUP*	*MAUP*
constant	coefficient	-6.591	-7.797	-4.378	-5.860
	t-stat	-0.341	-0.412	0.226	-0.309
	p	(0.734)	(0.681)	(0.821)	(0.758)
DELAY	coefficient	-0.825**	-0.835**	-0.836**	-0.839**
	t-stat	-3.911	-4.045	-3.972	-4.064
	p	(0.000)	(0.000)	(0.000)	(0.000)
OWN	coefficient	0.463*	0.464*	0.451*	0.451*
	t-stat	2.375	2.434	2.328	2.376
	p	(0.037)	(0.032)	(0.042)	(0.037)
SIGMA	coefficient	6.697**	6.719**	6.460**	6.494**
	t-stat	4.613	4.729	4.461	4.576
	p	(0.000)	(0.000)	(0.000)	(0.000)
UW	coefficient	23.809*	25.296*	23.927*	25.262*
	t-stat	2.401	-2.606	2.419	2.606
	p	(0.035)	(0.020)	(0.033)	(0.020)
MP_{PE}	coefficient	-9.642	-9.678		
	t-stat	-1.267	-1.299		
	p	(0.414)	(0.392)		
MP_{EBO50}	coefficient			-11.817	-10.573
	t-stat			-1.498	-1.367
	p			(0.272)	(0.347)
AR^2		0.178**	0.165**	0.158**	0.166**
JB		1 401**	1 476**	1 414**	1 476**
	p	(0.000)	(0.000)	(0.000)	(0.000)
White's	*p*	(0.317)	(0.309)	(0.236)	(0.236)
DW		1.702	1.747	1.704	1.743
RESET	*F*	7.550**	7.476**	6.598**	7.771**
	p	(0.001)	(0.001)	(0.002)	(0.001)
SIC		10.678	10.635	10.674	10.634

** Significant at <1% (two-tailed). * Significant at < 5% (two-tailed). # Significant at < 10% (two-tailed).
RUP = [(Market price - offer price) / offer price] x 100. *MAUP* = *RUP* – return on the market index. *DELAY* = days from prospectus date to listing date. *OWN* = (shares retained by pre-IPO owners / minimum shares offered) x 100. .*SIGMA* = standard deviation of 20 daily returns from listing date. *UW* = dichotomous variable equal to one if the issue is underwritten. MP_{PE} = offer price minus the comparable firms estimate of value. MP_{EBO50} = offer price minus the EBO model value where r_{50} is the discount rate.

Compared to the results for the baseline model in table 8.4, estimation of model 8.1 provides an increase in AR^2 of about 2.5% with the MP_{PE} variable and *RUP*, but no change is observed where *MAUP* is the dependent variable. Adding the MP_{EBO50} mispricing variable to the baseline model only increases AR^2 by around 0.5%. The AR^2 is directly comparable for two models with the same dependent variable (Gujarati, 2003). As noted previously, it is not possible to test for the statistical significance of any difference as AR^2 does not have an identified distribution (Brooks, 2002).

A penalty for additional variables is used to adjust R^2 for the effects of additional variables, but this penalty may not be optimal (Brooks, 2002). Compared to that used by the AR^2, larger penalties are imposed by information criteria (such as the Akaike, Schwarz and Hannan-Quinn criteria) for additional variables (Gujarati, 2003). While no information criterion is necessarily superior to the others (Gujarati, 2003), the Schwarz information criterion (SIC) applies the harshest penalty for the inclusion of additional variables (Brooks, 2002). Therefore, the SIC provides an appropriate means for comparing the explanatory power of the baseline model and the models tested in this chapter.

When comparing models, the lower the SIC the better the model (Gujarati, 2003). As the SICs from the regressions of model 8.1 are higher than those for the baseline model (see table 8.4), the baseline model is preferred to model 8.1. Therefore, including the *MP* variable with those from the baseline model does not produce a model of underpricing with higher explanatory power. Further, RESET tests continue to indicate highly significant model specification error indicating that the inclusion *MP* does not correct the specification error.

8.6.3 Misvaluation and the baseline model

Model 8.2 extends the empirical baseline model by adding *MV* as an independent variable. MV_{PE} and MV_{EBO50} are included as the alternate measures of misvaluation. Results for these regressions are presented in table 8.9. Coefficients on the independent variables show the predicted relationships with underpricing. However, the introduction of the *MV* variables causes substantial changes to the results reported for the baseline model (table 8.4). The AR^2s are more than double those in table 8.4 and the coefficients on the *MV* variables are highly significant. Comparing the SICs from model 8.2 with those for the baseline model indicates the former as the preferred model.

Table 8.9 Model 8.2 regression results for 180 IPOs, 1997-2006

		Dependent variables			
Independent variables		*RUP*	*MAUP*	*RUP*	*MAUP*
constant	coefficient	-6.533	-7.756	-13.705	-14.789
	t-stat	-0.450	-0.561	-0.912	-1.034
	p	(0.653)	(0.575)	(0.363)	(0.303)
DELAY	coefficient	-0.286	-0.312#	-0.270	-0.289#
	t-stat	-1.819	-2.178	-1.783	-2.102
	p	(0.141)	(0.076)	(0.152)	(0.074)
OWN	coefficient	0.171	0.182	0.218	0.223
	t-stat	1.196	1.277	1.582	1.636
	p	(0.466)	(0.407)	(0.231)	(0.207)
SIGMA	coefficient	4.741*	4.825*	5.548**	5.587**
	t-stat	2.549	2.653	2.995	3.089
	p	(0.023)	(0.017)	(0.006)	(0.005)
UW	coefficient	9.675	11.594	9.646	11.348
	t-stat	1.264	1.575	1.306	1.614
	p	(0.416)	(0.234)	(0.387)	(0.217)
MV_{PE}	coefficient	38.191**	36.893**		
	t-stat	3.770	3.670		
	p	(0.000)	(0.000)		
MV_{EBO50}	coefficient			39.995**	39.313**
	t-stat			3.941	3.947
	p			(0.000)	(0.000)
AR^2		0.368 **	0.370**	0.374**	0.383**
JB		491**	563**	398**	475**
	p	(0.000)	(0.000)	(0.000)	(0.000)
White's	*p*	(0.000)	(0.005)	(0.000)	(0.000)
DW		1.785	1.804	1.775	1.826
RESET	*F*	31.316**	32.772**	26.981**	27.338**
	p	(0.000)	(0.000)	(0.000)	(0.000)
SIC		10.388	10.354	10.378	10.333

** Significant at <1% (two-tailed). * Significant at < 5% (two-tailed). # Significant at < 10% (two-tailed).
t-statistics are White-corrected.
RUP = [(Market price - offer price) / offer price] x 100. *MAUP = RUP* – return on the market index. *DELAY* = days from prospectus date to listing date. *OWN* = (shares retained by pre-IPO owners / minimum shares offered) x 100. .*SIGMA* = standard deviation of 20 daily returns from listing date. *UW* = dichotomous variable equal to one if the issue is underwritten. MV_{PE} = price minus the comparable firms estimate of value. MV_{EBO50} = price minus the EBO model value where r_{50} is the discount rate.

The *OWN* and *UW* independent variables are no longer significant. While the addition of the *MP* variable has little effect on the results for other variables from the baseline model, *MV* appears to capture some of the explanatory power attributed to *DELAY*. *DELAY* is not significant with *RUP* and has only marginal significance for the *MAUP* dependent variable. Further, the t-statistics on *SIGMA* fall and this variable is now only significant at the conventional level with MV_{PE} while they remain highly significant with MV_{EBO}.

As discussed in chapter 2, Australian underpricing models frequently report *DELAY* as significant for the explanation of underpricing. In contrast, underpricing models that include OPV_{PE} ratio as an independent variable find *DELAY* lacks significance [Cotter, Goyen & Hegarty (2005); How, Lam & Yeo (2007)]. How, Lam and Yeo (2007) attribute this result for *DELAY* to the relatively fewer available observations when the sample is constrained by the provision of earnings forecasts. As shown in table 8.4, *DELAY* is highly significant in the re-estimation of the baseline model on this reduced sample. *DELAY* remains highly significant when the mispricing variable is included in model 8.1. Therefore, the loss of significance for *DELAY* in prior research is not attributable to a constrained sample of earnings forecasters nor to the inclusion of a mispricing variable. This issue will be discussed further in chapter 9.

8.6.4 Testing model 8.3

The rationale for model 8.3 was provided in section 8.5. In this model, variables that explain misvaluation (*II%* and *BULL)* are added to model 8.1. Results for these regressions are presented in table 8.10.

Compared to the results for model 8.1, including *II%* and *BULL* results in substantial increases of around 6 to 8% to AR^2s. Although the SICs for model 8.1 indicate that the baseline model is preferred, SICs for model 8.3 indicate the inclusion of *II%* and *BULL* offers higher explanatory power than the baseline. *BULL* is highly significant and, as predicted, has a positive association with both measures of underpricing. *II%* is not significant.

Table 8.10 Model 8.3 regression results for 180 IPOs, 1997-2006

Independent variables		Dependent variables *RUP*	*MAUP*	*RUP*	*MAUP*
constant	coefficient	-24.662	-21.509	-23.886	-20.866
	t-stat	-1.072	-0.944	-1.030	-0.910
	p	(0.285)	(0.346)	(0.305)	(0.365)
DELAY	coefficient	-0.932**	-0.932**	-0.925**	-0.920**
	t-stat	-4.594	-4.638	-4.558	-4.577
	p	(0.000)	(0.000)	(0.000)	(0.000)
OWN	coefficient	0.458#	0.446#	0.449#	0.435#
	t-stat	2.21	2.183	2.186	2.136
	p	(0.055)	(0.061)	(0.060)	(0.068)
SIGMA	coefficient	7.027**	7.182**	7.183**	7.089**
	t-stat	5.164	5.149	5.087	5.067
	p	(0.000)	(0.000)	(0.000)	(0.000)
UW	coefficient	27.046*	28.343**	26.869*	28.072**
	t-stat	2.832	2.996	2.814	2.967
	p	(0.010)	(0.006)	(0.011)	(0.007)
MP_{PE}	coefficient	-4.210	-4.910		
	t-stat	-0.574	-0676		
	p	(1.000)	(1.000)		
MP_{EBO50}	coefficient			-3.089	-2.925
	t-stat			-0.397	-0.380
	p			(1.000)	(1.000)
II%	coefficient	-0.456	-0.436	-0.459	-0.442
	t-stat	-1.759	-1.700	-1.770	-1.720
	p	(0.161)	(0.182)	(0.157)	(0.175)
BULL	coefficient	33.944**	29.102**	33.813**	29.124**
	t-stat	4.070	3.523	3.976	3.456
	p	(0.000)	(0.001)	(0.000)	(0.001)
AR^2		0.236**	0.228**	0.236**	0.226**
JB		1 407**	1 429**	1 403**	1 419**
	p	(0.000)	(0.000)	(0.000)	(0.000)
White's	*p*	(0.358)	(0.310)	(0.277)	(0.247)
DW		1.839	1.841	1.840	1.842
RESET	*F*	10.260**	10.210**	10.297**	10.208**
	p	(0.000)	(0.000)	(0.000)	(0.000)
SIC		10.623	10.604	10.624	10.605

** Significant at <1% (two-tailed). * Significant at < 5% (two-tailed). # Significant at < 10% (two-tailed).
RUP = [(Market price - offer price) / offer price] x 100. *MAUP* = *RUP* – return on the market index. *DELAY* = days from prospectus date to listing date. *OWN* = (shares retained by pre-IPO owners / minimum shares offered) x 100. .*SIGMA* = standard deviation of 20 daily returns from listing date. *UW* = dichotomous variable equal to one if the issue is underwritten. MP_{PE} = offer price minus the comparable firms estimate of value. MP_{EBO50} = offer price minus the EBO model value where r_{50} is the discount rate. *II%* = the proportion of 'top 20' shares held by institutional investors. *BULL* = dichotomous variable coded as 'one' when listing date occurs during a bull market.

DELAY and *SIGMA* remain highly significant when *BULL* and *II%* are included in model 8.1. However, *t*-statistics decrease to the point of marginal significance on the *OWN* coefficients. In contrast, *t*-statistics on the *UW* coefficients increase with *UW* now highly significant where *MAUP* is the dependent variable. *II%* follows a significantly different distribution for issues with underwriter participation, and median *II%* is higher for underwritten issues compared to issues that are not underwritten (see table 8.7). Therefore, the increased significance of *UW* may be attributable to this association. The residuals for this model remain significantly non-normal and the RESET tests continue to indicate significant model specification errors. The Durban-Watson statistics are improved, showing no significant autocorrelation of residuals for the *MODEL 8.3* regressions.

8.6.5 Testing model 8.4

The rationale for model 8.4 was provided in section 8.5. In this model, variables that have been identified as significant for explaining mispricing (*HOTN* and *SIZE)* are added to model 8.2. Results for these regressions are presented in table 8.11. Compared to the results for model 8.2, the model 8.4 regressions show small increases (around 1%) for AR^2s with the MV_{PE} measure of mispricing while there is no notable change with the MV_{EBO} independent variable. Comparison of the SICs from model 8.4 and the baseline indicates that the former is the preferred model. However, the SICs for model 8.2 are lower than those of model 8.4, indicating model 8.2 is preferred.

MV_{PE} and MV_{EBO50} remain highly significant while *HOTN* does not contribute to the explanation of underpricing. *SIZE*, contrary to expectations, has a significant negative association with the measures of underpricing when MV_{PE} is the measure of misvaluation. No relationship between *SIZE* and underpricing is observed when MV_{EBO} is the measure of misvaluation.

Table 8.11 Model 8.4 regression results for 180 IPOs, 1997-2006

		Dependent variables			
Independent variables		*RUP*	*MAUP*	*RUP*	*MAUP*
constant	coefficient	1.477	-0.355	-7.880	-9.371
	t-stat	0.0939	-0.024	-0.494	-0.617
	p	(0.925)	(0.981)	(0.622)	(0.538)
DELAY	coefficient	-0.318	-0.343*	-0.299	-0.318#
	t-stat	-1.897	-2.269	-1.888	-2.220
	p	(0.119)	(0.049)	(0.121)	(0.055)
OWN	coefficient	0.242	0.244	0.285#	0.284#
	t-stat	1.863	1.897	2.240	2.257
	p	(0.128)	(0.119)	(0.053)	(0.051)
SIGMA	coefficient	4.416*	4.445*	5.488**	5.460**
	t-stat	2.337	2.426	2.871	2.950
	p	(0.041)	(0.033)	(0.009)	(0.007)
UW	coefficient	12.415	14.192	11.915	13.564
	t-stat	1.669	1.971	1.644	1.952
	p	(0.194)	(0.101)	(0.204)	(0.105)
MV_{PE}	coefficient	43.1224**	41.700**		
	t-stat	4.079	3.977		
	p	(0.000)	(0.000)		
MV_{EBO50}	coefficient			43.236**	42.529**
	t-stat			4.110	1.952
	p			(0.000)	(0.000)
HOTN	coefficient	-0.386	-0.306	-0.381	-0.309
	t-stat	-1.127	-0.895	-1.094	-0.894
	p	(0.522)	(0.744)	(0.551)	(0.745)
SIZE	coefficient	-3.557*	-3.568*	-2.455	-2.577
	t-stat	-2.642	-2.774	-1.722	-1.900
	p	(0.018)	(0.012)	(0.174)	(0.118)
AR^2		0.380**	0.380**	0.379**	0.387**
JB		575**	628**	475**	538**
	p	(0.000)	(0.000)	(0.000)	(0.000)
White's	*p*	(0.005)	(0.005)	(0.001)	(0.002)
DW		1.800	1.811	1.765	1.812
RESET	*F*	28.906**	30.727**	25.577**	26.295**
	p	(0.000)	(0.000)	(0.000)	(0.000)
SIC		10.415	10.383	10.416	10.372

** Significant at <1% (two-tailed). * Significant at < 5% (two-tailed). # Significant at < 10% (two-tailed).
t-statistics are adjusted for heteroscedasticity using White's correction.
RUP = [(Market price - offer price) / offer price] x 100. *MAUP* = *RUP* – return on the market index. *DELAY* = days from prospectus date to listing date. *OWN* = (shares retained by pre-IPO owners / minimum shares offered) x 100. *SIGMA* = standard deviation of 20 daily returns from listing date. *UW* = dichotomous variable equal to one if the issue is underwritten. MV_{PE} = price minus the comparable firms estimate of value. MV_{EBO50} = price minus the EBO model value where r_{50} is the discount rate. *HOTN* = number of industrial IPOs in the three months preceding the prospectus date. *SIZE* = size of the firm post listing relative to industry median capitalisation for the year of listing.

8.6.6 Conclusions on the extended models of underpricing

Prior to undertaking robustness tests in the following section, some conclusions are now drawn from the results presented in section 8.6. Results for model 8.1 show that extending the baseline model via the inclusion of a mispricing variable does not increase explanatory power. Results for model 8.3 show the proxy for general market sentiment (*BULL*) is responsible for substantial increases in the AR^2s reported in table 8.10. Although the dollar measure of mispricing was not significant in model 8.1, the inclusion of *BULL* in model 8.3 has the unexpected effect of decreasing the *t*-statistics on the coefficients for *MP*.

In contrast, results from the estimation of model 8.2 show that extending the baseline model by including a measure of misvaluation provides greater explanatory power. Including MV_{EBO50} as an independent variable provides a model with a better fit and lower SICs than the alternative MV_{PE} measure of misvaluation. While the proxy for IPO market sentiment does not contribute to the explanation of underpricing, the mispricing variable *SIZE* has an unexpected negative and significant association with underpricing when MV_{PE} is included as an independent variable. This result is puzzling as the coefficient on *SIZE* has a positive relationship with the MP_{PE} variable in the mispricing model. As there is little to differentiate the explanatory power for model 8.4 with respect to AR^2s or SICs, this significant coefficient on *SIZE* is consistent with V_{EBO} capturing a size effect that is not represented in V_{PE}.

8.7 Robustness testing

This section discusses the robustness tests that evaluate the sensitivity of results reported for the extended models of underpricing. Alternative measures of value, mispricing, misvaluation and market sentiment are examined.

8.7.1 Re-estimation with transformed variables

The model 8.1 regressions in table 8.8 were re-estimated with logarithmic transformations of *SIGMA* and *DELAY* (*lnSIGMA* and *lnDELAY*). These unreported results show larger *F* statistics on the RESET tests, lower AR^2s (around 3%), higher SICs and the constants become significant. The coefficient on *MP* variable continues to lack significance while the other independent variables have around the same levels of significance as those reported in table 8.8. Therefore, the lack of significance for *MP* in the explanation of underpricing is insensitive to the use of transformed variables.

Similarly, the model 8.2 regressions in table 8.9 were re-estimated with logarithmic transformations *lnSIGMA* and *lnDELAY*. These unreported results show slightly lower AR^2s (around 1%) and the SICs are slightly higher. In contrast to the results for transformed variables in model 8.1, the *F* statistics on the RESET sets are similar to those reported in table 8.9 and the transformations do not result in significant coefficients on the constants for model 8.2. The only change to the results is that *DELAY* no longer shows marginal significance with the *MAUP* dependent variables. Therefore, the significant relationship between *MV* and underpricing is insensitive to the use of transformed variables.

The transformed variables (*lnDELAY* and *lnSIGMA*) and the square root transformation of *II%* (*sqrtII%*)[172] were used to re-estimate the *MODEL 8.3* regressions. With the exception of significant coefficients on the constants, results using transformed variables (unreported) are highly consistent with those presented in table 8.10. AR^2s are slightly lower (decreases of 1–2%) and, consistent with this, SICs are slightly higher. The *F* statistics on the RESET tests increase slightly and show that the model specification errors are not attributable to non-linearities in *DELAY*, *SIGMA* or *II%*.

The model 8.4 regressions were re-estimated with the transformed variables *lnDELAY*, *lnSIGMA*, *lnHOTN*[173] and *lnSIZE*. These unreported results show higher AR^2s (around 2.5%) and lower SICs than for the results reported in table 8.11. Again, the RESET tests show the model specification errors are not attributable to non-linearities in *DELAY*,

[172] *sqrtII%* does not make a significant departure from the normal distribution (K-S = 0.840, *p* = 0.480)
[173] As shown in table 8.6, the minimum value for *HOTN* in this sample is 2 so this variable is suitable for a logarithmic transformation. *lnHOTN* is not significantly different from the normal distribution (K-S = 1.246, *p* = 0.089)

SIGMA, *HOTN* or *SIZE*. While the coefficient on MV remains highly significant, other independent variables are quite sensitive to the application of variable transformations. *lnSIZE* is significant with MV_{EBO} variable and highly significant with MV_{PE}. While *lnSIGMA* is no longer significant with $MV_{PE,}$ it remains highly significant with MV_{EBO}. In contrast, *lnDELAY* is highly significant with MV_{PE} while and marginally significant with MV_{EBO}.

In summary, re-estimation of models 8.1, 8.2 and 8.3 are insensitive to the substitution of transformed variables. Results from the re-estimation of model 8.4, in contrast, exhibit sensitivity to the transformation of non-normal independent variables.

8.7.2 Sensitivity to the proxy for value

Results reported for models 8.1, 8.2 and 8.3 are insensitive to changing the value proxy from V_{PE} to V_{EBO}. Model 8.4, however, shows some sensitivity to a change in value proxy. *SIZE* is significant with the MV_{PE} variable while it lacks significance with MV_{EBO}. *SIGMA* is significant with the MV_{PE} while it is highly significant with the MV_{EBO} variable. Where *MAUP* is the dependent variable, *DELAY* is significant at the conventional level with MV_{PE} as an independent variable while it shows only marginal significance with MV_{EBO50}. *DELAY* is not significant when *RUP* is the dependent variable. Although it lacks significance at the conventional level, *OWN* also shows some sensitivity with marginal significance indicated with the MV_{EBO} variables and none with MV_{PE}.

Therefore, it is concluded that the overall results for models 8.1, 8.2 and 8.3 are robust to the changes in the measure of value. The extended model of underpricing that includes *MV* as an independent variable (*MODEL 8.4*) does, however, show some sensitivity when the measure of value is changed. As discussed in the following section, model 8.4 is also more sensitive to changes in the specification of the *MV* variable.

8.7.3 Sensitivity to the specification of mispricing and misvaluation

Consistent with the modelling of mispricing and misvaluation in chapters 6 and 7, dollar measures of *MP* and *MV* have been used in the primary testing for this chapter. The robustness of results from the mispricing and misvaluation models to scaling the *MP* and *MV* dependent variables by offer price and market price respectively was discussed in chapters 6 and 7. While these results were robust to the changes, the same sensitivity tests are now conducted for the four extended models of underpricing.

8.7.3.1 Models 8.1 and 8.2

As shown in section 8.7.1, some results for the extended models of underpricing are sensitive to the transformation of independent variables that do not follow a normal distribution. Therefore, transformed variables are used in these robustness tests for models 8.1 and 8.2. Table E.1 presents the results for the re-estimation of model 8.1 where mispricing is specified as a percentage of offer price (*MP%*).

The AR^2s in table E.1 are lower (around 1-3%) than those reported in table 8.8 while the SICs are higher indicating that *MP%* specification does not improve the fit of the model. With the exception of the lower AR^2s and the highly significant constants in all four regressions, the results from model 8.1 are robust to the change in specification of mispricing. *MP%* is not significant in the explanation of underpricing. The significant model specification errors identified in table 8.8 are also observed in table E.1.

Table E.2 presents the results for the re-estimation of model 8.2 where misvaluation is specified as a percentage of listing price (*MV%*). The AR^2s in table E.2 are less than half those reported in table 8.8 and the SICs are higher, indicating the *MV%* specification of misvaluation results in lower explanatory power for underpricing. The results for the independent variables are sensitive to the change in specification for misvaluation.

The *t*-statistics on the *MV%* coefficients decrease and $MV_{PE}\%$ is now only marginally significant with the *RUP* dependent variable while it is significant at the conventional level with *MAUP*. $MV_{EBO}\%$ shows marginal significance with the *MAUP* dependent variable, but lacks significance with *RUP*. *lnDELAY* is now significant at the conventional level with both measures of value and both measures of underpricing. *UW* has become significant with $MV_{EBO}\%$ and marginally significant with $MV_{PE}\%$ where it is not significant in the table 8.9 regressions. Again, all four regressions have significant model specification errors. Where *SIGMA* is significant with MV_{PE} in table 8.9, *lnSIGMA* is highly significant in table E.2. Similarly, where *OWN* lacks significance with the dollar measure of misvaluation, own has marginal significance in three of the table E.2 regressions and is significant at the conventional level with $MV_{EBO}\%$ and the *MAUP* dependent variable.

While these results suggest that non-linear relationships for underpricing and some independent variables has a substantial impact on the results, they are not the cause of the sensitivity observed in table E.2. The SICs using transformed variables and scaled *MV* are higher than those for untransformed variables (results unreported) and than those reported for table 8.9. Therefore, in addition to the sensitivity of the model 8.2 results to the transformation of independent variables, they are also sensitive to the specification of misvaluation.

