A PARAMETRIC, MODEL-BASED, ASSESSMENT OF THE POST-FLOATING BEHAVIOUR OF THE INDONESIAN CURRENCY - OCTOBER 2000 TO MARCH 2003

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ABSTRACT

The study, in the absence of pervious research, tests the post-1997 floating conformity of the Australian/Indonesian (AUD/IDR) exchange rate to international financial parities. That is, the study seeks to provide an initial, three-year, analysis of the post-floating behaviour of the Indonesian currency of early interest to commercial agents. The commencement date of the sample July 2000 was dictated by a required three-year post-floating adjustment period of the Indonesian exchange rate. A modified version of the *Guin and Maxwell* (1996) model was used to first test for interest rate parities (IRP). Model accuracy was then tested using conventional, scale-dependent, measures based on squared or absolute errors and *Theil's U statistic*. The sample period divides into a clear phase of instability of the IDR followed by a period of more sustainable equilibriums. Uncovered interest rate parity (UIRP) suggests that during a declining phase of Indonesian interest rates, with foreign interest rates remaining the same, the rupiah showed a marked tendency to divert from its implied UIRP path. If empirically confirmed, these findings may have significant implications for speculative transactions. However, the interest rate parity null, that mean errors for the sample exceed transaction costs, could not be rejected. The purchasing power parity (PPP) was also tested. The impact of the money supply on Indonesian inflation rates using the quantity theory of money was initially examined. Money supplies could however not be shown to be the primary cause of inflation in Indonesia during the research period. Two distinct and separate methodologies were then used to test for PPP. First, time series were computed and analysed for PPP deviations in terms of their length and magnitude. Standard autoregressive tests followed by unit root tests were then employed to further test findings. First-order differences were also analysed for confirmation of stationarity using conventional *Dickey-Fuller* tests. As a result, the null hypothesis, that the real exchange rate is non-stationary, could not be convincingly rejected. Policy implications for commercial agents arise from the expectation, given approximate IRP and continued interest differentials between Australia and Indonesia, that an appreciating IDR vs. the AUD is unlikely. It is in fact more likely that a gradual depreciation of the IDR vs. the AUD will occur. Moreover, deviations from PPP throughout the sample period signalled changes in international competitiveness, that is, commercial implications derived from PPP deviations depend on whether the foreign entity in question can be classified as a net exporter.

CERTIFICATE OF DISSERTATION

I certify that the ideas, experimental work, results, analysis, software and conclusions reported in this dissertation are entirely my own efforts, except where otherwise acknowledged. I also certify that the work is original and has not been previously submitted for any other awards. Third-party warrants of source confidentiality, as cited in the text, are upheld.

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CHAPTER 1 - INTRODUCTION

Chapter 1 introduces the research context, specifies research questions, and justifies the proposed research. The chapter also provides an outline of the research structure applicable to the sample period of 130 weeks from October 2000 to March 2003.

By way of introduction it is noted that the accelerated integration of international capital markets had necessitated a general refocusing of exchange rate-based research. As speculative, highly liquid, capital transactions became more prevalent in the 1970s—and the classical assumption of static exchange rates proved no longer supportable—these conditions led to a shift *force majeure*. From this point, the focus changed from current to capital account transactions and interest rates (Juettner 1997). The shift also forced monetary authorities to recognise that currency values would now, and to a far greater degree, be determined by capital flows (Hernandez & Montiel 2001). As a result, exchange rate modelling was given a major stimulus by the transition from the former Bretton Woods system of fixed, but adjustable par values, to predominantly floating exchange rates.[1] Prior to this date, most economic literature presented a standard currency-flow model. Rates, during a single period, equilibrated at levels consistent with trade or current account balances (Meese & Rogoff 1983).[2] Implicit in these models was the assumption that speculative capital flows could be regarded as negligible. Exchange rates were primarily, if not entirely, regarded as a product of the demand for and supply of goods on international markets.

This assumption is no longer valid. In the majority of cases, given floating exchange rates, currency values are now determined by capital transactions. In response, Bank Indonesia (BI) had introduced a number of sweeping changes in the 1970s designed to free-up the exchange that culminated in a semi-floating rate vs. a weighted basked of the currencies of Indonesia's main trade partners. This was subsequently changed to

1 Floating exchange rates had defeated the notion of single period equilibria in international goods and capital flows. Research, for this reason, started to focus on exchange-rate models that addressed the resultant equilibrium in asset stocks and capital flows (Juettner 1997). The focus now suggested that exchange rates, in the short run at least, could be regarded as consistent with asset market equilibria and their impact on current account balances.

2 The current account balance may also be defined as net capital outflows equal to domestic savings minus domestic investments.

peg the rupiah to the USD due to pressures from US investors. Post the 1997 Asian crisis, Indonesia finally abandoned its pegged exchange rate regime altogether.

The basic motivation for this study should be seen against this background: an analysis of the application of international financial parities, that is, an early examination of the post-floating behaviour of the exchange rate of one of Australia's major trading partners in Asia. The setting of interest and inflation rates is in this context of primary concern, i.e. secondary factors that influence the AUD/IDR exchange rate are not part of conventional parity testing and therefore excluded from the analysis (see also 4.4: Scope and Delimitations).

The study intends to provide answers to the following questions: have forex markets, post-floating the Indonesian currency in 1997, adjusted to reflect major exchange-rate parities; do certain parities work better than others as forecasting tools and, if so, do they work better in the short or longer term; what happens when the notion of perfect capital markets is relaxed; what role do monetary policies play in this context? The focus of the research is thus based on the basic dynamics that drive the AUD/IDR exchange rate. That is, the study's *prima facie* purpose, in line with DBA requirements to add commercial relevance to findings, is to test the theory and application of financial parities to assist commercial agents in establishing an early risk profile of Indonesia's new currency regime. To this degree, a longitudinal study of predominantly academic appeal is not intended. The research period, the window of opportunity of three years from 2000 to 2003, was bounded on one end by a requisite post-floating cooling off period of three years to allow for post-crisis adjustments of the Indonesian currency and on the other by time limits imposed on this dissertation.

1.1 Research Context

Both domestic and foreign commercial agents with unhedged foreign currency exposures incurred substantial monetary losses in the 1997 Asian crisis. Losses resulted from a previous reasonable belief that Central Banks[3] (CB) could and would maintain pegged exchange rates within a certain bandwidth to their anchor currency

3 The term 'central bank' is used in place of the more comprehensive term 'monetary authorities'. Actions taken by national treasuries, of course, do also affect monetary aggregates.

(Hunt & Terry 1997). This assumption proved ultimately incorrect[4] despite the fact that it resulted in the aggregation of substantial un-hedged foreign currency positions. CBs may actually allow rates to simply depreciate in line with market forces when they are either unable or unwilling to absorb developing currency shocks—a situation that occurred in Asia in 1997 (Pugel & Lindert 2000). For research purposes the crisis may be separated into four distinct but nevertheless interlinked stages (International Monetary Fund 1998):

(