8.7.3.2 Models 8.3 and 8.4

Model 8.3 is re-estimated with the *MP%* independent variable and the results are presented in Table E.3. As was the case for the re-estimation of models 8.1 and 8.2, models 8.3 and 8.4 are re-estimated with transformed variables.

Results presented in table E.3 show that re-estimating *MODEL 8.3* with *MP%* as the dependent variable, *lnDELAY, lnSIGMA, sqrtII%* and *lnSIZE* produces marginally lower AR^2s compared to those in table 8.10. The SICs are a little higher and the regression constants become significant. The most notable change is the effect on the *t*-statistics for the transformed *II%* variable (*sqrtII%*) with $MP_{PE}\%$. These increase to the conventional level of significance for *RUP* and to marginal significance with *MAUP*. The *sqrtII%* variable is also marginally significant for $MP_{EBO}\%$ and *RUP*, but not with *MAUP*. The *t*-statistics for the coefficients on *UW* increase. The coefficients on *UW* were highly significant in three of the table 8.10 regressions and are now highly significant in all four regressions.

While the *t*-statistics on the coefficients for both measures of *MP%* and both the *RUP* and *MAUP* dependent variables, these continue to lack significance at the conventional level. This result is interesting in light of the significant relationship for $MP_{PE}\%$ with both measures of underpricing and for $MP_{EBO}\%$ with *RUP* reported in table E.1. Given the highly significant correlations between *MP%* and *MV%*, it could indicate that the addition of *II%* and *BULL* to model 8.1 captures some of the effect of *MP%*. Alternately, it could reflect measurement error or statistical deficiencies in the model given the sensitivity of results to the specification of mispricing. RESET tests continue to indicate highly significant model specification error.

Table E.4 presents results for model 8.4 with the *MV%* independent variable. Again, the results for *MV%* and the ratio of *V/P* are the same and only the former are reported. Compared to the results for the model 8.4 regression presented in table 8.11, the results show sensitivity to the specification of the *MV* independent variable. Most notably, the *t*-statistics on coefficients for *MV* decline to the conventional level of significance for the *MAUP* dependent variables and the coefficients are now only marginally significant with *RUP*. This result is in contrast to the highly significant bivariate relationship for *MV* and underpricing[174]. *SIZE* is no longer significant when MV_{PE} is scaled by market price, suggesting scale effects may be responsible for the significance of *SIZE* in table 8.11.

While *OWN* continues to lack significance at the conventional level, the scaled specification of *MV* results in marginal significance for the coefficients on *OWN* with $MV_{PE}\%$ while $MV_{EBO}\%$ remains marginally significant. *UW* is not significant in table 8.11 but is marginally significant in three of the table E.4 regressions and is significant at the conventional level for $MV_{EBO}\%$ where *RUP* is the dependent variable. The coefficient on *lnDELAY* is now significant with $MV_{PE}\%$ where it lacked significance in

[174] Spearman's *rho* for $MV_{PE}\%$ and *MAUP*, for example is 0.359 ($p = 0.000$) while for $MV_{EBO}\%$ and *RUP* *rho* is 0.288 ($p = 0.000$).

the table 8.11 regressions. The AR^2s reported in table E.4 are less than half those reported in table 8.11. Correspondingly, the SICs are higher. The Durban-Watson statistics fall within the indecision area for autocorrelation of residuals. The *F* statistics on the RESET tests decline but these continue to identify significant model specification errors.

As a further robustness test for the specification of *MV* and to facilitate comparison with prior literature, table E.5 (appendix E) presents results for model 8.3 with *OP/V* as the measure of mispricing. Results in table E.5 are broadly consistent with those for the dollar amount of mispricing variable in table 8.10. AR^2s from table E.5 are slightly lower (by about 1-2%) and SICs are a little higher, indicating that the table 8.10 regressions provide a better fit to the data. In contrast to the constants from table 8.10, those in table E.5 regressions are highly significant. The *OP/V* specification of mispricing is not significant.

Mispricing (specified as *OP/V*) is not significant in the explanation of underpricing. Therefore, it is concluded that lack of significance for mispricing in the explanation of underpricing does not result from the way mispricing is specified. The significant relationship for the *OP* to *V* ratio and underpricing reported by Cotter, Goyen and Hegarty (2005) and How, Lam and Yeo (2007) is not observed in this more recent sample. The relationship of *OP/V* and underpricing may be sample-period specific. Support for this notion is provided by comparing the median V_{PE} and V_{EBO} reported by Cotter, Goyen and Hegarty to that for this sample[175]. Median V_{PE} lower in this sample ($0.72 compared to $0.86) while median V_{EBO}[176] is higher ($0.87compared to $0.74). The estimation of both V_{PE} and V_{EBO} in this sample is consistent with that used by Cotter, Goyen and Hegarty.

Table E.6 presents results for model 8.4 where misvaluation is specified as *P/V*. Again, transformed variables (*lnDELAY*, *lnSIGMA*, *lnHOTN* and *lnSIZE*) are used in the model.

---

[175] How, Lam and Yeo do not report descriptive statistics for their measures of value.
[176]For consistency with Cotter, Goyen and Hegarty, the measure of V_{EBO} used here reflects zero value for imputation credits.

DELAY lacked significance with the *RUP* dependent variable and with MV_{EBO} with *MAUP* in table 8.11. Table E.6 reports *lnDELAY* is highly significant in all four regressions with misvaluation specified as *P/V*. *UW* was not significant in the table 8.11 regressions while it is now significant at the conventional level for the four regressions in table E.6. Where *SIZE* is significant at the conventional level with MV_{PE} in table 8.11, it is not significant in table E.6. Compared to those reported for the dollar measure of misvaluation, results for *OWN*, *SIGMA* and *HOTN* are unchanged. As was the case when misvaluation is specified as a percentage in table E.4, the AR^2s in table E.6 are less than half those in table 8.11 and the SICs are correspondingly higher.

Compared to the results for *MV%* in table E.4, AR^2s are higher with the *P/V* specification of misvaluation. The SICs in table E.6 are lower than those in table E.4, indicating that the *P/V* specification of misvaluation provides a better fit to the data than does *MV%*. Results reported in table E.4 are somewhat sensitive to the change in specification of misvaluation to *P/V*. Most importantly, the *t*-statistics on the P/V_{EBO} coefficients increase and misvaluation is now significant with the *RUP* dependent variable and remains significant with *MAUP*. In contrast, the t-statistics on the P/V_{PE} coefficients decrease and the V_{PE} misvaluation proxy is no longer significant. These results indicate sensitivity to the value proxy when misvaluation is specified as the ratio of price to value.

The constants from regressions including P/V_{PE} become highly significant while they continue to lack significance with P/V_{EBO}. *lnDELAY* is highly significant with *P/V*, while it is significant at the conventional level at best with the *MV%* specification of misvaluation. The *t*-statistics on *lnSIGMA* fall with P/V_{PE} and this variable is now significant at the conventional level rather than highly significant. Conversely, the *t*-statistics for *OWN* increase and this variable is significant at the conventional level with *P/V*. Therefore, in addition to the significance of the misvaluation variable being reliant on the choice of value proxy, it is also sensitive to the choice of a dollar amount over scaled specifications.

In summary, results for *MODEL 8.3* are robust to scaling the dollar amount of mispricing by offer price and to the choice of value proxy. Mispricing is not significant for the explanation of underpricing in the multivariate context. In contrast, model 8.4 shows sensitivity to changes in the specification of the misvaluation variable. Further, the significance of the misvaluation variable is sensitive to the choice of value proxy with scaled specifications of misvaluation.

8.7.4 Sensitivity to the market sentiment proxy

The sensitivity of results to the proxy for market sentiment is investigated in this section. Table E.7 (appendix E) presents results for model 8.3 with the return on the market index for the two months prior to listing (*RM2*). *RM2* was included in the robustness tests of the misvaluation model in chapter 7. AR^2s are lower (by about 2%) than those for model 8.3 shown in table 8.10 and the RESET tests continue to identify significant model specification error.

Where *BULL* was highly significant for both dependent variables with both measures of mispricing, *RM2* is highly significant only with the *RUP* dependent variable. More noteworthy are the significant coefficients on *RM2* where *MAUP* is the dependent variable. *MAUP* is the initial return adjusted for the return on the market index over the delay period. Therefore, *RM2* was not expected to add explanatory power as an independent variable with the *MAUP* dependent variable. Comparisons of the SICs from table E.7 to those from table 8.10 are also interesting. While the SICs are lower where *RUP* is the dependent variable, they are slightly higher with *MAUP*. This indicates more explanatory power for RM2 with *RUP*, while *RM2* and *BULL* contribute around the same amount to the explanatory power for underpricing where *MAUP* is the dependent variable.

As is the case for the model 8.3 results reported in table 8.10, *DELAY*, *SIGMA* and *UW* continue to be highly significant. *OWN*, *MP* and *II%* continue to lack significance at the conventional level[177]. The robustness of the model 8.3 results to re-estimation with transformed independent variables was discussed in section 8.7.1. Results for the re-estimation regressions in table E.7 with transformed independent variables (results unreported) are also robust. It is, therefore, concluded that the results of model 8.3 are largely robust to the proxy for market sentiment.

8.8 Comparing results to prior research

In this chapter, the explanatory power of the extended models of underpricing has been compared to that of the re-estimated baseline model. Table 8.12 presents a summary of the extended models for comparison with prior Australian underpricing research. Prior research typically reports logarithmic transformations for *SIGMA* and *DELAY*. Therefore, results from this study reported in table 8.12 are from regressions with transformed variables.

The baseline model has the lowest explanatory power of any model in this chapter. These AR^2s are higher than five of those reported in table 2.2 (see chapter 2) from prior Australian research [How (1996); Lee, Taylor & Walter (1996); Lee, Lee & Taylor (2003); Dimovski & Brooks (2004); How, Lam & Yeo (2007)]. While the baseline is developed from prior Australian research, it is constructed from a number of different studies and does not replicate any particular model.

Model 8.3 with mispricing specified as *OP/V* is most similar to the models estimated by Cotter, Goyen and Hegarty (2005) and How, Lam and Yeo (2007). The Cotter, Goyen and Hegarty model with *MAUP* as the dependent variable has a comparable AR^2 (20.5%) to that reported for this specification of model 8.3. Further, as their model has the same number of independent variables, SICs are less critical for meaningful comparison. Modelling raw underpricing and including the *OP* to V_{PE} ratio, How, Lam and Yeo report

177 In unreported results, model 8.3 with the $MP_{PE}\%$ measure shows *II%* is significant for explaining *RUP* and highly significant when *MAUP* is the dependent variable. *II%* continues to lack significance with the $MP_{EBO50}\%$ variable.

a substantially lower AR^2 (9.59%) than in observed for model 8.3 with this specification of mispricing (AR^2 = 22.9%).

Table 8.12 AR^2s for chapter 8 underpricing models

Panel A Baseline model

	Dependent variable	AR^2	SIC
Baseline	*RUP*	0.133	10.680
	MAUP	0.138	10.645

Panel B Extended underpricing models

		Dependent variable			
		RUP		*MAUP*	
	Value proxy	AR^2	SIC	AR^2	SIC
Model 8.1	V_{PE}	0.135	10.702	0.139	10.666
	V_{EBO}	0.139	10.696	0.142	10.663
Model 8.2	V_{PE}	0.358	10.403	0.357	10.375
	V_{EBO}	0.362	10.396	0.369	10.356
Model 8.3 (*MP*)	V_{PE}	0.221	10.642	0.205	10.632
	V_{EBO}	0.221	10.642	0.205	10.633
Model 8.3 (*MP%*)	V_{PE}	0.149	10.685	0.148	10.656
	V_{EBO}	0.143	10.692	0.142	10.663
Model 8.3 (*0P/V*)	V_{PE}	0.229	10.663	0.211	10.625
	V_{EBO}	0.223	10.640	0.208	10.628
Model 8.4 (*MV*)	V_{PE}	0.412	10.362	0.403	10.347
	V_{EBO}	0.393	10.393	0.394	10.361
Model 8.4 (*MV%*)	V_{PE}	0.148	10.686	0.150	10.684
	V_{EBO}	0.158	10.644	0.161	10.640

Of the models using transformed variables, model 8.4 with the dollar measure of misvaluation has the highest AR^2s and lowest SICs of all models in this chapter. It also has greater explanatory power than those reported in prior Australian research. How and Howe (2001) report the largest AR^2s in an Australian published study with 30.3%. This result is not directly comparable as the sample includes both industrial and mining IPOs. Further, the model includes 11 independent variables (eight of which lack significance) while model 8.4 includes seven. It is difficult to make a meaningful comparison to How and Howe as they do not report the Schwarz information criterion. Model 8.2 also has higher explanatory power than the models reported in table 2.2.

Although the *MV%* specification of misvaluation results in lower explanatory power than the dollar amount of misvaluation, model 8.4 with transformed variables and the *MV%* independent variable has higher explanatory power than 40% of the models in the extant literature [i.e. How (1996); Lee, Taylor & Walter (1996); Lee, Lee & Taylor (2003); Dimovski & Brooks (2004); How, Lam & Yeo (2007)]. Thus, comparison with prior literature indicates that the inclusion of misvaluation as an independent variable in a model of underpricing results in higher explanatory power for the model.

8.9 Conclusions

This chapter uses the insights gleaned from modelling mispricing and misvaluation to determine the extent to which issuer- and investor-related factors contribute to the explanation of underpricing. Results from re-estimating the baseline model in this chapter show stronger relationships for underpricing and the independent variables than were observed in chapter 4. Variables identified by the disaggregation of underpricing into mispricing and misvaluation are used to extend the baseline model. When included with the baseline variables in model 8.1, the dollar amount of mispricing is not significant in the explanation of underpricing. Results from robustness testing show some sensitivity to the specification of mispricing. However, no significant relationships are reported for mispricing and underpricing. It is therefore concluded that mispricing does not increase the explanatory power of the baseline model of underpricing.

In contrast, the dollar measure of misvaluation (*MV*) is highly significant when included with the baseline variables. This result is sensitive to the specification of misvaluation and, to a lesser extent, the choice of value proxy. $MV_{PE}\%$ is significant at the conventional level with the *RUP* dependent variable, while it is only marginally significant with *MAUP*. $MV_{EBO}\%$ is marginally significant with *MAUP* and lacks significance with *RUP*. Therefore, evidence for the inclusion of misvaluation in the baseline model is somewhat mixed.

Results from testing model 8.3 show that the level of general market sentiment is highly significant for the explanation of underpricing. This result is robust to the choice of value proxy, the use of transformed variables and the specification of the mispricing variable. An alternate proxy for market sentiment, *RM2*, confirms a significant relationship for market sentiment and underpricing.

The model 8.4 regression results and robustness testing show the proxy for IPO market sentiment and market capitalisation relative to industry median market capitalisation are not significant for the explanation of underpricing. The significance of the relationship between *DELAY* and underpricing is not robust to changes in the specification of misvaluation. *OWN* and *UW* also show some sensitivities. The dollar amount of misvaluation is again highly significant. The percentage measures of misvaluation are significant for the explanation of market-adjusted underpricing while the relationship with raw underpricing is weak. When misvaluation is specified as the price to value ratio, significant relationships with underpricing are only observed with the V_{EBO} proxy for value.

Comparison of the SICs confirms that the addition of the *MP* variable to the baseline model (with or without transformed variables) does not improve the explanatory power of the baseline model. However, the lower SICs from the model 8.3 regressions indicate that inclusion of *II%* and *BULL* increase the explanatory power of the baseline model. SICs from the model 8.4 regressions are lower than are reported for model 8.3 indicating the former has higher explanatory power. Model 8.4 has the lowest SICs for *MAUP*, indicating this model provides the highest explanatory power for market adjusted underpricing[178]. SICs from model 8.2 are the lowest reported for the models in this chapter where *RUP* is the dependent variable. This indicates that the baseline model with the addition of the misvaluation variable has the greatest explanatory power for raw underpricing.

Therefore, it is concluded that the disaggregation of underpricing does contribute to the explanation of the underpricing. Unexpectedly, and in contrast to the results from prior

[178] Although the *HOTN* and *SIZE* variables are not significant, the t-statistics are greater than one so they increase the AR^2 (Gujarati, 2003)

research, mispricing does not have incremental explanatory power over the baseline variables. Further, variables that are significant for the explanation of mispricing (the level of IPO market sentiment and the size of the IPO relative to industry median market capitalisation) do not contribute to the explanation of underpricing.

While there is evidence that misvaluation contributes to the explanation of underpricing, it is somewhat sensitive to the way in which misvaluation is specified. One variable that is significant in the explanation of misvaluation (the level of general market sentiment) does contribute to the explanation of underpricing. With the re-aggregation of the mispricing and misvaluation variables now complete, the next chapter offers conclusions.

CHAPTER 9
CONCLUSIONS

9.1 Introduction

This chapter presents the overall conclusions of the research and discusses the contributions made to the literature. Results from the baseline model (chapter 4) and the disaggregation of underpricing via modelling mispricing (chapter 6) and misvaluation (chapter 7) are summarised. Implications from the inclusion of additional variables based on these results in the extended models of underpricing (chapter 8) are then discussed. Section 9.2 presents conclusions about the hypotheses. Section 9.3 draws conclusions about the research question identified in chapter 1, while the contributions to knowledge are presented in section 9.4. The potential limitations of the research are identified in section 9.5 and possible areas for further research are described in the final section.

9.2 Hypothesised and empirical relationships

This section summarises the results from testing the four hypotheses that address the research sub-questions articulated in chapter 1. Reflections on these results are also presented.

9.2.1 Baseline underpricing model

Prior to assessing the contribution from the disaggregation of underpricing, it is first necessary to establish the explanatory power of a 'current state' underpricing model. Therefore, the first research sub-question asks: which factors explain underpricing in Australia? This issue is addressed by evaluating extant Australian underpricing research and identifying empirical regularities in the explanation of underpricing in an Australian sample of fixed-price industrial IPOs. The first hypothesis is:

$H0_1$ *Underpricing in Australia is unrelated to time from prospectus issue to listing, the level of retained ownership, ex ante uncertainty, the participation of an underwriter and the inclusion of options at floatation.*

The hypothesised positive relationships are confirmed for the level of ex ante uncertainty (*SIGMA*) and underwriter participation (*UW*). The time from prospectus issue to listing (*DELAY*) has the hypothesised negative coefficient but the relationship with underpricing is, in contrast to much prior research, surprisingly weak. Underwriter participation (*UW*) shows a positive relationship with underpricing. Consistent with most prior Australian underpricing research, the level of ex ante uncertainty (*SIGMA*) is significant while the level of retained ownership (*OWN*) is unrelated to underpricing.

No directional relationship for the dichotomous variable indicating packaged issues (*OPT*) was predicted. *OPT* shows a highly significant negative relationship with raw underpricing (*RUP*) and market-adjusted underpricing (*MAUP*). However, when the underpricing measure includes the return on options (*PUP*), *OPT* is no longer significant. Thus, the significant negative relationship with RUP and MAUP is attributed to measurement error (i.e. ignoring the return on options) in the dependent variable. The highest AR^2 (0.122) is reported with *MAUP* as the dependent variable while the lowest (0.100) is observed with *PUP*. The low explanatory power of the baseline model indicates further research into the underpricing phenomenon is warranted.

The previously discussed results relate to a sample of 496 industrial fixed-price IPOs that have not been screened for management earnings forecasts disclosures. As the proxies for intrinsic value rely on management earnings forecasts, the baseline model is re-estimated on a sample of 180 IPOs that disclose these data. The re-estimation of the baseline model of underpricing shows a better fit for the earnings forecaster sub-sample than was reported for the larger sample. *DELAY*, for example, is not significant at the conventional level in the full sample while it is highly significant in the sample of earnings forecasters. Earnings forecasters take less time to list than non-forecasters and the speed at which they list has a negative and significant relationship with underpricing. The re-estimated baseline provides the basis for assessing the contribution of mispricing and misvaluation variables to the explanation of underpricing.

9.2.2 Mispricing model

The second research sub-question asks: which factors determine the level of IPO mispricing? Potential explanatory factors for mispricing are identified from domestic and international underpricing literature. The second hypothesis is:

HO_2 Mispricing in Australia is unrelated to the desired post-listing ownership structure, the wealth loss to owners, the disclosed share allocation policy and the state of the IPO market.

The state of the IPO market is proxied by the number of IPOs listing in the quarter preceding the prospectus date (*HOTN*). *HOTN* has the predicted positive relationship with *MP*, indicating that issuers exploit IPO market sentiment by setting offer prices in excess of value. Proxies for the post-listing ownership structure (*HOLDERS*), wealth loss to owners (*PTN* and *DTN*) and the disclosed allocation policy (*ALLOC*) are unrelated to mispricing. These results are robust to varying the proxy for wealth loss to owners, a narrower definition of underwriter participation in the allocation process and to the replacement of the *ALLOC* variable with a dichotomous underwriter variable.

No directional relationship for the control variable, IPO market capitalisation relative to industry median market capitalisation (*SIZE*), was predicted. A highly significant positive relationship is observed, indicating that larger IPO firms have more positive mispricing. This result is robust when controls for scale effects are considered. A second control variable that proxies for growth options (*GROWTH*) is unrelated to mispricing.

Alternate proxies for value are used to determine the *MP* dependent variable. The first of these is estimated using the comparable firms PE approach while the second is derived from the Edwards-Bell-Ohlson (EBO) model. Results are reasonably insensitive to the choice of value proxy, suggesting both estimates capture intrinsic value. Further, three EBO value proxies are developed based on differing assumptions about the value of dividend imputation credits. Broadly speaking, results are insensitive to changing the assumed value of imputation credits. Therefore, dividend imputation credits do not appear to exert a significant influence on IPO mispricing.

AR^2s for the *MP* model range from 0.204 (where MP_{EBO0} is the dependent variable) to 0.253 for the MP_{PE} dependent variable. Ramsey RESET tests show no significant model specification errors for the MP_{EBO} dependent variables. There is significant model specification error for the MP_{PE} dependent variable. These errors are attributed to non-linear relationships for some of the independent variables as they are resolved when the model is re-estimated with transformed variables. While lower AR^2s are reported when the dependent variables are scaled by offer price, results for independent variables are robust to this change.

9.2.3 Misvaluation model

The third research sub-question asks: which factors determine the level of IPO misvaluation? The third hypothesis is developed from extant signalling and behavioural theories.

HO_3 *Misvaluation in Australia is unrelated to the demand for the issue, the speculative nature of the issue, the participation of institutional investors, the participation of an underwriter, the level of retained ownership, the level of mispricing and the level of IPO market sentiment.*

The results indicate that *MP* is the primary factor for the explanation of misvaluation (*MV*). Thus, issues that experience more positive mispricing also tend to be overvalued in the market. An indirect proxy for the level of oversubscription (media reports) represents the level of demand for the issue. Bivariate tests show highly significant relationships for oversubscription (*OS*) and the misvaluation proxies. However, *OS* is unrelated to misvaluation in the multivariate context. This somewhat surprising result is attributed to other independent variables subsuming the effect of oversubscription. Also contrary to expectations, the speculative nature of an issue (*SPEC*), the number of participating institutional investors (*II*), underwriting (*UW*), the level of retained ownership (*OWN*) and the level of IPO market sentiment (*HOTU*) are unrelated to misvaluation.

Robustness testing reveals that the percentage of institutional investor participation identified from the Top 20 shareholder disclosure (*II%*) is a more informative measure than the number of participating institutions (*II*) as the former is marginally significant in the explanation of *MV*. Changing the proxy for IPO market sentiment to the number of industrial IPOs in the quarter preceding prospectus date does not affect the results. However, replacing the IPO market sentiment variable with proxies for general market sentiment show sentiment does have a role to play in misvaluation. Highly significant coefficients are reported when the return on the All Ordinaries index for two months prior to listing (*RM2*) or an indicator variable for bull markets (*BULL*) is included in the model.

While the primary tests show *SIZE* exhibits the expected positive relationship with *MV*, sensitivity testing suggests that this result is attributable to scale effects. The second control variable, *GROWTH*, is unrelated to misvaluation. AR^2s for the *MV* model are high, ranging from around 0.580 for the MV_{EBO} dependent variables to 0.609 for the MP_{PE} dependent variable. Ramsey RESET tests show no significant model specification error. The high AR^2s are attributed to the strong positive correlation between *MP* and *MV* as variance inflation factors do not indicate a problem with multicollinearity. As was the case for the mispricing model, results do not depend on the value proxy used to estimate the *MV* dependent variable. With the exception of reduced *t*-statistics on the coefficients for *SIZE*, the results are also robust to scaling the dependent variable by market price.

9.2.4 Extended underpricing models

The fourth research sub-question asks: to what extent do issuer-related mispricing and investor-related misvaluation factors contribute to the explanation of underpricing? The fourth hypothesis is used to investigate the incremental explanatory power of mispricing and misevaluation variables.

HO_4 *The explanatory power of the baseline model of underpricing is not increased when mispricing and misvaluation factors are added.*

Analysis of results in chapter 8 indicates that investor-related factors are the primary drivers of underpricing.

Insights gleaned from modelling mispricing and misvaluation are incorporated into the baseline underpricing model. By definition, the sum of dollar mispricing and misvaluation equals the dollar amount of underpricing. High correlations between *MP* and *MV* are expected and observed, precluding the inclusion of both of these variables in the same model of underpricing. Therefore, the incremental contribution to the explanation of underpricing is first assessed adding either *MP* or *MV* to the baseline model. The underpricing model with mispricing is then further extended by adding two independent variables associated with misvaluation. Similarly, the underpricing model with misvaluation is further extended by adding the two significant independent variables from the mispricing model.

In contrast to expectations and to results from prior research, mispricing is not significant in the explanation of underpricing. Incorporating factors representing misvaluation with *MP* and the baseline variables in model 8.3 shows the general market sentiment (*BULL*) is highly significant while the proportion of institutional investors identified from the Top 20 disclosure (*II%*) receiving large allocations in the issue does not contribute to the explanation of underpricing. The baseline model variables (*DELAY*, *OWN*, *SIGMA* and *UW*) continue to show significant relationships that are in the expected directions, although *OWN* shows some sensitivity with different measures of *MP*.

The addition of *MV* (the dollar measure of misvaluation) to the baseline variables shows this variable has a positive and highly significant association with underpricing. The strength of the associations between the baseline variables (*DELAY*, *OWN* and *UW*) and underpricing is weakened. *OWN* and *UW* are not significant using either value proxy or either measure of underpricing. *DELAY* is significant only with V_{PE} and *MAUP* as the dependent variable. *SIGMA*, however, continues to make a significant contribution to the explanation of underpricing.

MV remains significant when the variables representing mispricing are included in model 8.4. Consistent with the lack of association between *MP* and underpricing, the representative variables for mispricing (*HOTN* and *SIZE*) are not significant. Model 8.4 is sensitive to the specification of *MV* with only weak relationships reported for *RUP* with misvaluation scaled by market price (*MV%*) and no relationship with the ratio of market price to value (*P/V*). Significant relationships are observed with *MV%* and *MAUP*, and for P/V_{EBO} and both measures of underpricing. Extended models of underpricing that include *MV* as an independent variable have greater explanatory power than those including *MP* and than those in the prior literature. Overall, the results provide evidence of a relationship between misvaluation and underpricing.

9.3 Issuer- and investor-related influences on underpricing

The primary research question in this dissertation asks: is underpricing due to mispricing (i.e. issuer-related factors), misvaluation (i.e. investor-related factors) or a combination of these? Misvaluation has a significant positive correlation with underpricing and, when measured as a dollar amount, is highly significant in multivariate models. Tests of model 8.3 reveal the proportion of institutional investors identified from the Top 20 disclosure (*II%*) is not associated with underpricing. This result suggests misvaluation is primarily attributable to individual investors. While some prior literature provides evidence that sophisticated investors are not immune to the effects of market sentiment [c.f. Verma, Baklaci & Soydemir (2008)], the majority of researchers consider that individual investors are most influenced by sentiment [c.f. Barber, Odean & Zhu (2005); Brown & Cliff (2005); Kumar & Lee (2006)]. Combined with the lack of significance for *II%*, the highly significant relationship of *BULL* and underpricing provides evidence that individuals are largely responsible for the misvaluation of Australian fixed-price industrial IPOs. Ljungqvist, Nanda and Singh (2006) argue that institutions participate in IPOs to exploit sentiment (individual) investors. Support for this argument would be provided by a positive significant coefficient on *II%*. Therefore, the results in this dissertation do not provide evidence of the exploitation of individual investors by institutional investors.

Mispricing is uncorrelated with underpricing and lacks significance in the multivariate models. Using Australian data, Cotter, Goyen and Hegarty (2005) and How, Lam and Yeo (2007) report a negative relationship for their measure of mispricing (*OP*/*V*). This relationship may be sample-period specific. Comparison of the medians for the value proxies reported in Cotter, Goyen and Hegarty shows higher V_{PE} and lower V_{EBO} for the sample in this dissertation[179]. The result for mispricing is insensitive when model 8.3 is re-estimated with this specification of *MP*. Further, while *HOTN* and *SIZE* are significant for the explanation of mispricing[180], they are unrelated to underpricing.

Therefore, the analysis conducted in this dissertation provides evidence that underpricing is determined by investor- rather than issuer- related factors in the fixed-price context. IPOs are more underpriced during bull-market phases and issuers increase mispricing when IPO markets are hot. This result is consistent with a feedback loop with issuers increasing offer price relative to value on the expectation that investors will be willing to pay relatively more for companies listing during bull markets. While the level of IPO market sentiment is significant in the explanation of mispricing, the median amount of mispricing is small (about 4%) compared to the median amount of underpricing (10-12%). This indicates that the main influence of market sentiment on underpricing is via the listing price.

9.4 Contributions

This research makes eight major contributions to the extant literature. The main contribution of the research in this dissertation is the capacity to determine separately the component of underpricing attributable to issuer-related factors and that attributable to investor-related factors. With the few exceptions discussed below, underpricing research is predicated on the notion that market price (*P*) reflects intrinsic value (*V*). The difference between offer price and *P* represents mispricing under this paradigm. When *P* is not assumed to be the appropriate measure of *V*, underpricing includes components

[179] The V_{PE} and V_{EBO} measures in this research are directly comparable to those in Cotter, Goyen & Hegarty. How, Lam and Yeo do not report descriptive statistics for their value measures.
[180] *SIZE* is significant with the MP_{PE} variable in model 8.3. This relationship is no longer observed when MP_{PE} is scaled by offer price, suggesting that the significance of *SIZE* can be attributed to scale effects.

potentially attributable to both mispricing (offer price does not equal value) and misvaluation (market price does not equal value). The Australian fixed-price setting facilitates the estimation of intrinsic value without reliance on investors' valuations or on the earnings and capital structure prior to the IPO.

The second and third main contributions of this research relate to the development and testing of the first models of mispricing and misvaluation. The mispricing model is grounded in the literature with the identification of previously hypothesised issuer-related underpricing factors. The model incorporates underpricing variables from theories of ownership and control [c.f. Brennan & Franks (1997); Pham, Kalev & Steen (2003)], the wealth loss to owners theory (Habib & Ljungqvist, 2001), agency theory (c.f. Benveniste & Spindt, 1989) and the exploitation of investor optimism (Rajan & Servaes, 1997).

The misvaluation model is also grounded in the literature with the identification of previously hypothesised investor-related underpricing factors. The model incorporates underpricing variables from asymmetric information theories [ex ante uncertainty: c.f. Beatty & Ritter (1986) and signalling: c.f. Leyland & Pyle (1977) and Carter & Manaster (1990)], noise trader behaviour (Lee, 2001) and the exploitation of individual investor sentiment by institutional investors (Ljungqvist, Nanda & Singh, 2006).

The fourth major contribution of in this dissertation is the exploration of the relationships between mispricing, misvaluation and underpricing. While five prior published studies investigate the relationship between mispricing and underpricing, the results are equivocal. A positive association between mispricing and initial returns is reported for French data (Derrien, 2005) and for US data (Purnanandam & Swaminathan, 2004). After making methodological corrections to Purnanandam and Swaminathan, Zheng (2007) reports that US issues are not mispriced. Mispricing has a negative relationship with initial return in the Australian fixed-price setting [Cotter, Goyen & Hegarty (2005); How, Lam & Yeo (2007)]. Consistent with Zheng (2007), this research provides evidence that mispricing is unrelated to underpricing.

Results in this dissertation provide the first evidence on the relationships between mispricing and misvaluation and between misvaluation and underpricing. Mispricing has a strong positive relationship with misvaluation, as expected. However, as discussed in section 9.3, investor-related factors are more important for the explanation of underpricing than issuer-related factors. The explanatory power of models including an independent variable that captures misvaluation is substantially higher than any previously published Australian underpricing study. The extant underpricing literature has its focus on issuer-related factors and, after considerable efforts in this direction, the underpricing puzzle has remained unresolved. The important implication from this dissertation is that a change of focus from issuer- to investor-related underpricing factors is required to increase understanding of the phenomenon.

Documentation of the Australian institutional setting is the fifth major contribution of this research. The identification of institutional features that facilitate the disaggregation of underpricing is important as it will assist international researchers to identify other markets where issuer- and investor-related factors can be tested separately. Further, differences in institutional settings in these markets could also contribute to the understanding of mispricing and misvaluation factors. Comparisons of the levels of mispricing in markets where earnings forecasts are mandated disclosure or where there are legal restrictions on allocation methods, for example, may be able to shed light on issuer-related underpricing factors.

The comparison of the Australian and US institutional settings contributes to the literature by identifying some implications for the application of US underpricing theories and models in the Australian context. These features include the pricing mechanism, lower underwriter incentives to misprice, lack of price support, lack of a prescribed allocation mechanism, the allocation of shares to individual investors, the clear identification of speculative issues and the voluntary provision of management earnings forecasts. Cognisance of these institutional differences will assist researchers in the selection of appropriate theories developed in other settings for testing with Australian data.

The sixth major contribution is the Australian baseline underpricing model. This model represents a consolidation of prior Australian models. The independent variables are selected for their previously demonstrated explanatory power for underpricing. The baseline model can be used in future research to assess the incremental impact of additional factors to the ‘core’ underpricing variables. The baseline model also suggests two implications for future research. First, while the relationships for other explanatory variables are insensitive to the application of a market adjustment to the dependent variable, the negative relationship of a dichotomous variable for packaged issues is a function of measurement error in the dependent variable. Second, the relationships for the independent variables are substantially stronger when the sample is limited to IPOs providing management earnings forecasts. This indicates sample composition is a crucial consideration when comparing the results of prior studies.

Evidence that market sentiment is an explanatory factor for both mispricing and misvaluation in the fixed-price setting is the seventh major contribution to the IPO literature. IPO market sentiment has a strong positive association with mispricing while general market sentiment has a strong positive association with misvaluation and underpricing. This finding has an important implication for international research in the bookbuild setting – offer prices will be higher when market sentiment is high, but some of this effect could be attributable to higher price ranges established by issuers during these periods.

The final major contribution to the underpricing literature is evidence on the role of institutional investors in the fixed-price setting. A recent stream of the underpricing literature investigates the relative roles of institutional and individual investors [c.f. Derrien (2005); Ljungqvist, Nanda & Singh (2006); Ellul & Pagano (2006)]. The fundamental premise in this literature is that institutional investors hold IPO shares in hot markets to exploit the presence of irrationally-exuberant investors after listing. This dissertation provides some contrary evidence showing that *II%* is uncorrelated with the IPO market sentiment proxy (*HOTN*). Further, *II%* follows the same distribution in bull and bear markets. Therefore, the investment decisions of institutions participating in Australian fixed-price IPOs do not appear to be affected by market sentiment. Considering this result in light of those of research conducted with bookbuild IPOs, this result suggests the pricing mechanism is important in determining the capacity for institutional investors to influence underpricing.

With discussion of the major contributions from this research now complete, the remainder of this section presents further contributions. These relate to evidence on theories of underpricing provided by tests of key variables in the mispricing and misvaluation models, the investigation of demand proxies and the participation of institutional investors. These contributions are discussed in turn below.

This research contributes to the ownership and control IPO literature. Several theories [c.f. Mello & Parsons (1998); Stoughton & Zechner (1998); Pham, Kalev & Steen (2003)] predict that post-listing ownership structure and liquidity requirements are associated with underpricing. Pham, Kalev and Steen (2003) report that Australian issuers use underpricing (i.e. they misprice) to achieve a diffuse ownership structure. In the sample used for this dissertation, the participation rate of vendors (*PTN*) and the dilution of ownership (*DTN*) have significant correlations with MP_{PE}. However, the results in chapter 6 show *DTN* and *PTN* are unrelated to mispricing in multivariate models. Further, mispricing does not have a significant correlation with the level of retained ownership indicating that issuers do not vary the level of mispricing with the proportion of the company they are selling.

A contribution is also made to the signalling literature. The level of retained ownership is hypothesised as a costly signal of firm quality [Leyland & Pyle (1977); Chemmanur & Fulghieri (1997)]. The proportion of post-listing shares retained by issuers (*OWN*) is expected to have a negative association with underpricing. While *OWN* does not contribute to the explanation of underpricing in the full sample, it has a positive coefficient in the re-estimation of the baseline using the earnings forecaster sub-sample. This result suggests the provision of an earnings forecast strengthens any signal provided by *OWN*. However, the highly significant negative correlation for *OWN* and *II%* suggests that the relationship of *OWN* and underpricing is a function of the level of institutional investor participation rather than an effective signal. *OWN* is not significant in the explanation of misvaluation.

This research also contributes to the asymmetric information theories of ex ante uncertainty where issuers and their advisors are assumed to have greater knowledge about the value of the firm. Speculative issues are expected to have higher levels of ex ante uncertainty (Beatty & Ritter, 1986). Proxies for the speculative nature of an issue include issue proceeds [c.f. Beatty & Ritter (1986); Tinic (1988)] and the number of risk factors disclosed in the prospectus [c.f. Beatty & Ritter (1986); Dalton, Certo & Daily (2003); Reber, Berry, & Toms (2005); Chang et al. (2008)]. Clear identification of speculative issues is required for Canadian IPOs. Using this direct indicator, Jog and McConomy (2003) do not find a significant relationship with underpricing. As the speculative nature of the issue is unrelated to misvaluation, results in this dissertation indicate that Australian investors do not experience greater difficulty when valuing fixed-price offers.

Evidence on potential agency conflict as a cause of underpricing is a further contribution to the literature. Ritter and Welch (2002) identify investigation of the allocation process as a potentially fruitful avenue for underpricing research. While Australian issuers are free to choose the allocation method, the data collected for this research show less than one percent of earnings forecasters specify a method not involving issuer discretion. Agency conflict arises when underwriters allocate shares to achieve their objectives rather than those of the issuer [Benveniste & Spindt (1989); Lee, Taylor & Walter (1996); Sherman (2000); Ljungqvist & Wilhelm (2002); Loughran & Ritter (2002); Sherman & Titman (2002); Jenkinson & Jones (2006); Reuter (2006); Nimalendran, Ritter & Zhang (2007)]. This agency argument predicts underwriters will allocate issues with negative mispricing to preferred clients when they participate in the allocation process. Results in this dissertation show that underwriter participation in the allocation process is unrelated to the level of mispricing. Further, underwriter participation in the issue is also unrelated to mispricing.

Finally, this research contributes specifically to Australian underpricing literature with evidence on the role of informed demand and the general level of demand in the explanation of underpricing. Much prior research has investigated the role of informed demand in the Australian context. The time from prospectus date to listing (*DELAY*) is hypothesised as a proxy for informed demand [Finn & Higham (1988); How, Izan & Monroe (1995); How (1996); Lee, Taylor & Walter (1996); How & Howe (2001); Lee, Lee & Taylor (2003); Cotter, Goyen & Hegarty (2005); How, Lam and Yeo (2007)]. It was expected that the inclusion of an institutional investor participation (*II%*) proxy with *DELAY* in model 8.3 would decrease the *t*-statistics on the latter. *DELAY*, however, continues to be highly significant.

The first potential explanation for this result is that the proportion of institutional investors represented in the Top 20 shareholder disclosures is a poor proxy for the level of informed demand for IPOs. This explanation is not compelling as *II%* is the more direct measure of institutional investor participation. The second and more plausible explanation is that *DELAY* captures more than the level of informed demand. *DELAY* could reasonably be expected to indicate the total level of demand for an issue rather than simply the level of informed demand. Results in this dissertation indicate that *II%* rather than *DELAY* should be used in future tests of Rock's winners' curse conducted in the Australian setting.

Subscription data has been examined in Singapore (Lee, Taylor & Walter, 1999), Malaysia (Jelic, Saadouni & Briston, 2001) and Europe (Jenkinson & Jones, 2006) and these results indicate a positive association for oversubscription and underpricing. Primary subscription data are not available for Australian IPOs so a proxy for excess demand (*OS*) is determined by reference to media reports. *OS* does not have a relationship with misvaluation.

9.5 Limitations

Six limitations for this research are identified in this section. These include the assumption that issuers and investors use earnings-based models to determine IPO value;

the endogeneity of the decision to provide management earnings forecasts; potential bias in management earnings forecasts; lack of an explicit assessment of growth in the value proxies; the dominance of bull market phases during the sample period; and the absence of a single industry classification system for the sample period.

The reliance on earnings-based valuation models represents a limitation for this research. At the most fundamental level, the requirement for disclosure of an earnings forecast constrains the sample size. Further, earnings-based models provide suitable proxies for value only when investors use forecast earnings in their investment decisions and when issuers use future earnings to establish offer price. As discussed in chapter 5, relatively fewer issuers disclose forecast dividends in their prospectuses. It is difficult to see how investors would be in a better position than issuers to make the reliable dividend forecasts required for implementation of the dividend discount model. Forecasting future free-cash flows would provide issuers and investors with an even greater challenge. Further, if investors are valuing IPOs with their own forecasts of future dividends or free-cash flows, such forecasts are not available for academic research.

As discussed earlier, the results for the mispricing and misvaluation models are robust to the choice of value proxy used to estimate the dependent variables. The use of two methods (V_{PE} and V_{EBO}) for establishing value protects this research from limitations arising from the reliance on one particular model. However, management earnings forecasts are the common component for both proxies for value. Therefore, any potential bias in management earnings forecasts presents a limitation for this research.

Second, IPO literature relating to the provision of management earnings forecasts reveals some systematic differences in the characteristics of earnings forecasters. Jog and McConomy (2003), for example, note the potential self-selection bias in a sample of earnings forecasters as the decision to forecast is endogenous. The comparable firms PE and EBO valuation models applied in this dissertation can only be implemented with IPOs that provide earnings forecasts. Thus, these results may not be generalisable to IPOs that do not forecast earnings.

Third, investigating the forecast accuracy of dividends and earnings disclosed in Australian prospectuses from 1984 to 1997, Brown et al. (2000) find earnings forecasts are optimistically biased. They report that 54% of earnings forecasts are 'over-predicted', 1% are correctly predicted and 45% are 'under-predicted'. Using the 1991-97 sub-sample of the Brown et al. (2000) research, How and Yeo (2001) find 59% of forecasts are over-predicted. Chapple, Clarkson and Peters (2005) also report a significant over-optimistic bias in forecast errors in their 1998 to 2002 sample.

While the majority of earnings forecasts are optimistic (i.e. 54% reported by Brown et al. and 59% reported by How and Yeo), the proportion of pessimistic forecasts (i.e. 45% in Brown et al. and 41% in How and Yeo) is non-trivial. As the forecast bias cannot be determined ex ante, it is not clear that a simple deflation of all forecasts by the mean forecast error would improve the integrity of the data. The disparate means and medians of forecast errors reported[181] suggest asymmetric distributions that will invalidate any adjustment using the average forecast errors from prior studies. Therefore, no attempt has been made to adjust management earnings forecasts when estimating value.

Fourth, the absence of firm-specific growth rates was identified in chapter 7 as a likely source of bias in the V_{PE} and V_{EBO} measures of value. It was argued that evidence of bias arising from the omission of growth in the value estimates would be provided by significant coefficients on *GROWTH* in the models of mispricing and misvaluation. These coefficients were not significant and it was concluded that growth prospects do not represent a source of bias in V_{PE} and V_{EBO}. While these results eliminate the most likely potential source of bias in the estimation of V, they do not preclude some other unidentified systematic sources of bias.

The dominance of bull market phases in this sample presents a further limitation. Brau, Ryan and DeGraw (2006) find larger IPOs and growth companies prefer to list during

[181] Chapple, Clarkson & Peters (2005) report mean and median forecast errors as 3.737 and 0.0119 respectively. Their mean and median absolute forecast errors are 4.062 and 0.381. How & Yeo (2001) report mean and median absolute forecast errors of 5.95 and 2.63, while mean and median forecast errors are -1.19 and 1.51 respectively.

bull markets, while liquidity considerations dominate bear markets. Valuation ratios for comparable firms exhibit an upward bias in bull markets (Coakley & Fuertes, 2006). Consistent results from V_{PE} and V_{EBO} proxies in the mispricing and misvaluation models suggest general overvaluation in the market does not have a substantial influence on the results in this research. As noted in chapter 7, 76% of sample issues are made during the two bull market phases. Bull market phases are present in sharemarket more than half (54%) the time (Coakley & Fuertes, 2006) and relatively fewer IPOs are offered during bear markets (see figure 3.1 – number of listings on the ASX, 1976-2006 and table 3.1). Therefore, this limitation is inherent to all underpricing studies spanning a number of market cycles.

The final limitation discussed relates to the lack of an industry classification system that spans the entire sample period. As noted in chapter 5, there are some substantial differences between the ASX industry classifications and the GICS system. These differences preclude meaningful comparison of sample firms on the basis of industry. Further, the absence of a single classification could potentially result in identical firms classified with different industry membership contingent only on listing date.

9.5 Further research

In addition to the previous recommendation for a shift in focus of underpricing research from issuer- to investor-related factors, several suggestions for further research are provided in this section. First, while underwriter participation in an issue is associated with higher underpricing, it is not associated with either mispricing or misvaluation. This result is puzzling as some researchers posit that underpricing arises as a result of underwriter self-interest [c.f. Baron (1982); Loughran & Ritter (2002)] while others consider that underwriters are engaged to provide a signal of issue quality [c.f. Beatty & Ritter (1986); Carter & Manaster (1990); Helou & Park (2001); Reber, Berry & Toms (2005); Brau & Fawcett (2006)].

Results for the underwriter variable are sensitive to the specification of misvaluation and the value proxy used to determine misvaluation. RESET tests for the extended models of underpricing report significant model misspecification, suggesting these continue to omit explanatory variables. The significant relationship between underwriter participation and the underpricing of earnings forecasters is most likely attributable to these omitted variables or to the endogenous decision to engage an underwriter. Provided the results from the disaggregation of underpricing are not driven by potential biases in earnings forecasts that invalidate the measures of value, they suggest further research into the role of underwriters in the fixed-price setting and the endogeneity of the choice to engage an underwriter as potentially fruitful.

Second, potential biases in management earnings forecasts may provide a productive avenue for future research. Comparative analysis of management forecasts and analyst forecasts and the impact of the forecast source on IPO valuation could shed light on the importance of any bias in management forecasts. Further, US research predominantly uses historic earnings and pre-listing capital structures. The prevalence of management earnings forecasts in Australian prospectuses would allow an assessment of the impact of the use of historic data in IPO valuation.

Finally, verification of the results in this research could be achieved by replication in different markets where issuers also choose the fixed-pricing mechanism. The mispricing and misvaluation models could also be tested in the bookbuild setting to gain greater understanding of the roles of both sentiment and institutional investors.

LIST OF REFERENCES

Aitken, M., Harris, F., McInnish, T. & Wong, K. 2005 'The role of the underwriter in the IPO aftermarket' Unpublished working paper, Available: http://wwwdocs.fce.unsw.edu.au/banking/seminar/2005/Underwriter_Nov05.pdf Accessed 15/11/07

Aggarwal, R. 2000 'Stabilization activities by underwriters after initial public offerings' Journal of Finance 55(3) pp.1075-1103

Aggarwal, R. 2003 'Allocation of initial public offerings and flipping activity' *Journal of Financial Economics* 58(1) pp. 111-35

Aggarwal, R., Krigman, L. & Womack, K. 2002 'Strategic IPO underpricing, information momentum, and lockup expiration selling' *Journal of Financial Economics* 66(1) pp. 105-37

Alford, A. 1992 'The effect of the set of comparable firms on the accuracy of the price-earnings valuation method' *Journal of Accounting Research* 30(1) pp. 94-108

Ali, A., Hwang, L. & Trombley, M. 2003 'Residual-income-based valuation predicts future stock returns: evidence on mispricing vs. risk explanations' *Accounting Review* 78(2) pp. 377-96

Allen, F. & Faulhaber, G. 1989 'Signalling by underpricing in the IPO market' *Journal of Financial Economics*, 23(2) pp. 303-23

Ariff, M., Prasad, D. & Vozikis, G. 2007 'Are government-linked IPOs underpriced? A three country privatization effort comparison' *International Entrepreneurship and Management Journal* 3(3) pp. 239-307

ASC, 1997 *Practice Note 67 Financial forecasts in prospectuses* Australian Securities Commission, Melbourne

ASIC, 2000 *ASIC interim guidance on market stabilisation (IROO-031)* [Online] available http://asic.gov.au Accessed 22/11/2007

ASIC, 2001 *IR 01/05 ASIC provides guidance for preparers and reviewers of prospective financial information included in disclosure document* Australian Securities and Investments Commission [Online] Available: http://www.asic.gov.au/asic/ASIC_PUB.NSF/ Accessed: 4/1/2007

ASIC, 2002 *Regulatory Guide 170 Prospective financial information* Australian Securities and Investments Commission, Melbourne

ASIC, 2005 *Market stabilisation – ASIC policy proposal* [Online] available http://asic.gov.au Accessed 22/11/2007

ASIC 2008 *What to look for in the prospectus* [Online] available: http://www.fido.gov.au/fido/fido.nsf/byheadline/Guide+to+reading+a+prospectus Accessed 19/9/2008

ASX 2002 *Guidance Note 11 Restricted securities and voluntary escrow* [Online] available: http://www.asx.com.au/guidance/gn11_restricted_securities.pdf Accessed 19/9/2008

ASX 2005 *ASX Listing Rules, Chapter 9, Restricted securities* [Online] available: http://www.asx.com.au/ListingRules/chapters/chapter09.pdf Accessed 19/9/2008

ASX 2006a *Disclosure around bookbuilds – ASX regulatory policy unit public consultation paper* [Online] available http://asx.com.au Accessed 6/1/2007

ASX, 2006b *ASX and FINSIA combine to extend equity research coverage for ASX-listed companies* ASX news release, 14 November [Online] Available: http://www.asx.com.au Accessed: 15/12/2008

ASX, 2007a Glossary of sharemarket terms [Online] Available: http://www.asx.com.au/webmcq/servlet/com.webmcq.glossary Accessed 8/12/2007

ASX, 2007b *LIC premiums/discounts to NTA* 30 June 2007 [Online] Available: http://www.asx.com.au/LMI Accessed 11/8/2007

ASX, 2008a *Australian market overview* [Online] Available: http://www.asx.com.au/about/asx/history/market_overview.htm Accessed 25/3/2008

ASX, 2008b *Historical market statistics* [Online] Available: http://www.asx.com.au/research/market_info/historical_equity_data.htm Accessed 25/3/2008

ASX, 2008c *S&P/ASX index overviews* Available: http://www.asx.com.au/research/indices/description.htm Accessed 13/05/08

Bae, S., Klein, D. & Bowyer, J. 1999 'Determinants of underwriter participation in initial public offerings of common stock: An empirical study' *Journal of Business Finance & Accounting* 26(5&6) pp. 595-619

Baker, M. & Wurgler, J. (2006) 'Investor sentiment and the cross-section of stock returns' *Journal of Finance* 61(4) pp. 1645-80

Balatbat, M., Taylor, S. & Walter, T. 2004 'Corporate governance, insider ownership and operating performance of Australian initial public offerings' *Accounting and Finance* 44(3) pp. 299-328

Barber, B. & Odean, T. 2008 'All that glitters: The effect of attention and news on the buying behavior of individual and institutional investors' *Review of Financial Studies* 21(2) pp. 785-818

Barber, B., Odean, T. & Zhu, N. 2005 'Do noise traders move markets?' SSRN [Online] available: http://papers.ssrn.com/paper.taf?abstract_id=869827 Accessed 24/02/2006

Barberis, N., Shleifer, A. & Vishny, R. 1998 'A model of investor sentiment' *Journal of Financial Economics* 49(3) pp. 307-43

Barberis, N. & Thaler, R. 2003 'A survey of behavioral finance' in *Handbook of Economics and Finance* Constaninides, Harris & Stulz (editors) [Online] available: http://badger.som.yale.edu/faculty/ncb25/ch18_6.pdf Accessed 24/03/2005

Barker, R. 2001 *Determining value: valuation models and financial statements* Prentice Hall Financial Times, Harlow, England

Barniv, R. & Myring, M. 2006 'An international analysis of historic and forecast earnings in accounting-based valuation models' *Journal of Business Finance & Accounting* 33(7) & (8) pp. 1087–1109

Baron, D. 1982 'A Model of the Demand for Investment Banking Advising and Distribution Services for New Issues' *Journal of Finance* 37(4) pp. 955-76

Barry, C. 1989 'Initial Public Offering Underpricing: The Issuer's View--A Comment' *Journal of Finance* 44(4) pp. 1099-1103

Barth, M. & Clinch, G. 2005 'Scale effects in capital markets-based accounting research' [Online] London Business School Accounting Available: http://ssrn.com/abstract=201228 Accessed 25/06/08

Barth, M. & Kallapur, S. 1996 'The effects of cross-sectional scale differences on regression results in empirical accounting research' *Contemporary Accounting Research* 13(2) pp. 527-67

Bayley, L., Lee, P. & Walter, T. 2006 'IPO flipping in Australia: cross-sectional explanations' *Pacific-Basin Finance Journal* 14(4) pp. 327-48

Beatty, R. & Ritter, J. 1986 'Investment banking, reputation, and the underpricing of initial public offerings' *Journal of Financial Economics* 15(1-2) pp. 213-32

Bedi, J. & Tennant, P. 2002 'Dual listed companies' *Reserve Bank Bulletin of Australia* October 2002 [Online] Available http://www.rba.gov.au/PublicationsAndResearch/Bulletin/bu_oct02/bu_1002_2.pdf Accessed 8/12/2007

Benveniste, L. & Busaba, W. 1997 'Bookbuilding vs. Fixed Price: An Analysis of Competing Strategies for Marketing' IPOs *The Journal of Financial and Quantitative Analysis* 32(4) pp. 383-403

Benveniste, L. & Spindt, P. 1989 'How investment bankers determine the offer price and allocation of new issues' *Journal of Financial Economics* 24(2) pp. 343-61

Benveniste, L. & Wilhelm, W. 1990 'A comparative analysis of IPO proceeds under alternative regulatory environments' *Journal of Financial Economics* 28(1-2) pp. 173-207

Berkman, H., Bradbury, M. & Ferguson, J. 2000 'The accuracy of price-earnings and discounted cash flow methods of IPO equity valuation' *Journal of International Financial Management and Accounting* 11(2) pp. 71-83

Bhojraj, S. & Lee, C. 2002 'Who is my peer? 'A valuation-based approach to the selection of comparable firms' *Journal of Accounting Research* 40(2) pp. 407-39

Bilson, C., Heaney, R., Powell, J. & Shi, J. 2007 'The decision to voluntarily provide an IPO prospectus earnings forecast' *Applied Financial Economics Letters* 3(2) pp. 99-102

Boatsman, J. & Baskin, E. 1981 'Asset valuation with incomplete markets' *The Accounting Review* 56(1) pp. 38-53

Bodie, Z., Ariff, M., da Silva Rosa, R., Kane, A. & Marcus, A. 2007 *Investments* McGraw-Hill Irwin, Boston

Booth, J & Chua, L. 1996 'Ownership dispersion, costly information, and IPO underpricing' *Journal of Financial Economics* 41(2) pp. 291-310

Bowman, R. & Graves, L. 2004 'A test of the usefulness of comparable company analysis in Australia' *Accounting Research Journal* 17(special issue) pp. 121-35

Brailsford, T., Handley, J. & Maheswaran, K. 2008 'Re-examination of the historical risk premium in Australia' *Accounting & Finance* 48(1) pp. 73-97

Brailsford, T., Heaney, R. Shi, J. 2001 The cyclical behaviour of the IPO [initial public offerings] market in Australia *Accounting Research Journal* 14(1) pp. 17-34

Brailsford, T., Heaney, R. Shi, J. 2004 'Modelling the behavior of the new issue market' *International Review of Financial Analysis* 13(2) pp. 119-32

Brau, J. & Fawcett, S. 2006 ‘Initial public offerings: an analysis of theory and practice’ *Journal of Finance* 61(1) pp. 399-436

Brau, J., Ryan, P. & DeGraw, I. 2006 ‘Initial public offerings: CFO perceptions’ *Financial Review* 41(4) pp. 483-511

Brealey, R. & Myers, S. 1996 *Principles of corporate finance* 5th ed. McGraw-Hill, New York

Brennan, M. & Franks, J. 1997 ‘Underpricing, ownership and control in initial public offerings of equity securities in the UK’ *Journal of Financial Economics* 45(3) pp. 391-413

Brooks, C. 2002 *Introductory econometrics for finance* Cambridge University Press, Cambridge

Brown, P., Clark, A., How, J. & Lim, K. 2000 ‘The accuracy of management dividend forecasts in Australia’ *Pacific-Basin Finance Journal* 8(3-4) pp. 309-31

Brown, G. & Cliff, M. 2005 ‘Investor sentiment and asset valuation’ *Journal of Business* 78(2) pp. 405-40

Brown, S., Lo, K. & Lys, T. 1999 ‘Use of R^2 in accounting research: measuring changes in value relevance over the last four decades’ *Journal of Accounting and Economics* 28(2) pp. 523-62

Busaba, W. 2006 ‘Bookbuilding, the option to withdraw, and the timing of IPOs’ *Journal of Corporate Finance* 12(2) pp. 159-86

Cassia, L., Guidici, G., Paleari, S. & Redondi, R. 2004 ‘IPO underpricing in Italy’ *Applied Financial Economics* 14(3) pp. 179-94

Carter, R. & Manaster, S. 1990 ‘Initial Public Offerings and Underwriter Reputation’ *Journal of Finance* 45(4) pp. 1045-67

Centre for Corporate Law and Securities Regulation 1998 Corporate Law Electronic Bulletin Number 5, January [Online] available http:cclsr.law.unimelb.edu.au/bulletins/archive/Bulletin005.htm Accessed 6/1/2007

Chalk, A. & Peavy, J. 1987 ‘Initial public offerings: daily returns, offering types and the price effect’ *Financial Analysts Journal* 43(5) pp. 65-9

Chang, X., Gygax, A., Oon, E. & Zhang, H. 2008 ‘Auditor quality, auditor compensation and initial public offering underpricing’ *Accounting and Finance* 48(3) pp. 391-416

Chapple, L., Clarkson, P. & Peters, C. 2005 'Impact of the *Corporate Law Economic Reform Program Act* 1999 on initial public offering prospectus earnings forecasts' *Accounting and Finance* 45(1) pp. 67-94

Chemmanur, T. & Fulghieri, P. 1997 'Why include warrants in new equity issues? A theory of unit IPOs' *Journal of Financial & Quantitative Analysis* 32(1) pp. 1-24

Chemmanur, T. & Krishnan, K. 2008 'Heterogeneous beliefs, short sale constraints, and the economic role of the underwriter in IPOs' EFA 2008 Athens Meetings Paper, Available: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=890859 Accessed 17/10/08

Chen, HC. & Ritter, J. 2000 'The seven percent solution' *Journal of Finance* 55(3) pp. 1105-31

Chiang, Qian & Sherman, A. 2008 'Endogenous entry and partial adjustment in IPO auctions: are institutional investors better informed?' SSRN [Online] available: http://ssrn.com/abstract=990929 Accessed 14/10 2008

Chowdhry, B. & Sherman, A. 1996 'The winner's curse and international methods of allocating initial public offerings' *Pacific-Basin Finance Journal* 4(1) pp. 15-30

Clarkson, P., Dontoh, A., Richardson, G. & Sefcik, S. 1992 'The voluntary inclusion of earnings forecasts in IPO prospectuses' *Contemporary Accounting Research* 8(2) pp. 601-26

Coakes, S., Steed, L. & Dzidic, P. 2006 *SPSS version 13.0 for Windows - Analysis without anguish* John Wiley & Sons Australia Ltd, Milton Queensland

Coakley, J. & Fuertes, A. 2006 'Valuation ratios and price deviations from fundamentals' *Journal of Banking & Finance* 30(6) pp. 2325-46

Cotter, J., Goyen, M. & Hegarty, S. 2005 'Offer pricing of Australian industrial initial public offers' *Accounting and Finance* 45(1) pp. 95-125

Cook, D., Kieschnick, R. and Van Ness, R. 2006 'On the marketing of IPOs' *Journal of Financial Economics* 82(1) pp. 35-61

Curtis, A. & Fargher, N. 2003 'A comparison of residual income and comparable firm valuation of initial public offerings' University of New South Wales Working paper [Online] Available: wwwdocs.foe.unsw.edu.au/accounting/news/conf_iqm2004/curtis_draft.pdf Accessed 8/8/8

Dalton, D., Certo, S. & Daily, C. 2003 'Initial public offerings as a web of conflicts of interest: an empirical assessment' *Business Ethics Quarterly* 13(3) pp. 289-314

Damodaran, A. 2001 *Corporate Finance: theory and practice* 2nd Edition, John Wiley & Sons, Inc, New York

Daniel, K., Hirshleifer, D. & Subrahmanyam, A. 1998 'Investor Psychology and Security Market under- and Overreactions' *Journal of Finance* 53(6) pp. 1839-85

da Silva Rosa, R., Velayuthen, G. & Walter, T. 2003 'The sharemarket performance of Australian venture capital-backed and non-venture capital-backed IPOs' *Pacific-Basin Finance Journal* 11(2) pp. 197-218

Datar, S., Feltham, G. & Hughes, J. 1991 'The role of audits and audit quality in valuing new issues' *Journal of Accounting and Economics* 14(1) pp. 3-49

Dechow, P., Hutton, A. & Sloan, R. 1999 'An empirical assessment of the residual income valuation model' *Journal of Accounting and Economics* 26(1-3) pp. 1-34

Derrien, F. 2005 'IPO pricing in 'hot' market conditions: who leaves money on the table?' *Journal of Finance* 60(1) pp. 487-521

Dimovski, W. & Brooks, R. 2004 'Initial Public Offerings in Australia 1994 to 1999, Recent Evidence of Underpricing and Underperformance' *Review of Quantitative Finance & Accounting* 22(3) pp. 179-98

Dimovski, B. & Brooks, R. 2005 'Dividend forecasts and dividend payments of initial public offers – when zero means zero and no comment most likely also means zero' *Applied Financial Economic Letters* 1(3) pp. 139-41

Downes, D. & Heinkel, R. 1982 'Signaling and the valuation of unseasoned new issues' *Journal of Finance* 37(1) pp. 1-10

Draho, J. 2004 *The IPO decision: Why and how companies go public* Edward Elgar, Cheltenham, UK

Durand, R., Woodliff, D. & Richards, O. 2003 'Spin-offs in Australia' *Accounting Research Journal* 16(2) pp. 90-101

Easton, P. & Sommers, G. 2003 'Scale and the scale effect in market-based accounting research' *Journal of Business Finance & Accounting* 30 (1&2) pp. 25-55

Ellis, K., Michaely, R. & O'Hara, M. 1999 'A guide to the initial public offering process' [Online] Available http://forum.johnson.cornell.edu/faculty/michaely/Guide.pdf Accessed 18/8/2006

Ellis, K., Michaely, R. & O'Hara, M. 2000 'When the underwriter is the market maker: An examination of trading in the IPO aftermarket' *Journal of Finance* 55(3) pp. 1039-74

Ellul, A. & Pagano, M. 2006 'IPO underpricing and after-market liquidity' *Review of Financial Studies* 19(2) pp. 381-421

Fama, E. & French, K. 2004 'New lists: fundamentals and survival rates' *Journal of Financial Economics* 73(2) pp. 229-269

Finn, F. & Higham, R. 1988 'The performance of unseasoned new equity issues-cum-stock exchange listings in Australia' *Journal of Banking & Finance* 12(3) pp. 333-51

Finnerty, J. & Emery, D. 2004 'The value of corporate control and the comparable company method of valuation' *Financial Management* 33(1) pp. 91-9

Firth, M. 1998 'IPO profit forecasts and their role in signalling firm value and explaining post-listing returns' *Applied Financial Economics* 8(1) pp. 29-39

Float.com.au (2007) [Online] Available http://www.float.com.au/scgi-bin/prod/dl.cgi Accessed 26/4/2007

Francis, J., Olsson, P. & Oswald, D. 2000 'Comparing the accuracy and explainability of dividend, free cash flow, and abnormal earnings equity value estimates' *Journal of Accounting Research* 38(1) pp. 45-70

Frankel, R. & Lee, C. 1998 'Accounting valuation, market expectation, and cross-sectional stock returns' *Journal of Accounting and Economics* 25(3) pp. 283-319

Gale, I. & Stiglitz, J. 1989 'The informational content of initial public offerings' *Journal of Finance* 44(2) pp. 469-77

Geczy, C., Musto, D. & Reed, A. 2002 'Stocks are special too: an analysis of the equity lending market' *Journal of Financial Economics* 66(1-2) pp. 241-69

Gompers, P. & Metrick, A. 2001 Institutional investors and equity prices *Quarterly Journal of Economics* 116(1) pp. 229-259.

Greenwald, B., Kahn, J., Sonkin, P. & Van Biema, M. 2001 *Value investing: from Graham to Buffet and beyond* John Wiley & Sons, Inc., New York

Grinblatt, M. & Hwang, C. 1989 'Signalling and the Pricing of New Issues' *Journal of Finance* 44(2) pp. 393-420

Gujarati, D. 2003 *Basic econometrics* 4th Edition, McGraw-Hill, Boston

Habib, M. & Ljungqvist, A. 2001 'Underpricing and entrepreneurial wealth losses in IPOs: theory and evidence' *The Review of Financial Studies* 14(2) pp. 433-458

Hair, J., Anderson, R., Tatham, R. & Black, W. 1998 *Multivariate data analysis* 5th Edition, Prentice Hall, New Jersey

Hegarty, S. 1999 *Fundamental analysis of the offer price for Australian initial public offers* Unpublished thesis submitted for B.Com.(Hons.), University of Southern Queensland

Helou, A. & Park, G. 2001 'Is there a signalling effect of underwriter reputation?' *Journal of Financial Research* 24(1) pp. 27-43

Helwege, J. & Liang, N. 2004 'Initial Public Offerings in Hot and Cold Markets' *Journal of Financial & Quantitative Analysis* 39(3) pp. 541-69

How, J. 1996 'Voluntary forecast disclosure and the underpricing of IPOs' *Accounting Research Journal* 9(1) pp. 17-28

How, J. 2000 'Initial and Long-Run Performance of Mining IPOs in Australia' *Australian Journal of Management* 25(1) pp. 95-118

How, J. & Howe, J. 2001 'Warrants in Initial Public Offerings: Empirical Evidence' *Journal of Business* 74(3) pp. 433-57

How, J., Izan, H. & Monroe, G. 1995 'Differential information and the underpricing of initial public offerings: Australian evidence' *Accounting and Finance* 35(1) pp. 87-105

How, J., Lam, J. & Yeo, J. 2007 'The use of the comparable firm approach in valuing Australian IPOs' *International Review of Financial Analysis* 16(2) pp. 99-115

How, J. & Low, J. 1993 Fractional ownership and underpricing: signals of IPO firm value *Pacific-Basin Finance Journal* 1(1) pp. 47-65

How, J. & Yeo, J. 2000 'The pricing of underwriting services in the Australian capital market' *Pacific-Basin Finance Journal* 8(3-4) pp. 347-373

How, J. & Yeo, J. 2001 'The impact of forecast disclosure and accuracy on equity pricing: the IPO perspective' *Journal of Accounting, Auditing & Finance* 16(4) pp. 401-25

Ibbotson, R., Sindelar, J. & Ritter, J. 1988 'Initial public offerings' *Journal of Applied Corporate Finance* 1(2) pp. 37-45

Jackson, A. 2003 'The aggregate behaviour of individual investors' SSRN [Online] available: http://ssrn.com/abstract=53942 Accessed 21/11/2006

James, K., How, J. & Izan, H. 1995 'An analysis of the pricing processes of Australian unit trust IPOs' *Pacific-Basin Finance Journal* 3(2-3) pp. 285-301

Jelic, R., Saadouni, B. & Briston, R. 2001 'Performance of Malaysian IPOs: underwriters reputation and management earnings forecasts' *Pacific-Basin Finance Journal* 9(5) pp. 457-86

Jenkinson, T. & Jones, H. 2004 'Bids and allocations in European IPO bookbuilding' *Journal of Finance* 59(5) pp. 2309-38

Jenkinson, T. & Jones, H. 2006 'IPO pricing and allocation: a survey of the views of institutional investors' Unpublished working paper, Available: http://ssrn.com/abstract=891396 Accessed 10/11/07

Jenkinson, T. & Ljungqvist, A. 2001 *Going public: the theory and evidence on how companies raise equity finance* Oxford University Press, Oxford, 2nd edition

Jensen, M. 2005 'Agency Costs of Overvalued Equity', *Financial Management* 34(1) pp. 5-19

Jog, V. & McConomy, B. 2003 'Voluntary disclosure of management earnings forecasts in IPO prospectuses' *Journal of Business Finance & Accounting* 30(1&2) pp. 125-67

Jones, S., Megginson, W., Nash, R. & Netter, J. 1999 'Share issue privatizations as financial means to political and economic ends' *Journal of Financial Economics* 53(2) pp. 217-53

Kandel, S., Sarid, O. & Wohl, A. 2001 'Do investors prefer round stock prices? Evidence from Israeli IPO auctions' *Journal of Banking & Finance* 25(8) pp. 1543-51

Kennedy, P. 1985 *A guide to econometrics* 2nd Edition, Basil Blackwell, Oxford

Kim, M. & Ritter, J. 1999 'Valuing IPOs' Journal of Financial Economics 53(3) pp. 409-37

Klein, A. 1996 'Can investors use the prospectus to price initial public offerings' *Journal of Financial Statement Analysis* 2(1) pp. 23-39

Kmenta, J. 1971 *Elements of econometrics* The Macmillan Company, New York

Krupa, V. 2006 'The pricing of insurer demutualization initial public offerings' *Journal of Risk & Insurance* 73(3) pp. 439-68

Kumar, A. & Lee, C. 2006 'Retail investor sentiment and return comovements' *Journal of Finance* 61(5) pp. 2451-86

Law, L. & Callum, C. 1997 'Is there an obligation to disclose earnings forecasts in IPO prospectuses?' *Accounting Research Journal* 10(1) pp. 44-58

Lee, C. 1996 'Measuring wealth' *CA Magazine* 129(3) pp. 32-7

Lee, C. 2001 'Market efficiency and capital market research: a discussion of "capital market research in accounting by S.P. Kothari"' *Journal of Accounting and Economics* 31 (1-3) pp. 233-53

Lee, M., Lee, P. & Taylor, S. 2003 'Unit initial public offerings: Staged equity or signalling mechanism?' *Accounting and Finance* 43(1) pp. 63-85

Lee, C., Myers, J. & Swaminathan, B. 1999 'What is the intrinsic value of the Dow?' *Journal of Finance* 54(5) pp. 1693-1741

Lee, P., Stokes, D., Taylor, S. & Walter, T. 2003 'The association between audit quality, accounting disclosures and firm-specific risk: evidence from initial public offerings' *Journal of Accounting and Public Policy* 22(5) pp. 377-400

Lee, P., Taylor, S. & Walter, T. 1996 'Australian IPO pricing in the short and long run' *Journal of Banking & Finance* 20(7) pp. 1189-1210

Lee, P., Taylor, S. & Walter, T. 1999 'IPO underpricing explanations: Implications from investor application and allocation schedules' *Journal of Financial and Quantitative Financial Analysis* 34(4) pp. 425-44

Leung, J. & Menyah, K. 2006 'Issuer-oriented underpricing costs in initial public offers: evidence from Hong Kong' *Journal of Corporate Finance* 12(5) pp. 897-905

Leyland, H. & Pyle, D. (1977) Informational asymmetries, financial structure, and financial intermediation *Journal of Finance* 32(2) pp. 371-87

Ljungqvist, A. 2004 'IPO Underpricing: A Survey' in *Handbook in corporate finance: Empirical corporate finance*, B. Espen Eckbo (ed) [Online] Available http://papers.ssrn.com/sol3/papers.cfm?abstract_id=609422 Accessed 5/11/2004

Ljungqvist, A., Nanda, V. & Singh, R. 2006 'Hot markets, investor sentiment, and IPO pricing' *Journal of Business* 79(4) pp. 1667-1702

Ljungqvist, A. & Wilhelm, W. 2002 'IPO allocations: discriminatory or discretionary?' *Journal of Financial Economics* 65(2) pp. 167-201

Lo, K. 2005 'The effects of scale differences on inferences in accounting research: coefficient estimates, tests of incremental association and relative value relevance' Unpublished working paper, [Online] Available: http://ssrn.com/abstract Accessed 5/01/09

Lo, K. & Lys, T. 2000 'The Ohlson model: contribution to valuation theory, limitations, and empirical applications' *Journal of Accounting, Auditing & Finance* 15(3) pp. 337-67

Logue, D. 1973 'On the pricing of unseasoned equity issues: 1965-1969' *Journal of Financial and Quantitative Analysis* 8(1) pp. 91-103

Loughran, T. 2002 'The changing nature of the initial public offering market' *Journal of Psychology and Financial Markets* 3(1) pp. 23-8

Loughran, T. & Ritter, J. 2002 'Why don't issuers get upset about leaving money on the table in IPOs?' *Review of Financial Studies* 15(2) pp. 413-43

Loughran, T., Ritter, J. & Rydqvist, K. 1994 'Initial public offerings: international insights' *Pacific-Basin Finance Journal* 2(2/3) pp. 165-99

Lowry, M. 2003 'Why does IPO volume fluctuate so much?' *Journal of Financial Economics* 63(1) pp. 3-40

Lowry, M. & Schwert, G. 2004 'Is the IPO pricing process efficient?' *Journal of Financial Economics* 71(1) pp. 3-26

Lundholm, R. & Sloan, R. 2004 *Equity valuation and analysis* McGraw-Hill Irwin, New York

Luplau, D. 1998 *Understanding a prospectus: a guide to buying value* 2nd ed. Wrightbooks, North Brighton, Vic.

Mello, A. & Parsons, J. 1998 'Going public and the ownership structure of the firm' *Journal of Financial Economics* 49(1) 79-109

Mendenhall, W., Reinmuth, J. & Beaver, R. 1982 *Statistics for management and economics* 6th ed. PWS-Kent Publishing Company, Boston

Merton, R. 1987 'A simple model of capital market equilibrium with incomplete information' *Journal of Finance* 62(3) pp. 483-510

Miller, E. 1977 'Risk, uncertainty and divergence of opinion' *Journal of Finance* 32(4) pp. 1151-68

Mohan, N. & Chen, C. 2001 'Information content of lock-up provisions in initial public offerings' *International Review of Economics & Finance* 10(1) pp. 41-59

Muscarella, C. & Vetsuypens, M. 1989 'A simple test of Baron's model of IPO underpricing' *Journal of Financial Economics* 24(1) 125-35

Nimalendran, M., Ritter, J. & Zhang, D. 2007 'Do today's trades affect tomorrow's IPO allocations?' *Journal of Financial Economics* 84(1) pp. 87-109

Nofsinger, J. 2005 'Social Mood and Financial Economics' *Social Mood and Financial Economics* 6(3) pp. 144-60

Nofsinger, J. & Sias, R. 1999 'Herding and feedback trading by institutional and individual investors' *Journal of Finance* 54(6) pp. 2263-95

Ogden, J., Jen, F. & O'Connor, P. 2003 *Advanced corporate finance – policies and strategies* Prentice Hall, Upper Saddle River, New Jersey

Ohlson, J. 1995 'Earnings, book value, and dividends in security valuation' *Contemporary Accounting Research* 11(1) pp. 661-687

Offerman, T. & Sonnemans, J. 2004 'What's causing overreaction? An experimental investigation of recency and the hot-hand effect' *Scandinavian Journal of Economics* 106(3) pp. 533-54

Paudyal, K., Saadouni, B. & Briston, R. 1998 'Privatisation initial public offerings in Malaysia: Initial premium and long-term performance' *Pacific-Basin Finance Journal* 6(5) pp. 427-51

Penman, S. 2007 *Financial statement analysis and security valuation* 3rd Ed, McGraw-Hill Irwin, New York

Penman, S. & Sougiannis, T. 1998 'A comparison of dividend, cash flow and earnings approaches to equity valuation' *Contemporary Accounting Research* 15(3) pp. 343-83

Pham, P., Kalev, P. & Steen, A. 2003 'Underpricing, stock allocation, ownership structure and post-listing liquidity of newly listed firms' *Journal of Banking & Finance* 27(5) pp. 919-947

Purnanandam, A. & Swaminathan, B. 2004 'Are IPOs really underpriced?' *Review of Financial Studies* 17(3) pp. 811-48

Rajan, R. & Servaes, H. 1997 'Analyst following of initial public offerings' *Journal of Finance* 52(2) pp. 507-29

RBA 1997 'Privatisation in Australia' *Reserve Bank Bulletin of Australia* December 1997 [Online] Available http://www.rba.gov.au/PublicationsAndResearch/Bulletin/bu_dec97/bu_1297_2.pdf Accessed 8/12/2007

RBA 1999 'Demutualisation in Australia' *Reserve Bank Bulletin of Australia* January 1999 [Online] Available http://www.rba.gov.au/PublicationsAndResearch/Bulletin/bu_jan99/bu_0199_1.pdf Accessed 8/12/2007

Reber, B., Berry, B. & Toms, S. 2005 'Firm resources and quality signalling: evidence from UK initial public offerings' *Applied Financial Economics* 15(8) pp. 575-86

Reuter, J. 2006 'Are IPO allocations for sale? Evidence from mutual funds' *Journal of Finance* 61(5) pp. 2289-2324

Ritter, J. 1984(a) 'The "Hot Issue" Market of 1980' *Journal of Business* 57(2) pp. 215-40

Ritter, J. 1984(b) 'Signaling and the valuation of unseasoned new issues: a comment' *Journal of Finance* 39(4) pp. 1231-7

Ritter, J. 1991 'The long-run performance of initial public offerings' *Journal of Finance* 46(1) pp. 3-27

Ritter, J. 2003 'Differences between European and American IPO Markets' *European Financial Management* 9(4) pp. 421-34

Ritter, J. & Welch, I. 2002 'A review of IPO activity, pricing and allocations' *Journal of Finance* 57(4) pp. 1795-1828

Rock, K. 1986 'Why new issues are underpriced' *Journal of Financial Economics* 15(1-2) pp. 187-212

Ruud, J. 1993 'Underwriter Price Support and the IPO Underpricing Puzzle' *Journal of Financial Economics* 34(2) pp. 135–51

SFE 2005 *Trading options and futures* Available:
http://www.sfe.com.au/content/aboutsfe/brochures/005_introduction.pdf
Accessed 14/10/08

Sharpe, I. & Woo, L. 2005 'Corporate control, expected underpricing, and the choice of issuance mechanism in unseasoned equity markets' *Journal of Corporate Finance* 11(4) pp. 716-35

Shamsuddin, A. & Hillier, J. 2004 'Fundamental determinants of the Australian price–earnings multiple' *Pacific-Basin Finance Journal* 12(5) pp. 565-76

Sherman, A. 2000 'IPOs and long-term relationships: an advantage of bookbuilding' *Review of Financial Studies* 13(3) pp. 697-714

Sherman, A. 2005 'Global trends in IPO methods: Book building versus auctions with endogenous entry' *Journal of Financial Economics* 78(3) pp. 615-649

Sherman, A. & Titman, S. 2002 'Building the IPO order book: underpricing and participation limits with costly information' *Journal of Financial Economics* 65(1) pp. 3-29

Shi, J. 2003 ‘The interrelationship between the US and Australian IPO [Initial public offerings] markets’ *Accounting Research Journal* 16(2) pp. 133-143

Shi, J., Bilson, C. & Powell, J. 2008 ‘Valuation uncertainty risk compensation and IPO prospectus earnings forecasts’ *Applied Economics Letters* 15(5) pp. 331-5

Shiller, R. 1984 ‘Stock prices and social dynamics’ *Brookings Papers on Economic Activity* 2 pp. 457-98

Shiller, R. 1990 ‘Speculative prices and popular models’ *Journal of Economic Perspectives* 4(2) pp. 55-65

Shiwakoti, R., Hudson, R. & Short, H. 2005 ‘A study of the initial returns and the aftermarket performance of initial public offerings of demutualized building societies in the UK’ *Applied Economics Letters* 12(7) pp. 403-9

Shefrin, H. & Statman, M. 1994 ‘Behavioral Capital Asset Pricing Theory’ *Journal of Financial and Quantitative Analysis* 29(3) pp. 323-49

Shleifer, A. & Summers, L. 1990 ‘The noise trader approach to finance’ *Journal of Economic Perspectives* 4(2) pp. 19-33

Shleifer, A. & Vishny, R. 1997 ‘The limits to arbitrage’ *Journal of Finance* 52(1) pp. 35-55

Shultz, P. (1993) ‘Unit initial public offerings: a form of staged financing’ *Journal of Financial Economics* 34, pp. 199-229

Shultz, P. & Zaman, A. 1994 ‘Aftermarket support and underpricing of initial public offerings’ *Journal of Financial Economics* 35(2) pp. 199-219

Siegel, S. & Castellan, N. 1988 *Nonparametric statistics for the behavioral sciences* 2nd Edition, McGraw-Hill Inc. New York

Smart, S., Megginson, W & Gitman, L. 2004 *Corporate Finance* Thomson South Western, Mason, Ohio

Smullen, J. & Hand, N. (eds) 2005 *Oxford dictionary of finance and banking* 3rd ed, Oxford University Press, Oxford UK

Sprent, P. 1993 *Applied nonparametric statistical methods* 2nd Edition, Chapman & Hall, London

Stoughton, N. & Zechner, J. 1998 ‘IPO-mechanism, monitoring and ownership structure’ *Journal of Financial Economics* 49(1) pp. 45-77

Suchard, J. & Woo, L. 2003 'Are hot markets driven by hot resource shares or hot commodities' *Australian Journal of Management* 28(3) pp. 319-44

Tabachnick, B. & Fidell, L. 1996 *Using multivariate statistics* 3rd Edition, Harper Collins College Publishers, New York

Tinic, S. 1988 'Anatomy of initial public offerings of common stock' *Journal of Finance* 43(4) pp. 789-822

Titman, S. & Trueman, B. 1986 'Information quality and the valuation of new issues' *Journal of Accounting and Economics* 8(2) pp. 159-72

Verma, R., Baklaci, H. & Soydemir, G. 2008 'The impact of rational and irrational sentiments of individual and institutional investors on DJIA and S&P500 index returns' *Applied Financial Economics* 18(16) pp. 1303-17

Welch, I. 1989 'Seasoned offerings, imitation costs, and the underpricing of initial public offerings' *Journal of Finance* 44(2) pp. 421-49

Welch, I. 1992 'Sequential Sales, Learning, and Cascades' *Journal of Finance* 47(2) pp. 695-732

White, G., Sondhi, A. & Fried, D. 1998 *The analysis and use of financial statements* 2nd ed, John Wiley & Sons Inc, New York

Wolfe G.A. & Cooperman, E.S. 1990 'A reassessment of the "excess return phenomenon" for initial public offerings of common stock' *Journal of Applied Business Research* 6 pp. 40–50

Wong, K. 2005 *The aftermarket role of IPO underwriting syndicates in Australia* [Online] Available: http://scholar.google.com/scholar?hl=en&lr=&q=cache:UgT0343DlGUJ:www.asianfa.com/INVEST/350/AP/350_AP003.pdf+underwriting+Australia

Zarowin, P. 1990 'What determines earnings-price ratios: revisited' *Journal of Accounting, Auditing and Finance* 5(3) pp. 439-54

Zhang, S. 2005 'Underpricing, share overhang, and insider selling in follow-on offers' *The Financial Review* 40(3) pp. 409-28

Zheng, S. 2007 'Are IPOs really overpriced?' *Journal of Empirical Finance* 14(3) pp. 287-309

Zheng, S., Ogden, J. & Jen, F. 2005 'Pursuing value through liquidity in IPOs: underpricing, share retention, lockup, and trading volume relationships' *Review of Quantitative Finance and Accounting* 25(3) pp. 293-312

APPENDICES

APPENDIX A: SUMMARY OF DATA SOURCES AND VARIABLE MEASUREMENTS

Table A.1 <u>Summary of data sources and variable measurements</u>

Data	**Source**	**Description or measure**
Sample selection		
Number of corporate listings	DatAnalysis database	Number of corporate listings for each year.
Stapled securities and multiple security offers	Prospectus	Non-detachable securities sold as a package or more than one type of security offered in the prospectus.
Attaching options	Prospectus	Options allocated with shares for no charge.
Bookbuild issues	Prospectus	Offer price not fixed at prospectus date.
Extractive industries	DatAnalysis database or tables in 'Shares' magazines	Industry classification at listing.
Listed managed funds	Prospectus	Offer of shares in a portfolio of financial assets.
Demutalisations and co-operatives	Prospectus	Mutual or co-operative structure of business prior to listing.
Cross-listing	DatAnalysis database and prospectus	Listed on foreign exchange prior to Australian IPO.
Listing on regional exchange	Prospectus and Factiva database	Listed on Australian regional exchange prior to prospectus date.
Relistings	DatAnalysis database and Factiva database	Listed on ASX in same industry prior to prospectus date.
Restructuring	Prospectus and Factiva database	New company created by reorganisation of existing entities where original shareholders receive shares in the new company. Does not include spin-offs with new capital raising.

Data	**Source**	**Description or measure**
Sample descriptives		
Issue size	Prospectus	Minimum subscription size (2006 A$'000).
Gross proceeds to company	Prospectus	Minimum received from the sale of new shares (2006A$'000)
Gross proceeds to owners	Prospectus	Minimum received from the sale of vendor shares (2006A$'000)
Total assets	Prospectus	Total assets from the pro-forma balance sheet (2006A$'000)
Leverage %	Prospectus	Total liabilities from the pro-forma balance sheet / Total assets from the pro-forma balance sheet
Market capitalisation	Prospectus	Minimum number of shares on offer multiplied by the offer price.
Prospectus date	Prospectus	Date the prospectus is lodged with ASIC.
Listing date	DatAnalysis database and Factiva database	Date when the IPO shares can be traded on the ASX.
Measures of underpricing		
Offer price (*OP*)	Prospectus	Subscription price per share.
Market price (*P*)	Float.com.au website	Observed trading price at the end of the listing date.
Market return	Datastream database	Return on the Small Ordinaries Accumulation Index
Raw UP (*RUP*)	Offer price and market price	[(Market price - offer price) / offer price] x 100
Market adjusted UP (*MAUP*)	Offer price, market price, market return	Raw UP – return on the market index.
Package UP (*PUP*)	Offer price, market price of shares and attaching options, market return	[(Market price of share - offer price + (ratio of shares to attaching options x option price) / offer price] x 100

Data	Source	Description or measure
Baseline independent variables		
DELAY	Prospectus date, listing date	Listing date minus prospectus date.
OWN	Prospectus	(shares retained by pre-IPO owners / minimum shares offered) x 100
SIGMA	Market price	Standard deviation of daily returns for days 2 to 20 from listing date.
UW	Prospectus	Dichotomous variable equal to one if the issue is underwritten.
OPT	Prospectus	Dichotomous variable equal to one if the issue includes attaching options.
lnDELAY	Prospectus date, listing date	Natural logarithm of listing date minus prospectus date
tOWN	Prospectus	Square root of reflected value of [(shares retained by pre-IPO owners / minimum shares offered) x 100]
lnSIGMA	Market price	Natural logarithm of standard deviation of daily returns for days 2 to 20 from listing date
Value proxies		
EPS_{t+1}	Prospectus	Forecast earnings per share for the first financial year after listing
PE multiple	Aspect Financial, AGSM, FinAnalysis	Industry median PE for the year prior to listing
Risk-free rate (r_f)	RBA website	90-day bank-accepted bill rate
Scholes-Williams beta (β)	AGSM	Industry beta for the year prior to the prospectus date
Market risk premium	Brailsford, Handley & Maheswaran (2008)	3 alternate specifications – zero, 50% or 100% value for imputation credits
Book value (B_t)	Prospectus	Book value from pro-forma financial statements divided by number of shares at listing
V_{PE}		PE multiple x EPS_{t+1}
V_{EBO0}		EBO value proxy with zero value for imputation credits
V_{EBO50}		EBO value proxy with 50% value for imputation credits
V_{EBO100}		EBO value proxy with 100% value for imputation credits

Data	Source	Description or measure
Measures of mispricing and misvaluation		
MP		*OP* minus value proxy
MP%		[(*OP* minus value proxy) / *OP*] x 100
V/OP		Ratio of value proxy to offer price
OP/V		Ratio of offer price to value proxy
AMP		Aggregate mispricing - the product of *MP* and the number of shares offered
MV		*P* minus value proxy
MV%		[(*P* minus value proxy) / *P*] x 100
V/P		Ratio of value proxy to market price
P/V		Ratio of market price to value proxy
AMV		Aggregate misvaluation - the product of *MV* and the number of shares offered
Independent variables for mispricing and misvaluation		
Shareholder dispersion (*HOLDERS*)	Top 20 shareholder disclosures on the ASX website, prospectus	The sum of the number of shares held by the top 20 shareholders less the number of shares retained by the vendors all scaled by the number of shares offered in the prospectus
Participation rate (*PTN*)	Prospectus	The ratio of the number of secondary shares offered to the total number of original shares
Dilution rate (*DTN*)	Prospectus	The ratio of the number of primary shares offered to the total number of original shares

Data	Source	Description or measure
Allocation method (*ALLOC*)	Prospectus	Dichotomous variable is coded as one where the underwriter participates in the allocation process.
Underwriter discretion in allocation (*ALLOC1*)	Prospectus	Dichotomous variable is coded as one where the underwriter has complete discretion in the allocation process.
IPO market sentiment proxy (*HOTN*)	Count of industrial IPOs during sample period	The number of industrial IPOs in the three months preceding the prospectus date.
Relative size (*SIZE*)	Prospectus, FinAnalysis database	Firm size is measured as the total number of shares at listing multiplied by the offer price. Firm size is divided by industry median capitalisation for the year of listing.
Growth options (*GROWTH*)	Prospectus	1-(book value of ordinary shareholders' equity / offer price).
lnDTN		Natural logarithm of (1+*DTN*)
lnHOTN		Natural logarithm of (1+*HOTN*)
lnSIZE		Natural logarithm of *SIZE*
Oversubscription (*OS*)	Factiva for media reports	Dichotomous variable coded one where the issue is reported in the financial press as 'oversubscribed' or 'closed early'.
Speculative issue (*SPEC*)	Prospectus	Dichotomous variable equal to one if the issuer identifies the offer as speculative in the prospectus.
Number of institutional investors (*II*)	Top 20 shareholder disclosures on the ASX website	Number of institutional investors identified from the Top 20 shareholders disclosure.
Proportion of institutional investors (*II%*)	Top 20 shareholder disclosures on the ASX website	The percentage of shares held by institutional investors identified from the Top 20 shareholder disclosure.
IPO market sentiment proxy (*HOTU*)	Float.com.au website	Average underpricing for industrial IPOs in the three months preceding listing date.
General market sentiment proxy (*RM2*)	Datastream database	Return on the All Ordinaries Index for the two months prior to the listing date.
General market sentiment proxy (*RM4*)	Datastream database	Return on the All Ordinaries Index for the four months prior to the listing date.
General market sentiment proxy (*BULL*)	Factiva for media reports	Dichotomous variable coded one where the issue is made during a period identified in the financial press as a bull market.

APPENDIX B: DESCRIPTIVE STATISTICS FROM PRIOR AUSTRALIAN RESEARCH

Table B.1 Sample means (medians where available) from prior Australian research

Authors	**Sample years**	***n***	**DELAY**	**OWN**	**SIGMA**	**UW**	**OPT**
Finn & Higham (1988)	1966-78	125	(25)	-	-	-	-
Lee, Taylor & Walter (1996)	1976-89	266	52.81	54.6	15.11	-	-
Lee, Lee & Taylor (2003)	1976-89	394	54.84 (49)	47.9 (51.1)	13.35 (10.78)	-	16.75*
Balatbat, Taylor & Walter (2004)	1976-93	313	-	50.64 (54.8)	-	-	-
How & Low (1993)	1979-89	523	-	44.83	-	-	-
How (1996)	1979-90	266	77.25 (49)	46.18 (51)	3.88 (3.03)	-	24.06*
How & Howe (2001)	1979-90	396	**	**	**	-	34*
How, Izan & Monroe (1995)	1980-90	214	73 (49)	-	4.07 (3.17)	-	-
How & Yeo (2000)	1980-96	282	65	49 (52)	-	73	16*
Sharpe & Woo (2005)	1983-95	983	-	42.67	-	82.4	-
Da Silva Rosa, Velayuthen & Walter (2003)	1991-99	-	-	49.63 (54.3)	-	-	-
How, Lam & Yeo (2007)	1993-2000	275	57.82 (49)	56 (60)	10 (4)	71	13*
Cotter, Goyen & Hegarty (2005)	1995-98	71	58.6 (52)	56 (60)	-	75	-
Wong (2005)	1996-99	214	-	-	-	82.2	-
Bayley, Lee & Walter (2006)	1996-2000	419	-	-	5	-	-

* Includes attaching and sold options
** Means and medians are reported for share only and packaged IPOs, not for the full sample

APPENDIX C MISPRICING ROBUSTNESS TESTS

Table C.1 Mispricing regression results with transformed independent variables

Independent variables		MP_{PE}	MP_{EBO0}	MP_{EBO50}	MP_{EBO100}
		Dependent variable			
constant	coefficient	-0.479**	-0.342*	-0.253	-0.177
	t-stat	-3.076	-2.160	-1.615	-1.133
	p	(0.002)	(0.032)	(0.216)	(0.259)
HOLDERS	coefficient	-0.024	0.097	0.108	0.116
	t-stat	-0.358	1.451	1.28	1.765
	p	(1.000)	(0.297)	(0.211)	(0.159)
lnDTN	coefficient	0.045	-0.123	-0.108	-0.180
	t-stat	0.355	-0.955	-1.209	-1.416
	p	(1.000)	(0.682)	(0.457)	(0.317)
ALLOC	coefficient	-0.008	0.013	0.021	0.027
	t-stat	-0.133	0.196	0.308	0.406
	p	(1.000)	(1.000)	(1.000)	(1.000)
lnHOTN	coefficient	0.154**	0.163**	0.153**	0.144**
	t-stat	3.160	3.287	3.117	2.949
	p	(0.004)	(0.002)	(0.004)	(0.007)
lnSIZE	coefficient	0.184**	0.152**	0.156**	0.159**
	t-stat	6.683	5.453	5.641	5.757
	p	(0.000)	(0.000)	(0.000)	(0.000)
GROWTH	coefficient	0.249#	-0.188	-0.195	-0.200
	t-stat	2.074	-1.543	-1.619	-1.668
	p	(0.079)	(0.249)	(0.215)	(0.194)
AR^2		0.277**	0.187**	0.199**	0.208**
JB		55.370**	23.317**	26.648**	29.246**
White's	*p*	(0.833)	(0.304)	(0.205)	(0.156)
DW		1.732	1.705	1.704	1.705
RESET	F	1.942	5.444**	5.452**	5.329**
	p	(0.147)	(0.005)	(0.005)	(0.005)

** Significant at <1% (two tailed for *lnSIZE* and one tailed for *HOLDERS, lnDTN, GROWTH, lnHOTN* and *ALLOC*)
* Significant at <5% (two tailed for *lnSIZE* and one tailed for *HOLDERS, lnDTN, GROWTH, lnHOTN* and *ALLOC*)
# Significant at <10% *(two tailed for SIZE and one tailed for HOLDERS, DTN, GROWTH, HOTN and ALLOC)*
t-statistics are White's heteroscedasticity adjusted for the MP_{EBO100} measure of mispricing.
MP_{PE} = offer price minus the comparable firms estimate of value. MP_{EBO0} = offer price minus the EBO model value where r_0 is the discount rate. MP_{EBO50} = offer price minus the EBO model value where r_{50} is the discount rate. MP_{EBO100} = offer price minus the EBO model value where r_{100} is the discount rate. *HOLDERS* = the sum of the number of shares held by the top 20 shareholders less the number of shares retained by the vendors all scaled by the number of shares offered in the prospectus. *lnDTN* = log of one plus the ratio of the number of primary shares offered to the total number of original shares. *ALLOC* = dichotomous variable coded as 'one' where the underwriter participates in the allocation process. *lnHOTN* = log of one plus the number of industrial IPOs in the three months preceding the prospectus date. *lnSIZE* = log of (market capitalisation of the IPO post listing relative to industry median capitalisation for the year of listing). *GROWTH* = 1-(book value of ordinary shareholders' equity / offer price).

Table C.2 Mispricing regression results with *PTN* and *DTN* as independent variables

Independent variables		*Dependent variable*			
		MP_{PE}	MP_{EBO0}	MP_{EBO50}	MP_{EBO100}
constant	coefficient	-0.405**	-0.285**	-0.225*	-0.172
	t-stat	-2.931	-3.121	-2.485	-1.913
	p	(0.004)	(0.002)	(0.014)	(0.115)
HOLDERS	coefficient	-0.022	0.105	0.109	0.112
	t-stat	-0.320	1.553	1.639	1.698
	p	(1.000)	(0.245)	(0.206)	(0.183)
DTN	coefficient	0.009	-0.058	-0.063	-0.068
	t-stat	0.185	-1.100	-1.216	-1.306
	p	(1.000)	(0.546)	(0.451)	(0.386)
PTN	coefficient	0.031	0.067	0.128	0.179
	t-stat	0.199	0.430	0.826	1.166
	p	(1.000)	(1.000)	(0.819)	(0.491)
ALLOC	coefficient	-0.014	0.044	0.045	0.046
	t-stat	-0.201	0.637	0.660	0.678
	p	(1.000)	(1.000)	(1.000)	(0.997)
HOTN^	coefficient	0.136**	0.009**	0.009**	0.008*
	t-stat	2.671	3.218	2.966	2.729
	p	(0.003)	(0.003)	(0.007)	(0.014)
SIZE^	coefficient	0.182**	0.112**	0.113**	0.115**
	t-stat	6.606	5.713	5.870	5.958
	p	(0.000)	(0.000)	(0.000)	(0.000)
GROWTH	coefficient	0.241#	-0.223	-0.227	-0.231
	t-stat	2.025	-1.858	-1.921	-1.958
	p	(0.089)	(0.130)	(0.113)	(0.104)
AR^2		0.269**	0.200**	0.213**	0.222**
JB		55.421**	49.139**	58.071**	65.027**
White's	*p*	(0.763)	(0.662)	(0.583)	(0.524)
DW		1.735	1.820	1.812	1.805
RESET	F	2.297	1.294	1.095	0.9111
	p	(0.104)	(0.277)	(0.337)	(0.404)

** Significant at <1% (two tailed for *SIZE* and one tailed for *HOLDERS*, *DTN*, *PTN*, *GROWTH*, *HOTN* and *ALLOC*)
* Significant at <5% (two tailed for *SIZE* and one tailed for *HOLDERS*, *DTN*, *PTN*, *GROWTH*, *HOTN* and *ALLOC*)
# Significant at <10% (two tailed for *SIZE* and one tailed for *HOLDERS*, *DTN*, *PTN*, *GROWTH*, *HOTN* and *ALLOC*)
^ Logarithmic transformations of *SIZE* and one plus *HOTN* and are used in with the MP_{PE} dependent variable
MP_{PE} = offer price minus the comparable firms estimate of value. MP_{EBO0} = offer price minus the EBO model value where r_0 is the discount rate. MP_{EBO50} = offer price minus the EBO model value where r_{50} is the discount rate. MP_{EBO100} = offer price minus the EBO model value where r_{100} is the discount rate. *HOLDERS* = the sum of the number of shares held by the top 20 shareholders less the number of shares retained by the vendors all scaled by the number of shares offered in the prospectus. *DTN* = the ratio of the number of primary shares offered to the total number of original shares. *PTN* = the ratio of the number of secondary shares offered to the total number of original shares. *ALLOC* = dichotomous variable coded as 'one' where the underwriter participates in the allocation process. *HOTN* = the number of industrial IPOs in the three months preceding the prospectus date. *SIZE* = market capitalisation of the IPO post listing relative to industry median capitalisation for the year of listing. *GROWTH* = 1-(book value of ordinary shareholders' equity / offer price).

Table C.3 Mispricing regression results with *PTN* as an independent variable

Independent variables		*Dependent variable* MP_{PE}	MP_{EBO0}	MP_{EBO50}	MP_{EBO100}
constant	coefficient	-0.459**	-0.332**	-0.275**	-0.226**
	t-stat	-3.214	-4.084	-3.425	-2.826
	p	(0.002)	(0.000)	(0.001)	(0.005)
HOLDERS	coefficient	-0.016	0.076	0.077	0.079
	t-stat	-0.261	1.221	1.263	1.289
	p	(1.000)	(0.448)	(0.416)	(0.398)
PTN	coefficient	0.025	0.109	0.173	0.227
	t-stat	0.169	0.717	1.153	1.524
	p	(1.000)	(0.949)	(0.500)	(0.259)
ALLOC	coefficient	-0.012	0.0411	0.042	0.043
	t-stat	-0.177	0.603	0.621	0.636
	p	(1.000)	(1.000)	(1.000)	(1.000)
HOTN^	coefficient	0.153**	0.010**	0.009**	0.008**
	t-stat	3.144	3.363	3.121	2.891
	p	(0.004)	(0.002)	(0.002)	(0.009)
SIZE^	coefficient	0.182**	0.115**	0.117**	0.118**
	t-stat	6.687	5.912	6.081	6.178
	p	(0.000)	(0.000)	(0.000)	(0.000)
GROWTH	coefficient	0.234#	-0.199	-0.201	-0.203
	t-stat	2.021	-1.685	-1.726	-1.746
	p	(0.089)	(0.187)	(0.172)	(0.165)
AR^2		0.277**	0.199**	0.210**	0.219**
JB		56.661**	46.328**	54.663**	61.179**
White's	*p*	(0.531)	(0.505)	(0.425)	(0.372)
DW		1.737	1.799	1.787	1.777
RESET	F	2.040	1.394	1.177	0.981
	p	(0.133)	(0.251)	(0.311)	(0.377)

** Significant at <1% (two tailed for *SIZE* and one tailed for *HOLDERS*, *PTN*, *GROWTH*, *HOTN* and *ALLOC*)
* Significant at <5% (two tailed for *SIZE* and one tailed for *HOLDERS*, *PTN*, *GROWTH*, *HOTN* and *ALLOC*)
# Significant at <10% (two tailed for *SIZE* and one tailed for *HOLDERS*, *PTN*, *GROWTH*, *HOTN* and *ALLOC*)
^ Logarithmic transformations of *SIZE* and one plus *HOTN* and are used in with the MP_{PE} dependent variable
MP_{PE} = offer price minus the comparable firms estimate of value. MP_{EBO0} = offer price minus the EBO model value where r_0 is the discount rate. MP_{EBO50} = offer price minus the EBO model value where r_{50} is the discount rate. MP_{EBO100} = offer price minus the EBO model value where r_{100} is the discount rate. *HOLDERS* = the sum of the number of shares held by the top 20 shareholders less the number of shares retained by the vendors all scaled by the number of shares offered in the prospectus. *PTN* = the ratio of the number of secondary shares offered to the total number of original shares. *ALLOC* = dichotomous variable coded as 'one' where the underwriter participates in the allocation process. *HOTN* = number of industrial IPOs in the three months preceding the prospectus date. *SIZE* = market capitalisation of the IPO post listing relative to industry median capitalisation for the year of listing. *GROWTH* = 1-(book value of ordinary shareholders' equity / offer price).

Table C.4 Mispricing regression results with *ALLOC1* as an independent variable

Independent variables		*Dependent variable* MP_{PE}	MP_{EBO0}	MP_{EBO50}	MP_{EBO100}
constant	coefficient	-0.484**	-0.261**	-0.927*	-0.134
	t-stat	-3.147	-2.967	-2.212	-1.540
	p	(0.002)	(0.003)	(0.028)	(0.126)
HOLDERS	coefficient	-0.023	0.108	0.117	0.125
	t-stat	-0.349	1.631	1.785	1.901
	p	(1.000)	(0.209)	(0.152)	(0.118)
DTN^	coefficient	0.045	-0.065	-0.075	-0.084
	t-stat	0.358	-1.273	-1.491	-1.667
	p	(1.000)	(0.410)	(0.275)	(0.194)
ALLOC1	coefficient	0.010	-0.011	0.002	0.012
	t-stat	0.077	-0.083	0.013	0.096
	p	(1.000)	(1.000)	(1.000)	(1.000)
HOTN^	coefficient	0.154**	0.009**	0.008**	0.008*
	t-stat	3.150	3.122	2.834	2.565
	p	(0.004)	(0.004)	(0.005)	(0.022)
SIZE^	coefficient	0.183**	0.114**	0.117**	0.120**
	t-stat	6.808	5.827	6.033	6.159
	p	(0.000)	(0.000)	(0.000)	(0.000)
GROWTH	coefficient	0.245#	-0.205	-0.207	-0.209
	t-stat	2.016	-1.682	-1.719	-1.734
	p	(0.091)	(0.189)	(0.175)	(0.170)
AR^2		0.277**	0.201**	0.210**	0.216**
JB		54.300**	43.786**	50.623**	56.095**
White's	*p*	(0.950)	(0.499)	(0.384)	(0.318)
DW		1.729	1.810	1.799	1.789
RESET	F	1.981	1.681	1.691	1.650
	p	(0.141)	(0.189)	(0.187)	(0.195)

** Significant at <1% (two tailed for *SIZE* and one tailed for *HOLDERS, DTN, GROWTH, HOTN* and *ALLOC1*)
* Significant at <5% (two tailed for *SIZE* and one tailed for *HOLDERS, DTN, GROWTH, HOTN* and *ALLOC1*)
# Significant at <10% (two tailed for *SIZE* and one tailed for *HOLDERS, DTN, GROWTH, HOTN* and *ALLOC1*)
^ Logarithmic transformations of *SIZE*, one plus *DTN* and one plus *HOTN* are used in with the MP_{PE} dependent variable
MP_{PE} = offer price minus the comparable firms estimate of value. MP_{EBO0} = offer price minus the EBO model value where r_0 is the discount rate. MP_{EBO50} = offer price minus the EBO model value where r_{50} is the discount rate. MP_{EBO100} = offer price minus the EBO model value where r_{100} is the discount rate. *HOLDERS* = the sum of the number of shares held by the top 20 shareholders less the number of shares retained by the vendors all scaled by the number of shares offered in the prospectus. *DTN* = the ratio of the number of primary shares offered to the total number of original shares. *ALLOC1* = dichotomous variable coded as 'one' where the underwriter has complete discretion over the allocation process. *HOTN* = number of industrial IPOs in the three months preceding the prospectus date. *SIZE* = market capitalisation of the IPO post listing relative to industry median capitalisation for the year of listing. *GROWTH* = 1-(book value of ordinary shareholders' equity / offer price).

Table C.5 Mispricing regression results with *UW* as a dependent variable

Independent variables		*Dependent variable* MP_{PE}	MP_{EBO0}	MP_{EBO50}	MP_{EBO100}
constant	coefficient	-0.462**	-0.310**	-0.254*	-0.207*
	t-stat	-2.856	-3.067	-2.546	-2.072
	p	(0.005)	(0.003)	(0.012)	(0.040)
HOLDERS	coefficient	-0.020	0.100	0.106	0.112
	t-stat	-0.304	1.497	1.611	1.695
	p	(1.000)	(0.273)	(0.218)	(0.184)
DTN^	coefficient	0.055	-0.071	-0.083	-0.093
	t-stat	0.427	-1.383	-1.640	-1.849
	p	(1.000)	(0.337)	(0.206)	(0.132)
UW	coefficient	-0.037	0.085	0.108	0.128
	t-stat	-0.410	0.948	1.224	1.456
	p	(1.000)	(0.689)	(0.445)	(0.294)
HOTN^	coefficient	0.156**	0.009**	0.008**	0.007*
	t-stat	3.167	3.166	2.861	2.576
	p	(0.004)	(0.004)	(0.009)	(0.022)
SIZE^	coefficient	0.186**	0.111**	0.112**	0.114**
	t-stat	6.728	5.638	5.791	5.875
	p	(0.000)	(0.000)	(0.000)	(0.000)
GROWTH	coefficient	0.257#	-0.226	-0.232	-0.235#
	t-stat	2.112	-1.889	-1.954	-1.991
	p	(0.072)	(0.121)	(0.105)	(0.082)
AR^2		0.278**	0.201**	0.217**	0.225**
JB		53.000**	43.285**	50.116**	55.609**
White's	*p*	(0.783)	(0.469)	(0.370)	(0.303)
DW		1.727	1.812	1.807	1.804
RESET	F	2.148	1.438	1.389	1.315
	p	(0.120)	(0.240)	(0.252)	(0.271)

** Significant at <1% (two tailed for *SIZE* and one tailed for *HOLDERS, UW, GROWTH, HOTN* and *ALLOC*)
* Significant at <5% (two tailed for *SIZE* and one tailed for *HOLDERS, UW, GROWTH, HOTN* and *ALLOC*)
# Significant at <10% (two tailed for *SIZE* and one tailed for *HOLDERS, UW, GROWTH, HOTN* and *ALLOC*)
^ Logarithmic transformations of *SIZE*, one plus *DTN* and one plus *HOTN* are used in with the MP_{PE} dependent variable
MP_{PE} = offer price minus the comparable firms estimate of value. MP_{EBO0} = offer price minus the EBO model value where r_0 is the discount rate. MP_{EBO50} = offer price minus the EBO model value where r_{50} is the discount rate. MP_{EBO100} = offer price minus the EBO model value where r_{100} is the discount rate. *HOLDERS* = the sum of the number of shares held by the top 20 shareholders less the number of shares retained by the vendors all scaled by the number of shares offered in the prospectus. *DTN* = the ratio of the number of primary shares offered to the total number of original shares. *UW* = dichotomous variable coded as 'one' when an underwriter participates in the issue. *HOTN* = number of industrial IPOs in the three months preceding the prospectus date. *SIZE* = market capitalisation of the IPO post listing relative to industry median capitalisation for the year of listing. *GROWTH* = 1-(book value of ordinary shareholders' equity / offer price).

Table C.6 Mispricing regression results with *MP%* as dependent variables

		Dependent variable			
Independent variables		$MP_{PE}\%$	$MP_{EBO0}\%$	$MP_{EBO50}\%$	$MP_{EBO100}\%$
constant	coefficient	-65.046*	-59.565#	-48.128	-38.326
	t-stat	-2.111	-1.725	-1.394	-1.108
	p	(0.036)	(0.086)	(0.165)	(0.269)
HOLDERS	coefficient	-5.223	9.836	10.279	10.603
	t-stat	-0.783	1.213	1.296	1.356
	p	(0.869)	(0.453)	(0.394)	(0.354)
lnDTN	coefficient	13.991	-8.125	-9.771	-17.285
	t-stat	0.540	-0.225	-0.266	-0.298
	p	(1.000)	(1.000)	(1.000)	(1.000)
ALLOC	coefficient	2.069	13.599	14.001	14.361
	t-stat	0.295	1.536	1.609	1.668
	p	(1.000)	(0.253)	(0.219)	(0.194)
lnHOTN	coefficient	16.630*	20.474*	18.763*	17.285*
	t-stat	2.497	2.807	2.619	2.436
	p	(0.027)	(0.011)	(0.019)	(0.032)
lnSIZE	coefficient	27.131**	26.889*	26.307*	25.760*
	t-stat	3.079	2.592	2.531	2.473
	p	(0.005)	(0.021)	(0.025)	(0.029)
GROWTH	coefficient	27.063	-40.192	-41.045#	-41.64#
	t-stat	1.754	-1.972	-2.029	-2.069
	p	(0.162)	(0.100)	(0.088)	(0.080)
AR^2		0.241**	0.163**	0.158**	0.152**
JB		11 085**	6 064**	7 003**	7 778**
White's	*p*	(0.000)	(0.000)	(0.000)	(0.000)
DW		1.951	1.928	1.940#	1.951#
RESET	F	1.676	2.258	2.350	2.435
	p	(0.190)	(0.108)	(0.099)	(0.091)

** Significant at <1% (two tailed for *lnSIZE* and one tailed for *HOLDERS, lnDTN, GROWTH, lnHOTN* and *ALLOC*)
* Significant at <5% (two tailed for *lnSIZE* and one tailed for *HOLDERS, lnDTN, GROWTH, lnHOTN* and *ALLOC*)
# Significant at <10% (two tailed for *lnSIZE* and one tailed for *HOLDERS, lnDTN, GROWTH, lnHOTN* and *ALLOC*)
All *t*-statistics are White's heteroscedasticity adjusted.
$MP_{PE}\%$ = (offer price minus the comparable firms estimate of value) / offer price. $MP_{EBO0}\%$ = (offer price minus the EBO model value where r_0 is the discount rate) / offer price. $MP_{EBO50}\%$ = (offer price minus the EBO model value where r_{50} is the discount rate) / offer price. $MP_{EBO100}\%$ = (offer price minus the EBO model value where r_{100} is the discount rate) / offer price. *HOLDERS* = the sum of the number of shares held by the top 20 shareholders less the number of shares retained by the vendors all scaled by the number of shares offered in the prospectus. *lnDTN* = log of one plus the ratio of the number of primary shares offered to the total number of original shares. *ALLOC* = dichotomous variable coded as 'one' where the underwriter participates in the allocation process. *lnHOTN* = log of one plus the number of industrial IPOs in the three months preceding the prospectus date. *lnSIZE* = log of (market capitalisation of the IPO post listing relative to industry median capitalisation for the year of listing). *GROWTH* = 1-(book value of ordinary shareholders' equity / offer price).

Table C.7 Mispricing regression results with *V/OP* as dependent variables

Independent variables		*Dependent variable* V_{PE}/OP	V_{EBO0}/OP	V_{EBO50}/OP	V_{EBO100}/OP
constant	coefficient	2.075**	2.090**	1.959**	1.846**
	t-stat	8.106	6.928	6.511	6.134
	p	(0.000)	(0.000)	(0.000)	(0.000)
HOLDERS	coefficient	0.043	-0.092	-0.099	-0.103
	t-stat	0.429	-0.770	-0.819	-0.855
	p	(1.000)	(0.885)	(0.828)	(0.788)
lnDTN	coefficient	-0.127	0.058	0.077	0.094
	t-stat	-0.641	0.267	0.333	0.403
	p	(1.000)	(1.000)	(1.000)	(1.000)
ALLOC	coefficient	-0.075	-0.176	-0.181	-0.184
	t-stat	-0.740	-1.468	-1.507	-1.539
	p	(1.000)	(0.288)	(0.267)	(0.252)
lnHOTN	coefficient	-0.148	-0.193#	-0.176#	-0.161
	t-stat	-1.964	-2.170	-1.981	-1.812
	p	(0.102)	(0.063)	(0.098)	(0.144)
lnSIZE	coefficient	-0.540**	-0.624**	-0.604**	-0.585**
	t-stat	-5.268	-5.173	-5.015	-4.857
	p	(0.000)	(0.000)	(0.000)	(0.000)
GROWTH	coefficient	-0.250	0.459#	0.463#	0.466#
	t-stat	-1.326	2.069	2.094	2.105
	p	(0.373)	(0.080)	(0.075)	(0.074)
AR^2		0.181**	0.153**	0.146**	0.138**
JB		16 638**	10 064**	11 337**	12 326**
White's	*p*	(0.056)	(0.091)	(0.091)	(0.091)
DW		1.941	1.988	1.998	2.008
RESET	F	8.370	0.953	0.973	0.987
	p	(0.000)	(0.388)	(0.380)	(0.375)

** Significant at <1% (two tailed for *lnSIZE* and one tailed for *HOLDERS, lnDTN, GROWTH, lnHOTN* and *ALLOC*)
* Significant at <5% (two tailed for *lnSIZE* and one tailed for *HOLDERS, lnDTN, GROWTH, lnHOTN* and *ALLOC*)
# Significant at <10% (two tailed for *lnSIZE* and one tailed for *HOLDERS, lnDTN, GROWTH, lnHOTN* and *ALLOC*)
All *t*-statistics are White's heteroscedasticity adjusted.
$MP_{PE}R$ = ratio of the comparable firms estimate of value to offer price. $MP_{EBO0}R$ = ratio of the EBO model value where r_0 is the discount rate to offer price. $MP_{EBO50}R$ = ratio of the EBO model value where r_{50} is the discount rate to offer price. $MP_{EBO100}R$ = ratio of the EBO model value where r_{100} is the discount rate to offer price. *HOLDERS* = the sum of the number of shares held by the top 20 shareholders less the number of shares retained by the vendors all scaled by the number of shares offered in the prospectus. *lnDTN* = log of one plus the ratio of the number of primary shares offered to the total number of original shares. *ALLOC* = dichotomous variable coded as 'one' where the underwriter participates in the allocation process. *lnHOTN* = log of one plus the number of industrial IPOs in the three months preceding the prospectus date. *lnSIZE* = log of (market capitalisation of the IPO post listing relative to industry median capitalisation for the year of listing). *GROWTH* = 1-(book value of ordinary shareholders' equity / offer price).

Table C.8 Mispricing regression results with *AMP* as dependent variables

		Dependent variable			
Independent variables		AMP_{PE}	AMP_{EBO0}	AMP_{EBO50}	AMP_{EBO100}
constant	coefficient	-7 725 816**	-4 471 111#	-3 694 086	-3 026 713
	t-stat	-2.944	-1.799	-1.473	-1.189
	p	(0.004)	(0.084)	(0.143)	(0.236)
HOLDERS	coefficient	-986 616	657 631	938 124	1 175 272
	t-stat	-0.511	0.511	0.741	0.933
	p	(1.000)	(1.000)	(0.920)	(0.704)
DTN	coefficient	360 619	-1 520 326	-1 546 679	-1 561 573
	t-stat	0.244	-0.950	-1.017	-1.070
	p	(1.000)	(0.687)	(0.621)	(0.572)
ALLOC	coefficient	-1 545 949	128 500	756 220	1 30 439
	t-stat	-0.809	0.071	0.405	0.670
	p	(0.839)	(1.000)	(1.000)	(1.000)
HOTN	coefficient	174 814#	152 927	126 524	104 088
	t-stat	2.044	1.693	1.348	1.067
	p	(0.085)	(0.184)	(0.359)	(0.575)
SIZE	coefficient	4 503 305**	3 547 877**	3 917 428**	4 227 199**
	t-stat	7.870	4.574	4.700	4.751
	p	(0.000)	(0.000)	(0.000)	(0.000)
GROWTH	coefficient	376 696	-4 307 259#	-4 189 326#	-4 080 534#
	t-stat	0.108	-2.066	-1.995	-1.900
	p	(1.000)	(0.081)	(0.095)	(0.118)
AR^2		0.270**	0.232**	0.261**	0.279**
JB		1 140**	107.538**	140.808**	176.015**
White's	*p*	(0.902)	(0.001)**	(0.001)**	(0.001)**
DW		1.996	1.950	1.940	1.930
RESET	F	2.910*	3.223*	3.224*	3.124*
	p	(0.049)	(0.042)	(0.042)	(0.040)

** Significant at <1% (two tailed for *SIZE* and one tailed for *HOLDERS, DTN, GROWTH, HOTN* and *ALLOC*)
* Significant at <5% (two tailed for *SIZE* and one tailed for *HOLDERS, DTN, GROWTH, HOTN* and *ALLOC*)
# Significant at <10% (two tailed for *SIZE* and one tailed for *HOLDERS, DTN, GROWTH, HOTN* and *ALLOC*)
t-statistics are White's heteroscedasticity adjusted for MP_{EBO} measures of mispricing.
AMP_{PE} = number of shares offered times (offer price minus the comparable firms estimate of value). AMP_{EBO0} = number of shares offered times (offer price minus the EBO model value where r_0 is the discount rate). AMP_{EBO50} = number of shares offered times (offer price minus the EBO model value where r_{50} is the discount rate). AMP_{EBO100} = number of shares offered times (offer price minus the EBO model value where r_{100} is the discount rate). *HOLDERS* = the sum of the number of shares held by the top 20 shareholders less the number of shares retained by the vendors all scaled by the number of shares offered in the prospectus. *DTN* = ratio of the number of primary shares offered to the total number of original shares. *ALLOC* = dichotomous variable coded as 'one' where the underwriter participates in the allocation process. *HOTN* = number of industrial IPOs in the three months preceding the prospectus date. *SIZE* = market capitalisation of the IPO post listing relative to industry median capitalisation for the year of listing. *GROWTH* = 1-(book value of ordinary shareholders' equity / offer price).

APPENDIX D MISVALUATION ROBUSTNESS TESTS

Table D.1 Misvaluation regression results with *II%* as an independent variable

Independent variables		Dependent variables MV_{PE}	MV_{BO0}	MV_{EBO50}	MV_{EBO100}
constant	coefficient	-0.107	-0.100	-0.097	-0.094
	t-stat	-0.621	-0.581	-0.563	-0.546
	p	(0.535)	(0.562)	(0.574)	(0.586)
OS	coefficient	0.101	0.101	0.101	0.100
	t-stat	1.449	1.452	1.450	1.448
	p	(0.298)	(0.297)	(0.298)	(0.299)
SPEC	coefficient	-0.156	-0.154	-0.156	-0.157
	t-stat	-1.860	-1.820	-1.846	-1.868
	p	(0.129)	(0.141)	(0.133)	(0.127)
II%	coefficient	-0.005#	-0.005#	-0.005#	-0.005#
	t-stat	-2.216	-2.207	-2.197	-2.090
	p	(0.056)	(0.057)	(0.059)	(0.060)
UW	coefficient	0.001	0.136	0.136	0.136
	t-stat	1.441	1.473	1.450	1.481
	p	(0.303)	(0.285)	(0.298)	(0.280)
OWN	coefficient	0.001	0.001	0.001	0.001
	t-stat	0.551	0.538	0.529	0.520
	p	(1.000)	(1.000)	(1.000)	(1.000)
HOTU	coefficient	0.001	0.001	0.001	0.002
	t-stat	1.420	1.389	1.377	1.366
	p	(0.315)	(0.333)	(0.283)	(0.374)
MP	coefficient	0.936**	0.951**	0.949**	0.948**
	t-stat	12.894	13.434	13.198	13.059
	p	(0.000)	(0.000)	(0.000)	(0.000)
SIZE	coefficient	0.047*	0.045*	0.045*	0.045*
	t-stat	2.738	2.684	2.689	2.691
	p	(0.014)	(0.016)	(0.016)	(0.016)
GROWTH	coefficient	0.157	0.134	0.135	0.135
	t-stat	1.352	1.204	1.209	1.213
	p	(0.356)	(0.461)	(0.457)	(0.454)
AR^2		0.620**	0.592**	0.590**	0.590**
JB		3 015**	3 024**	3 007**	2 993**
White's	*p*	(0.476)	(0.267)	(0.252)	(0.240)
DW		1.455	1.459	1.458	1.458
RESET	*F*	2.069	0.881	0.938	0.973
	p	(0.130)	(0.416)	(0.394)	(0.380)

** Significant at <1% (one-tailed). * Significant at <5% (one-tailed). # Significant at <10% (one-tailed).
MV_{PE} = price minus the comparable firms estimate of value. MV_{EBO0} = price minus the EBO model value where r_0 is the discount rate. MV_{EBO50} = price minus the EBO model value where r_{50} is the discount rate. MV_{EBO100} = price minus the EBO model value where r_{100} is the discount rate. *OS* = dichotomous variable coded as 'one' when the issue is reported in the financial press as 'oversubscribed' or 'closed early'. *SPEC* = dichotomous variable coded as 'one' when the issuer identifies the offer as speculative in the prospectus. *II%* = percentage of shares held by institutional investors identified from the top 20 shareholders disclosure. *UW* = dichotomous variable coded as 'one' when an underwriter participates in the issue. *OWN* = (shares retained by pre-IPO owners / shares offered) x 100. *HOTU* = average underpricing for industrial IPOs in the three months preceding listing date. *MP* = offer price minus the relevant estimate of value. *SIZE* = market capitalisation of the IPO post listing relative to industry median capitalisation for the year of listing. *GROWTH* = 1-(book value of ordinary shareholders' equity / offer price).

Table D.2 Misvaluation regression results with *HOTN* as an independent variable

Independent variables		Dependent variables MV_{PE}	MV_{BO0}	MV_{EBO50}	MV_{EBO100}
constant	coefficient	-0.248	-0.243	-0.239	-0.235
	t-stat	-1.370	-1.344	-1.332	-1.316
	p	(0.143)	(0.181)	(0.185)	(0.190)
OS	coefficient	0.109	0.110	0.110	0.110
	t-stat	1.529	1.548	1.549	1.548
	p	(0.256)	(0.247)	(0.246)	(0.247)
SPEC	coefficient	-0.152	-0.148	-0.150	-0.152
	t-stat	-1.753	-1.699	-1.730	-1.758
	p	(0.163)	(0.182)	(0.171)	(0.161)
II	coefficient	-0.001	-0.001	-0.001	-0.001
	t-stat	-0.176	-0.169	-0.155	-0.144
	p	(1.000)	(1.000)	(1.000)	(1.000)
UW	coefficient	0.087	0.092	0.092	0.093
	t-stat	0.914	0.961	0.969	0.977
	p	(0.724)	(0.676)	(0.668)	(0.660)
OWN	coefficient	0.003	0.003	0.003	0.003
	t-stat	0.749	1.468	1.457	1.446
	p	(0.910)	(0.288)	(0.294)	(0.300)
HOTN	coefficient	0.001	0.001	0.001	0.001
	t-stat	0.242	0.244	0.238	0.229
	p	(1.000)	(1.000)	(1.000)	(1.000)
MP	coefficient	0.927**	0.935**	0.931**	0.927**
	t-stat	12.237	12.583	12.373	12.258
	p	(0.000)	(0.000)	(0.000)	(0.000)
SIZE	coefficient	0.044*	0.035	0.043*	0.043*
	t-stat	2.396	2.354	2.369	2.380
	p	(0.035)	(0.039)	(0.038)	(0.037)
GROWTH	coefficient	0.198	0.174	0.175	0.175
	t-stat	1.742	1.561	1.565	1.569
	p	(0.167)	(0.241)	(0.239)	(0.237)
AR^2		0.605**	0.577**	0.575**	0.576**
JB		3 381**	3 394**	3 379**	3 364**
White's	*p*	(0.762)	(0.672)	(0.638)	(0.609)
DW		1.500	1.504	1.503	1.503
RESET	*F*	2.164	0.936	0.954	0.962
	p	(0.118)	(0.394)	(0.387)	(0.384)

** Significant at <1% (one-tailed). * Significant at <5% (one-tailed). # Significant at <10% (one-tailed).
MV_{PE} = price minus the comparable firms estimate of value. MV_{EBO0} = price minus the EBO model value where r_0 is the discount rate. MV_{EBO50} = price minus the EBO model value where r_{50} is the discount rate. MV_{EBO100} = price minus the EBO model value where r_{100} is the discount rate. *OS* = dichotomous variable coded as 'one' when the issue is reported in the financial press as 'oversubscribed' or 'closed early'. *SPEC* = dichotomous variable coded as 'one' when the issuer identifies the offer as speculative in the prospectus. *II* = number of institutional investors identified from the top 20 shareholders disclosure. *UW* = dichotomous variable coded 'one' if the issue is underwritten. *OWN* = (shares retained by pre-IPO owners / shares offered) x 100. *HOTN* = number of industrial IPOs in the three months preceding the prospectus date. *MP* = offer price minus the relevant estimate of value. *SIZE* = market capitalisation of the IPO post listing relative to industry median capitalisation for the year of listing. *GROWTH* = 1-(book value of ordinary shareholders' equity / offer price).

Table D.3 Misvaluation regression results with *BULL* as an independent variable

Independent variables		*Dependent variables* MV_{PE}	MV_{BO0}	MV_{EBO50}	MV_{EBO100}
constant	coefficient	-0.513**	-0.506	-0.506**	-0.506**
	t-stat	-2.665	-2.637	-2.643	-2.643
	p	(0.008)	(0.009)	(0.009)	(0.009)
OS	coefficient	0.114	0.110	0.111	0.112
	t-stat	1.682	1.617	1.635	1.648
	p	(0.189)	(0.215)	(0.208)	(0.202)
SPEC	coefficient	-0.144	-0.147	-0.146	-0.146
	t-stat	-1.723	-1.743	-1.738	-1.737
	p	(0.173)	(0.166)	(0.168)	(0.168)
II	coefficient	-0.002	-0.001	-0.001	-0.001
	t-stat	-0.191	-0.216	-0.237	-0.223
	p	(1.000)	(1.000)	(1.000)	(1.000)
UW	coefficient	0.092	0.093	0.093	0.004
	t-stat	0.998	1.006	1.008	1.011
	p	(0.640)	(0.631)	(0.630)	(0.627)
OWN	coefficient	0.004#	0.004#	0.004#	0.004#
	t-stat	2.167	2.158	2.157	2.154
	p	(0.063)	(0.065)	(0.065)	(0.065)
BULL	coefficient	0.255**	0.262**	0.260**	0.259**
	t-stat	3.305	3.314	3.298	3.288
	p	(0.002)	(0.002)	(0.002)	(0.001)
MP	coefficient	0.975**	1.007**	1.000**	0.994**
	t-stat	13.302	13.743	13.474	13.309
	p	(0.000)	(0.000)	(0.000)	(0.000)
SIZE	coefficient	0.034	0.0.032	0.032	0.032
	t-stat	1.936	1.840	1.870	1.873
	p	(0.109)	(0.135)	(0.130)	(0.126)
GROWTH	coefficient	0.229#	0.222#	0.222#	0.222#
	t-stat	2.090	2.063	2.059	2.057
	p	(0.076)	(0.081)	(0.082)	(0.082)
AR^2		0.629**	0.602**	0.600**	0.601**
JB		3 521**	3 495**	3 502**	3 505**
White's	*p*	(0.928)	(0.766)	(0.759)	(0.753)
DW		1.604	1.614	1.612	1.610
RESET	*F*	2.817#	0.789	0.793	0.794
	p	(0.063)	(0.456)	(0.454)	(0.454)

** Significant at <1% (one-tailed). * Significant at <5% (one-tailed). # Significant at <10% (one-tailed).
MV_{PE} = price minus the comparable firms estimate of value. MV_{EBO0} = price minus the EBO model value where r_0 is the discount rate. MV_{EBO50} = price minus the EBO model value where r_{50} is the discount rate. MV_{EBO100} = price minus the EBO model value where r_{100} is the discount rate. *OS* = dichotomous variable coded as 'one' when the issue is reported in the financial press as 'oversubscribed' or 'closed early'. *SPEC* = dichotomous variable coded as 'one' when the issuer identifies the offer as speculative in the prospectus. *II* = number of institutional investors identified from the top 20 shareholders disclosure. *UW* = dichotomous variable coded 'one' if the issue is underwritten. *OWN* = (shares retained by pre-IPO owners / shares offered) x 100. *BULL* = dichotomous variable coded 'one' if listing date is during a bull market. *MP* = offer price minus the relevant estimate of value. *SIZE* = market capitalisation of the IPO post listing relative to industry median capitalisation for the year of listing. *GROWTH* = 1-(book value of ordinary shareholders' equity / offer price).

Table D.4 Misvaluation regression results with *RM4* as an independent variable

Independent variables		*Dependent variables* MV_{PE}	MV_{BO0}	MV_{EBO50}	MV_{EBO100}
constant	coefficient	-0.255	-0.250	-0.247	-0.243
	t-stat	-1.405	-1.380	-1.369	-1.354
	p	(0.162)	(0.170)	(0.173)	(0.177)
OS	coefficient	0.110	0.112	0.112	0.111
	t-stat	1.573	1.584	1.587	1.587
	p	(0.235)	(0.230)	(0.229)	(0.229)
SPEC	coefficient	-0.151	-0.148	-0.150	-0.152
	t-stat	-1.752	-1.704	-1.731	-1.757
	p	(0.163)	(0.181)	(0.170)	(0.161)
II	coefficient	-0.002	-0.001	-0.001	-0.001
	t-stat	-0.183	-0.178	-0.165	-0.154
	p	(1.000)	(1.000)	(1.000)	(1.000)
UW	coefficient	0.097	0.101	0.102	0.102
	t-stat	0.998	1.041	1.047	1.541
	p	(0.639)	(0.598)	(0.593)	(0.588)
OWN	coefficient	0.003	0.003	0.003	0.003
	t-stat	1.579	1.562	1.552	1.541
	p	(0.233)	(0.240)	(0.245)	(0.251)
RM4	coefficient	0.003	0.003	0.003	0.003
	t-stat	0.478	0.481	0.474	0.468
	p	(1.000)	(1.000)	(1.000)	(1.000)
MP	coefficient	0.934**	0.942**	0.938**	0.934**
	t-stat	12.520	12.934	12.663	12.497
	p	(0.000)	(0.000)	(0.000)	(0.000)
SIZE	coefficient	0.042*	0.041*	0.041*	0.041*
	t-stat	2.350	2.307	2.323	2.335
	p	(0.040)	(0.044)	(0.043)	(0.041)
GROWTH	coefficient	0.193	0.172	0.173	0.173
	t-stat	1.701	1.551	1.554	1.557
	p	(0.181)	(0.245)	(0.244)	(0.243)
AR^2		0.606**	0.577**	0.575**	0.576**
JB		3 414**	3 426**	3 411**	3 396**
White's	*p*	(0.967)	(0.927)	(0.902)	(0.914)
DW		1.496	1.500	1.499	1.489
RESET	*F*	2.478#	0.906	0.909	0.906
	p	(0.087)	(0.406)	(0.405)	(0.406)

** Significant at <1% (one-tailed). * Significant at <5% (one-tailed). # Significant at <10% (one-tailed).
MV_{PE} = price minus the comparable firms estimate of value. MV_{EBO0} = price minus the EBO model value where r_0 is the discount rate. MV_{EBO50} = price minus the EBO model value where r_{50} is the discount rate. MV_{EBO100} = price minus the EBO model value where r_{100} is the discount rate. *OS* = dichotomous variable coded as 'one' when the issue is reported in the financial press as 'oversubscribed' or 'closed early'. *SPEC* = dichotomous variable coded as 'one' when the issuer identifies the offer as speculative in the prospectus. *II* = number of institutional investors identified from the top 20 shareholders disclosure. *UW* = dichotomous variable coded 'one' if the issue is underwritten. *OWN* = (shares retained by pre-IPO owners / shares offered) x 100. *RM4* = return on the All Ordinaries index for the four months prior to the listing date *MP* = offer price minus the relevant estimate of value. *SIZE* = market capitalisation of the IPO post listing relative to industry median capitalisation for the year of listing. *GROWTH* = 1-(book value of ordinary shareholders' equity / offer price).

Table D.5 Misvaluation regression results with *RM2* as an independent variable

Independent variables		MV_{PE}	MV_{BO0}	MV_{EBO50}	MV_{EBO100}
		Dependent variables			
constant	coefficient	-0.323#	-0.307#	-0.305#	-0.302#
	t-stat	-1.833	-1.747	-1.744	-1.737
	p	(0.069)	(0.083)	(0.083)	(0.084)
OS	coefficient	0.118	0.116	0.116	0.116
	t-stat	1.739	1.702	1.706	1.707
	p	(0.168)	(0.181)	(0.180)	(0.179)
SPEC	coefficient	-0.134	-0.133	-0.135	-0.136
	t-stat	-1.596	-1.579	-1.600	-1.619
	p	(0.224)	(0.232)	(0.223)	(0.215)
II	coefficient	0.003	0.002	0.003	0.003
	t-stat	0.042	0.370	0.379	0.387
	p	(1.000)	(1.000)	(1.000)	(1.000)
UW	coefficient	0.098	0.101	0.102	0.103
	t-stat	1.060	1.097	1.102	1.108
	p	(0.581)	(0.548)	(0.544)	(0.539)
OWN	coefficient	0.003	0.003	0.001	0.003
	t-stat	1.670	1.631	1.624	1.616
	p	(0.195)	(0.210)	(0.213)	(0.216)
RM2	coefficient	0.023**	0.023**	0.023**	0.023**
	t-stat	3.299	3.226	3.221	3.217
	p	(0.002)	(0.003)	(0.003)	(0.003)
MP	coefficient	0.929**	0.959**	0.955**	0.952**
	t-stat	12.900	13.560	13.286	13.120
	p	(0.000)	(0.000)	(0.000)	(0.000)
SIZE	coefficient	0.037#	0.034#	0.035#	0.035#
	t-stat	2.116	2.007	2.020	2.030
	p	(0.072)	(0.093)	(0.090)	(0.088)
GROWTH	coefficient	0.203	0.181	0.181	0.181
	t-stat	1.856	1.669	1.687	1.689
	p	(0.130)	(0.187)	(0.187)	(0.186)
AR^2		0.629**	0.601**	0.599**	0.600**
JB		3 338**	3 323**	3 315**	3 305**
White's	*p*	(0.859)	(0.732)	(0.852)	(0.725)
DW		1.597	1.601	1.600	1.600
RESET	*F*	2.473#	0.906	0.909	0.906
	p	(0.087)	(0.406)	(0.405)	(0.406)

** Significant at <1% (one-tailed). * Significant at <5% (one-tailed). # Significant at <10% (one-tailed).
MV_{PE} = price minus the comparable firms estimate of value. MV_{EBO0} = price minus the EBO model value where r_0 is the discount rate. MV_{EBO50} = price minus the EBO model value where r_{50} is the discount rate. MV_{EBO100} = price minus the EBO model value where r_{100} is the discount rate. *OS* = dichotomous variable coded as 'one' when the issue is reported in the financial press as 'oversubscribed' or 'closed early'. *SPEC* = dichotomous variable coded as 'one' when the issuer identifies the offer as speculative in the prospectus. *II* = number of institutional investors identified from the top 20 shareholders disclosure. *UW* = dichotomous variable coded 'one' if the issue is underwritten. *OWN* = (shares retained by pre-IPO owners / shares offered) x 100. *RM2* = return on the All Ordinaries index for the two months prior to the listing date *MP* = offer price minus the relevant estimate of value. *SIZE* = market capitalisation of the IPO post listing relative to industry median capitalisation for the year of listing. *GROWTH* = 1-(book value of ordinary shareholders' equity / offer price).

Table D.6 Misvaluation regression results with *MV%* as dependent variables

Independent variables		*Dependent variables* $MV_{PE}\%$	$MV_{BO0}\%$	$MV_{EBO50}\%$	$MV_{EBO100}\%$
constant	coefficient	-0.207	3.757	3.235	2.647
	t-stat	-0.016	0.290	0.255	0.219
	p	(0.988)	(0.772)	(0.799)	(0.817)
OS	coefficient	5.802	5.587	4.925	4.369
	t-stat	1.007	1.093	0.895	0.807
	p	(0.631)	(0.552)	(0.744)	(0.842)
SPEC	coefficient	-11.579	-13.711#	-13.309#	-12.941#
	t-stat	-1.869	-2.206	-1.989	-1.996
	p	(0.127)	(0.057)	(0.097)	(0.095)
II	coefficient	-0.413	-0.592	-0.557	-0.524
	t-stat	-0.831	-1.018	-1.126	-1.104
	p	(0.815)	(0.620)	(0.523)	(0.542)
UW	coefficient	12.031	11.676	11.525	11.414
	t-stat	1.791	1.690	1.594	1.599
	p	(0.150)	(0.186)	(0.226)	(0.223)
OWN	coefficient	0.076	0.054	0.056	0.058
	t-stat	0.617	0.392	0.462	0.495
	p	(1.000)	(1.000)	(1.000)	(1.000)
HOTU	coefficient	0.056	0.020	0.025	0.031
	t-stat	0.455	0.205	0.227	0.276
	p	(1.000)	(1.000)	(1.000)	(1.000)
MP%	coefficient	0.958**	0.989**	0.994**	0.997**
	t-stat	7.723	32.019	10.457	10.446
	p	(0.000)	(0.000)	(0.000)	(0.000)
SIZE	coefficient	-0.459	-0.287	-0.329	-0.359
	t-stat	-0.416	-0.230	-0.325	-0.367
	p	(1.000)	(1.000)	(1.000)	(1.000)
GROWTH	coefficient	0.385	4.292	3.842	3.439
	t-stat	0.064	0.527	0.558	0.508
	p	(1.000)	(1.000)	(1.000)	(1.000)
AR^2		0.843**	0.869**	0.873**	0.878**
JB		1 277**	335.928**	416.949**	505.869**
White's	*p*	(0.000)	(0.000)	(0.000)	(0.000)
DW		1.653	1.560	1.575	1.591
RESET	*F*	44.915**	23.061**	24.155**	25.204**
	p	(0.000)	(0.000)	(0.000)	(0.000)

** Significant at <1% (one-tailed). * Significant at <5% (one-tailed). # Significant at <10% (one-tailed).
All *t*-statistics are White's heteroscedasticity adjusted.
$MV_{PE}\%$ = (price minus the comparable firms estimate of value) / price. $MV_{EBO0}\%$ = (price minus the EBO model value where r_0 is the discount rate) / price. $MV_{EBO50}\%$ = (price minus the EBO model value where r_{50} is the discount rate) / price. MV_{EBO100} = (price minus the EBO model value where r_{100} is the discount rate) / price. *OS* = dichotomous variable coded as 'one' when the issue is reported in the financial press as 'oversubscribed' or 'closed early'. *SPEC* = dichotomous variable coded as 'one' when the issuer identifies the offer as speculative in the prospectus. *II* = number of institutional investors identified from the top 20 shareholders disclosure. *UW* = dichotomous variable coded 'one' if the issue is underwritten. *OWN* = (shares retained by pre-IPO owners / shares offered) x 100. *HOTU* = average underpricing for industrial IPOs in the three months preceding listing date. *MP%* = (offer price minus the relevant estimate of value) / offer price. *SIZE* = market capitalisation of the IPO post listing relative to industry median capitalisation for the year of listing. *GROWTH* = 1-(book value of ordinary shareholders' equity / offer price).

Table D.7 Misvaluation regression results with *VP* ratios as dependent variables

Independent variables		Dependent variables			
		V_{PE}/P	V_{BO0}/P	V_{EBO50}/P	V_{EBO100}/P
constant	coefficient	0.047	-0.026	-0.024	-0.021
	t-stat	0.212	-0.127	-0.125	-0.113
	p	(0.832)	(0.899)	(0.901)	(0.910)
OS	coefficient	-0.057	-0.058	-0.051	-0.045
	t-stat	-0.997	-1.027	-0.923	-0.832
	p	(0.640)	(0.612)	(0.715)	(0.813)
SPEC	coefficient	0.124	0.142	0.138#	0.134#
	t-stat	1.900	1.971	1.995	2.000
	p	(0.118)	(0.101)	(0.095)	(0.093)
II	coefficient	0.004	0.005	0.005	0.004
	t-stat	0.793	1.107	1.058	1.044
	p	(0.858)	(0.575)	(0.553)	(0.596)
UW	coefficient	-0.125	-0.125	-0.123	-0.121
	t-stat	-1.852	-1.607	-1.752	-1.753
	p	(0.131)	(0.164)	(0.163)	(0.163)
OWN	coefficient	-0.001	-0.001	-0.001	-0.001
	t-stat	-0.647	-0.516	-0.539	-0.562
	p	(1.000)	(1.000)	(1.000)	(1.000)
HOTU	coefficient	-0.001	-0.001	-0.001	-0.000
	t-stat	-0.446	-0.281	-0.327	-0.370
	p	(1.000)	(1.000)	(1.000)	(1.000)
V/OP	coefficient	0.968**	0.993**	0.997**	1.000**
	t-stat	7.695	10.526	10.488	10.486
	p	(0.000)	(0.000)	(0.000)	(0.000)
lnSIZE	coefficient	0.018	0.009	0.009	0.010
	t-stat	0.744	0.436	0.476	0.501
	p	(0.915)	(1.000)	(1.000)	(1.000)
GROWTH	coefficient	-0.007	-0.045	-0.041	-0.037
	t-stat	-0.109	-0.643	-0.595	-0.548
	p	(1.000)	(1.000)	(1.000)	(1.000)
AR^2		0.845**	0.869**	0.874**	0.878**
JB		1 223**	311**	389**	476**
White's	*p*	(0.000)	(0.000)	(0.000)	(0.000)
DW		1.677	1.585	1.600	1.615
RESET	*F*	43.881**	23.032**	24.109**	25.146**
	p	(0.000)	(0.000)	(0.000)	(0.000)

** Significant at <1% (one-tailed). * Significant at <5% (one-tailed). # Significant at <10% (one-tailed).
All *t*-statistics are White's heteroscedasticity adjusted.
$MV_{PE}R$ = comparable firms estimate of value / price. $MV_{EBO0}R$ = EBO model value where r_0 is the discount rate / price. $MV_{EBO50}R$ = EBO model value where r_{50} is the discount rate / price. MV_{EBO100} = EBO model value where r_{100} is the discount rate / price. *OS* = dichotomous variable coded as 'one' when the issue is reported in the financial press as 'oversubscribed' or 'closed early'. *SPEC* = dichotomous variable coded as 'one' when the issuer identifies the offer as speculative in the prospectus. *II* = number of institutional investors identified from the top 20 shareholders disclosure. *UW* = dichotomous variable coded 'one' if the issue is underwritten. *OWN* = (shares retained by pre-IPO owners / shares offered) x 100. ln*HOTU* = log of the average underpricing for industrial IPOs in the three months preceding listing date. *MPratio* = relevant estimate of value / offer price. *lnSIZE* = log of the market capitalisation of the IPO post listing relative to industry median capitalisation for the year of listing. *GROWTH* = 1-(book value of ordinary shareholders' equity / offer price).

Table D.8 Misvaluation regression results with *AMV* as dependent variables

Independent variables		Dependent variables			
		AMV_{PE}	AMV_{EBO0}	AMV_{EBO50}	AMV_{EBO100}
constant	coefficient	-4 306 885	-4 264 271	-3 888 818	-3 688 021
	t-stat	-0.835	-0.830	-0.755	-0.713
	p	(0.405)	(0.408)	(0.451)	(0.477)
OS	coefficient	2 772 853	3 049 786	2 958 071	2 884 515
	t-stat	1.352	1.481	1.434	1.398
	p	(0.356)	(0.281)	(0.307)	(0.328)
SPEC	coefficient	-2 738 867	-2 461 325	-2 624 148	-2 740 823
	t-stat	-1.084	-0.971	-1.036	-1.083
	p	(0.560)	(0.665)	(0.603)	(0.561)
II	coefficient	132 510	156 728	156 777	154 578
	t-stat	0.566	0.669	0.667	0.655
	p	(1.000)	(1.000)	(1.000)	(1.000)
UW	coefficient	610 630	508 340	558 738	609 583
	t-stat	0.218	0.182	0.200	0.217
	p	(1.000)	(1.000)	(1.000)	(1.000)
OWN	coefficient	4 841	163	-2 757	-3 676
	t-stat	0.867	0.003	-0.049	-0.065
	p	(1.000)	(1.000)	(1.000)	(1.000)
HOTU	coefficient	25 457	24 593	24 238	24 049
	t-stat	0.655	0.635	0.624	0.618
	p	(1.000)	(1.000)	(1.000)	(1.000)
AMP	coefficient	0.907**	0.874**	0.897**	0.917**
	t-stat	12.010	10.822	11.201	11.628
	p	(0.000)	(0.000)	(0.000)	(0.000)
SIZE	coefficient	2 171 420**	2 127 073**	2 121 252**	2 103 617**
	t-stat	4.008	4.111	4.038	3.954
	p	(0.000)	(0.000)	(0.000)	(0.000)
GROWTH	coefficient	4 482 062	4 409 954	4 403 276	4 386 715
	t-stat	1.355	1.339	1.333	1.326
	p	(0.354)	(0.365)	(0.369)	(0.373)
AR^2		0.609**	0.542**	0.574**	0.603**
JB		2 243**	2 359**	2 330**	2 306**
	p	(0.000)	(0.000)	(0.000)	(0.000)
White's	*p*	(0.214)	(0.368)	(0.371)	(0.379)
DW		1.870	1.877	1.876	1.874
RESET	*F*	2.879#	0.857	0.276	0.020
	p	(0.059)	(0.426)	(0.759)	(0.980)

** Significant at <1% (one-tailed). * Significant at <5% (one-tailed). # Significant at <10% (one-tailed).
AMV_{PE} = shares offered times MV_{PE}. AMV_{EBO0} = shares offered MV_{EBO} where r_0 is the discount rate. AMV_{EBO50} = shares offered times MV_{EBO} where r_{50} is the discount rate. AMV_{EBO100} = shares offered times MV_{EBO} model value where r_{100} is the discount rate. *OS* = dichotomous variable coded as 'one' when the issue is reported in the financial press as 'oversubscribed' or 'closed early'. *SPEC* = dichotomous variable coded as 'one' when the issuer identifies the offer as speculative in the prospectus. *II* = number of institutional investors identified from the top 20 shareholders disclosure. *UW* = dichotomous variable coded 'one' if the issue is underwritten. *OWN* = (shares retained by pre-IPO owners / shares offered) x 100. *HOTU* = average underpricing for industrial IPOs in the three months preceding listing date. A*MP* = shares offered *MP*. *SIZE* = market capitalisation of the IPO post listing relative to industry median capitalisation for the year of listing. *GROWTH* = 1-(book value of ordinary shareholders' equity / offer price).

Table D.9 Misvaluation regression results with *OP* as an independent variable

Independent variables		*Dependent variable* MV_{PE}	MV_{EBO0}	MV_{EBO50}	MV_{EBO100}
constant	coefficient	-0.801**	-0.952**	-0.894**	-0.843**
	t-stat	-3.158	-4.227	-4.033	-3.848
	p	(0.002)	(0.000)	(0.000)	(0.000)
OS	coefficient	0.205#	0.271**	0.265**	0.259**
	t-stat	2.115	3.544	3.587	3.611
	p	(0.072)	(0.001)	(0.001)	(0.001)
SPEC	coefficient	-0.068	0.062	0.031	0.005
	t-stat	-0.560	0.743	0.384	0.062
	p	(1.000)	(0.917)	(1.000)	(1.000)
II	coefficient	0.010	0.007	0.007	0.006
	t-stat	0.869	0.657	0.632	0.608
	p	(0.773)	(1.000)	(1.000)	(1.000)
UW	coefficient	0.047	0.069	0.071	0.072
	t-stat	0.352	0.700	0.737	0.768
	p	(1.000)	(0.969)	(0.924)	(0.887)
OWN	coefficient	0.004	0.005#	0.004#	0.004
	t-stat	1.692	2.091	1.979	1.874
	p	(0.185)	(0.076)	(0.099)	(0.125)
HOTU	coefficient	0.003	0.003	0.002	0.002
	t-stat	1.509	1.288	1.183	1.091
	p	(0.266)	(0.399)	(0.477)	(0.553)
OP	coefficient	0.137	0.400**	0.439**	0.472**
	t-stat	1.238	3.578	3.977	0.000
	p	(0.435)	(0.001)	(0.000)	(0.000)
SIZE	coefficient	5.036	0.056	0.056	0.055
	t-stat	1.650	1.403	1.450	1.489
	p	(0.202)	(0.325)	(0.298)	(0.277)
GROWTH	coefficient	0.088	0.063	0.065	0.068
	t-stat	3.543	0.484	0.512	0.591
	p	(0.000)	(1.000)	(1.000)	(1.000)
AR^2		0.257**	0.226**	0.251**	0.273**
JB		202.456**	324.244**	368.748**	408.750**
	p	(0.000)	(0.000)	(0.000)	(0.000)
White's	*p*	(0.095)	(0.026)*	(0.023)*	(0.020)*
DW		1.589	1.580	1.571	1.567
RESET	*F*	10.711**	10.622**	10.437**	10.043**
	p	(0.000)	(0.000)	(0.000)	(0.000)

** Significant at <1% (one-tailed). * Significant at <5% (one-tailed). # Significant at <10% (one-tailed).
t-statistics are White's heteroscedasticity adjusted for MV_{EBO} measures of the dependent variable.
MV_{PE} = price minus the comparable firms estimate of value. MV_{EBO0} = price minus the EBO model value where r_0 is the discount rate. MV_{EBO50} = price minus the EBO model value where r_{50} is the discount rate. MV_{EBO100} = price minus the EBO model value where r_{100} is the discount rate. *OS* = dichotomous variable coded as 'one' when the issue is reported in the financial press as 'oversubscribed' or 'closed early'. *SPEC* = dichotomous variable coded as 'one' when the issuer identifies the offer as speculative in the prospectus. *II* = number of institutional investors identified from the top 20 shareholders disclosure. *UW* = dichotomous variable coded 'one' if the issue is underwritten. *OWN* = (shares retained by pre-IPO owners / shares offered) x 100. *HOTU* = average underpricing for industrial IPOs in the three months preceding listing date. *OP* = offer price per share. *SIZE* = market capitalisation of the IPO post listing relative to industry median capitalisation for the year of listing. *GROWTH* = 1-(book value of ordinary shareholders' equity / offer price).

APPENDIX E UNDERPRICING ROBUSTNESS TESTS

Table E.1 Model 8.1 regression with *MP%* as the mispricing measure

		Dependent variables			
Independent variables		*RUP*	*MAUP*	*RUP*	*MAUP*
constant	coefficient	162.596**	153.258**	162.441**	150.786**
	t-stat	2.986	2.856	2.928	2.758
	p	(0.003)	(0.005)	(0.008)	(0.006)
lnDELAY	coefficient	-55.644**	-53.377**	-55.159**	-52.316**
	t-stat	-3.998	-3.891	-3.898	-3.751
	p	(0.000)	(0.000)	(0.000)	(0.000)
OWN	coefficient	0.490*	0.482*	0.474*	0.468*
	t-stat	2.486	2.485	2.405	2.408
	p	(0.028)	(0.028)	(0.034)	(0.034)
lnSIGMA	coefficient	22.998**	22.818**	22.034**	22.090**
	t-stat	3.812	3.838	3.620	3.681
	p	(0.000)	(0.000)	(0.001)	(0.000)
UW	coefficient	25.336*	26.539*	25.346*	26.395*
	t-stat	2.544	2.704	2.532	2.675
	p	(0.024)	(0.015)	(0.024)	(0.016)
$MP_{PE}\%$	coefficient	-0.109	-0.091		
	t-stat	-2.038	-1.738		
	p	(0.086)	(0.168)		
$MP_{EBO50}\%$	coefficient			-0.088	-0.068
	t-stat			-1.741	-1.359
	p			(0.167)	(0.352)
AR^2		0.149**	0.148**	0.143**	0.142**
JB		1 286**	1 322**	1 300**	1 340**
	p	(0.000)	(0.000)	(0.000)	(0.000)
White's	*p*	(0.113)	(0.080)	(0.174)	(0.147)
DW		1.701	1.734	1.703	1.733
RESET	*F*	11.879**	12.836**	10.290**	11.259**
	p	(0.000)	(0.000)	(0.000)	(0.000)
SIC		10.685	10.656	10.692	10.663

** Significant at <1% (two-tailed). * Significant at < 5% (two-tailed). # Significant at < 10% (two-tailed).
RUP = [(Market price - offer price) / offer price] x 100. *MAUP* = *RUP* – return on the market index. *lnDELAY* = log of days from prospectus date to listing date. *OWN* = (shares retained by pre-IPO owners / minimum shares offered) x 100. *lnSIGMA* = log of the standard deviation of 20 daily returns from listing date. *UW* = dichotomous variable equal to one if the issue is underwritten. $MP_{PE}\%$ = (offer price minus the comparable firms estimate of value) / offer price. $MP_{EBO50}\%$ = (offer price minus the EBO model value where r_{50} is the discount rate) / offer price.

Table E.2 Model 8.2 regression with *MV%* as the misvaluation measure

		Dependent variables			
Independent variables		*RUP*	*MAUP*	*RUP*	*MAUP*
constant	coefficient	88.859	80.814	82.243#	72.142
	t-stat	1.596	1.482	1.869	1.644
	p	(0.112)	(0.140)	(0.063)	(0.102)
lnDELAY	coefficient	-34.091*	-32.203*	-32.634*	-30.208*
	t-stat	-2.379	-2.295	-2.733	-2.521
	p	(0.037)	(0.046)	(0.014)	(0.025)
OWN	coefficient	0.397#	0.392#	0.410#	0.404*
	t-stat	2.014	2.023	2.261	2.277
	p	(0.091)	(0.089)	(0.050)	(0.048)
lnSIGMA	coefficient	22.916**	22.678**	23.909**	23.791**
	t-stat	3.798	3.837	3.023	3.063
	p	(0.000)	(0.000)	(0.006)	(0.005)
UW	coefficient	20.037#	21.269#	19.555*	20.631*
	t-stat	1.998	2.165	2.298	2.522
	p	(0.095)	(0.063)	(0.045)	(0.025)
$MV_{PE}\%$	coefficient	0.106#	0.116*		
	t-stat	2.023	2.270		
	p	(0.089)	(0.049)		
$MV_{EBO50}\%$	coefficient			0.102	0.115#
	t-stat			1.739	2.085
	p			(0.167)	(0.077)
AR^2		0.148 **	0.158**	0.150**	0.161**
JB		1 273**	1 651**	1 253**	1 330**
	p	(0.000)	(0.000)	(0.000)	(0.000)
White's	*p*	(0.090)	(0.091)	(0.033)	(0.033)
DW		1.733	1.767	1.740	1.781
RESET	*F*	14.350**	15.399**	15.442**	16.757**
	p	(0.000)	(0.000)	(0.000)	(0.000)
SIC		10.686	10.644	10.684	10.640

** Significant at <1% (two-tailed). * Significant at < 5% (two-tailed). # Significant at < 10% (two-tailed).
t-statistics are White's heteroscedasticity adjusted where $MV_{EBO50}\%$ is the measure of mispricing.
RUP = [(Market price - offer price) / offer price] x 100. *MAUP* = *RUP* – return on the market index. *lnDELAY* = log of days from prospectus date to listing date. *OWN* = (shares retained by pre-IPO owners / minimum shares offered) x 100. *lnSIGMA* = log of the standard deviation of 20 daily returns from listing date. *UW* = dichotomous variable equal to one if the issue is underwritten. $MV_{PE}\%$ = (price minus the comparable firms estimate of value) / price. $MV_{EBO50}\%$ = (price minus the EBO model value where r_{50} is the discount rate) / price.

Table E.3 Model 8.3 regression results with *MP%* as the mispricing measure

		Dependent variables			
Independent variables		*RUP*	*MAUP*	*RUP*	*MAUP*
constant	coefficient	184.213**	176.094**	177.315**	167.376*
	t-stat	4.241	3.985	2.971	2.813
	p	(0.000)	(0.000)	(0.007)	(0.011)
lnDELAY	coefficient	-65.747**	-62.729**	-63.757**	-60.349**
	t-stat	-5.036	-4.726	-4.554	-4.324
	p	(0.000)	(0.000)	(0.000)	(0.000)
OWN	coefficient	0.469#	0.452#	0.459#	0.444#
	t-stat	2.214	2.162	2.225	2.159
	p	(0.056)	(0.064)	(0.055)	(0.064)
lnSIGMA	coefficient	25.670**	24.998**	25.247**	24.775**
	t-stat	3.265	3.176	4.223	4.157
	p	(0.003)	(0.004)	(0.000)	(0.000)
UW	coefficient	31.951**	32.715**	31.501**	32.162**
	t-stat	3.280	3.367	3.167	3.243
	p	(0.003)	(0.002)	(0.004)	(0.002)
$MP_{PE}\%$	coefficient	-0.079	-0.066		
	t-stat	-1.218	-0.969		
	p	(0.450)	(0.668)		
$MP_{EBO50}\%$	coefficient			-0.049	-0.034
	t-stat			-0.990	-0.687
	p			(0.647)	(0.986)
sqrtII%	coefficient	-4.334*	-4.086#	-4.251#	-4.003
	t-stat	-2.418	-2.250	-1.986	-1.876
	p	(0.033)	(0.051)	(0.097)	(0.125)
BULL	coefficient	33.140**	28.592**	33.520**	29.177**
	t-stat	4.016	3.474	3.916	3.420
	p	(0.002)	(0.001)	(0.000)	(0.002)
AR^2		0.231**	0.212**	0.225**	0.206**
JB		1 316**	1 311**	1 337**	1 337**
	p	(0.000)	(0.000)	(0.000)	(0.000)
White's	*p*	(0.043)	(0.028)	(0.107)	(0.087)
DW		1.780	1.794	1.804	1.801
RESET	*F*	12.213**	13.330**	11.194**	12.322**
	p	(0.000)	(0.000)	(0.000)	(0.000)
SIC		10.630	10.624	10.637	10.630

** Significant at <1% (two-tailed). * Significant at < 5% (two-tailed). # Significant at < 10% (two-tailed).
t-statistics are White's heteroscedasticity adjusted for the $MP_{PE}\%$ measure of mispricing.
RUP = [(Market price - offer price) / offer price] x 100. *MAUP* = *RUP* – return on the market index. *lnDELAY* = log of days from prospectus date to listing date. *OWN* = (shares retained by pre-IPO owners / minimum shares offered) x 100. *lnSIGMA* = log of the standard deviation of 20 daily returns from listing date. *UW* = dichotomous variable equal to one if the issue is underwritten. $MP_{PE}\%$ = (offer price minus the comparable firms estimate of value) / offer price. $MP_{EBO50}\%$ = (offer price minus the EBO model value where r_{50} is the discount rate) / offer price. *sqrtII%* = square root of the proportion of 'top 20' shares held by institutional investors. *BULL* = dichotomous variable coded as 'one' when listing date occurs during a bull market.

Table E.4 Model 8.4 regression results with *MV%* as the misvaluation measure

		Dependent variables			
Independent variables		*RUP*	*MAUP*	*RUP*	*MAUP*
constant	coefficient	94.331	82.592	86.705	73.113
	t-stat	1.610	1.440	1.457	1.256
	p	(0.218)	(0.304)	(0.294)	(0.211)
lnDELAY	coefficient	-35.564*	-33.322*	-33.613#	-30.840#
	t-stat	-2.421	-2.316	-2.244	-2.105
	p	(0.033)	(0.044)	(0.052)	(0.074)
OWN	coefficient	0.413#	0.398#	0.421#	0.406#
	t-stat	2.034	2.003	2.080	2.051
	p	(0.087)	(0.094)	(0.078)	(0.084)
lnSIGMA	coefficient	22.277**	21.948**	23.681**	23.472**
	t-stat	3.577	3.599	3.813	3.863
	p	(0.001)	(0.008)	(0.004)	(0.000)
UW	coefficient	20.832#	21.857#	20.045	20.917#
	t-stat	2.042	2.187	1.958	2.088
	p	(0.085)	(0.060)	(0.104)	(0.077)
$MV_{PE}\%$	coefficient	0.115#	0.123*		
	t-stat	2.073	2.276		
	p	(0.079)	(0.048)		
$MV_{EBO50}\%$	coefficient			0.105#	0.116*
	t-stat			2.107	2.388
	p			(0.073)	(0.036)
lnHOTN	coefficient	-0.288	0.895	-0.593	0.523
	t-stat	-0.055	0.176	-0.114	0.102
	p	(1.000)	(1.000)	(1.000)	(1.000)
lnSIZE	coefficient	-1.741	-1.493	-0.911	-0.645
	t-stat	-0.527	-0.461	-0.285	-0.206
	p	(1.000)	(1.000)	(1.000)	(1.000)
AR^2		0.140**	0.149**	0.140**	0.152**
JB		1 312**	1 359**	1 282**	1 331**
	p	(0.000)	(0.000)	(0.000)	(0.000)
White's	*p*	(0.255)	(0.256)	(0.150)	(0.160)
DW		1.753	1.784	1.749	1.787
RESET	*F*	15.785**	16.84**	15.984**	17.527**
	p	(0.000)	(0.000)	(0.000)	(0.000)
SIC		10.742	10.700	10.749	10.697

** Significant at <1% (two-tailed). * Significant at < 5% (two-tailed). # Significant at < 10% (two-tailed).
RUP = [(Market price - offer price) / offer price] x 100. *MAUP* = *RUP* – return on the market index. *lnDELAY* = log of days from prospectus date to listing date. *OWN* = (shares retained by pre-IPO owners / minimum shares offered) x 100. *lnSIGMA* = log of the standard deviation of 20 daily returns from listing date. *UW* = dichotomous variable equal to one if the issue is underwritten. $MV_{PE}\%$ = (price minus the comparable firms estimate of value) / price. $MV_{EBO50}\%$ = (price minus the EBO model value where r_{50} is the discount rate) / price. *lnHOTN* = log of one plus the number of industrial IPOs in the three months preceding the prospectus date. *lnSIZE* = log of the size of the firm post listing relative to industry median capitalisation for the year of listing.

Table E.5 <u>Model 8.3 regression results with *OP/V* as the mispricing measure</u>

Independent variables		*Dependent variables* RUP	MAUP	RUP	MAUP
constant	coefficient	151.021**	147.945**	152.447**	147.326
	t-stat	2.696	2.651	2.703	2.628
	p	(0.008)	(0.009)	(0.008)	(0.009)
lnDELAY	coefficient	-57.235**	-55.505**	-58.600**	-56.665**
	t-stat	-4.373	-4.257	-4.478	-4.356
	p	(0.000)	(0.000)	(0.000)	(0.000)
OWN	coefficient	0.499*	0.480*	0.455#	0.440#
	t-stat	2.400	2.319	2.205	2.141
	p	(0.035)	(0.043)	(0.058)	(0.067)
lnSIGMA	coefficient	26.397**	25.622**	26.701**	26.138**
	t-stat	4.476	4.361	4.474	4.405
	p	(0.000)	(0.000)	(0.000)	(0.000)
UW	coefficient	31.384**	32.319**	30.972**	32.254**
	t-stat	2.954	3.283	3.117	3.266
	p	(0.004)	(0.002)	(0.004)	(0.003)
OPV_{PE}	coefficient	-2.936	-2.660		
	t-stat	-1.328	-1.207		
	p	(0.372)	(0.458)		
OPV_{EBO50}	coefficient			1.100	1.479
	t-stat			0.698	0.945
	p			(0.972)	(0.692)
sqrtII%	coefficient	-3.822	-3.634	-4.199	-3.992
	t-stat	-1.779	-1.698	-1.960	-1.875
	p	(0.154)	(0.183)	(0.142)	(0.125)
BULL	coefficient	34.091**	29.298**	37.028**	32.684**
	t-stat	4.064	3.506	4.260	3.782
	p	(0.002)	(0.001)	(0.000)	(0.000)
AR^2		0.229**	0.211**	0.223**	0.208**
JB		1 352**	1 354**	1 340**	1 414**
	p	(0.000)	(0.000)	(0.000)	(0.000)
White's	*p*	(0.196)	(0.173)	(0.248)	(0.233)
DW		1.817	1.807	1.858	1.861
RESET	*F*	12.525**	13.405**	11.401**	11.423**
	p	(0.000)	(0.000)	(0.000)	(0.000)
SIC		10.633	10.625	10.640	10.628

** Significant at <1% (two-tailed). * Significant at < 5% (two-tailed). # Significant at < 10% (two-tailed).
RUP = [(Market price - offer price) / offer price] x 100. *MAUP* = *RUP* – return on the market index. *lnDELAY* = log of days from prospectus date to listing date. *OWN* = (shares retained by pre-IPO owners / minimum shares offered) x 100. *lnSIGMA* = log of the standard deviation of 20 daily returns from listing date. *UW* = dichotomous variable equal to one if the issue is underwritten. OPV_{PE} = comparable firms estimate of value / offer price. OPV_{EBO50} = EBO model value where r_{50} is the discount rate / offer price. *sqrtII%* = square root of the proportion of 'top 20' shares held by institutional investors. *BULL* = dichotomous variable coded as 'one' when listing date occurs during a bull market.

Table E.6 Model 8.4 regression results with *P/V* as the misvaluation measure

		Dependent variables			
Independent variables		*RUP*	*MAUP*	*RUP*	*MAUP*
constant	coefficient	130.109**	120.689**	117.386#	107.214
	t-stat	3.091	2.922	2.076	1.939
	p	(0.002)	(0.008)	(0.079)	(0.108)
lnDELAY	coefficient	-45.53**	-44.010**	-43.175**	-41.463**
	t-stat	-4.161	-4.060	-3.101	-3.046
	p	(0.000)	(0.000)	(0.004)	(0.005)
OWN	coefficient	0.340#	0.327#	0.046#	0.401#
	t-stat	2.040	2.003	2.059	2.029
	p	(0.086)	(0.093)	(0.082)	(0.088)
lnSIGMA	coefficient	19.545*	19.297*	23.397**	23.157**
	t-stat	2.777	2.800	3.781	3.826
	p	(0.012)	(0.011)	(0.000)	(0.000)
UW	coefficient	19.069*	20.256*	25.057*	26.449*
	t-stat	2.330	2.551	2.351	2.661
	p	(0.042)	(0.023)	(0.029)	(0.017)
PV_{PE}	coefficient	7.899	7.881		
	t-stat	1.334	1.346		
	p	(0.368)	(0.360)		
PV_{EBO50}	coefficient			3.656*	4.011*
	t-stat			2.351	4.011
	p			(0.040)	(0.018)
lnHOTN	coefficient	-0.4912	0.772	-1.585	-0.551
	t-stat	-0.101	0.159	-0.302	-0.107
	p	(1.000)	(1.000)	(1.000)	(1.000)
lnSIZE	coefficient	-2.922	-2.502	-1.013	-0.743
	t-stat	-0.888	-0.761	-0.319	-0.239
	p	(0.752)	(1.000)	(1.000)	(1.000)
AR^2		0.172**	0.179**	0.146**	0.158**
JB		876**	917**	1 128**	1 167**
	p	(0.000)	(0.000)	(0.000)	(0.000)
White's	*p*	(0.000)	(0.000)	(0.163)	(0.184)
DW		1.803	1.834	1.742	1.816
RESET	*F*	9.169**	8.678**	7.200**	6.850**
	p	(0.000)	(0.000)	(0.001)	(0.002)
SIC		10.704	10.665	10.735	10.690

** Significant at <1% (two-tailed). * Significant at < 5% (two-tailed). # Significant at < 10% (two-tailed).
All *t*-statistics are White's heteroscedasticity adjusted.
RUP = [(Market price - offer price) / offer price] x 100. *MAUP* = *RUP* – return on the market index. *lnDELAY* = log of days from prospectus date to listing date. *OWN* = (shares retained by pre-IPO owners / minimum shares offered) x 100. *lnSIGMA* = log of the standard deviation of 20 daily returns from listing date. *UW* = dichotomous variable equal to one if the issue is underwritten. PV_{PE} = price minus the comparable firms estimate of value. PV_{EBO50} = price minus the EBO model value where r_{50} is the discount rate. *lnHOTN* = log of one plus the number of industrial IPOs in the three months preceding the prospectus date. *lnSIZE* = log of the size of the firm post listing relative to industry median capitalisation for the year of listing.

Table E.7 Model 8.3 regression with *RM2* as an independent variable

		Dependent variables			
Independent variables		*RUP*	*MAUP*	*RUP*	*MAUP*
constant	coefficient	5.454	5.229	7.160	6.875
	t-stat	0.255	0.246	0.335	0.323
	p	(0.799)	(0.806)	(0.738)	(0.747)
DELAY	coefficient	-0.890**	-0.896**	-0.883**	-0.886**
	t-stat	-4.345	-4.397	-4.305	-4.340
	p	(0.000)	(0.000)	(0.000)	(0.000)
OWN	coefficient	0.282	0.297	0.268	0.282
	t-stat	1.375	1.457	1.313	1.388
	p	(0.342)	(0.294)	(0.382)	(0.334)
SIGMA	coefficient	7.024**	6.896**	6.815**	6.691**
	t-stat	4.950	4.888	4.803	4.743
	p	(0.000)	(0.000)	(0.000)	(0.000)
UW	coefficient	29.498**	30.154**	29.185**	29.795**
	t-stat	3.043	3.130	3.012	3.092
	p	(0.003)	(0.004)	(0.006)	(0.004)
MP_{PE}	coefficient	-8.734	-8.748		
	t-stat	-1.585	-1.197		
	p	(0.229)	(0.466)		
MP_{EBO50}	coefficient			-7.816	-7.314
	t-stat			-1.017	-0.957
	p			(0.621)	(0.680)
II%	coefficient	-0.417	-0.414	-0.422	-0.421
	t-stat	-1.585	-1.584	-1.603	-1.606
	p	(0.229)	(0.230)	(0.222)	(0.220)
RM2	coefficient	2.688**	2.005*	2.597**	1.918*
	t-stat	3.498	2.624	3.358	2.495
	p	(0.001)	(0.02)	(0.002)	(0.027)
AR^2		0.218**	0.204**	0.217**	0.202**
JB		1 275**	1 320**	1 281**	1 322**
	p	(0.000)	(0.000)	(0.000)	(0.000)
White's	*p*	(0.221)	(0.225)	(0.164)	(0.159)
DW		1.758	1.749	1.754	1.743
RESET	*F*	7.415**	8.086**	8.005**	8.296**
	p	(0.001)	(0.000)	(0.000)	(0.000)
SIC		10.611	10.607	10.486	10.624

** Significant at <1% (two-tailed). * Significant at < 5% (two-tailed). # Significant at < 10% (two-tailed).
RUP = [(Market price - offer price) / offer price] x 100. *MAUP* = *RUP* – return on the market index. *DELAY* = days from prospectus date to listing date. *OWN* = (shares retained by pre-IPO owners / minimum shares offered) x 100. *SIGMA* = standard deviation of 20 daily returns from listing date. *UW* = dichotomous variable equal to one if the issue is underwritten. MP_{PE} = offer price minus the comparable firms estimate of value. MP_{EBO50} = offer price minus the EBO model value where r_{50} is the discount rate. *II%* = the proportion of 'top 20' shares held by institutional investors. *RM2* = return on the All-Ordinaries index for the two months prior to listing.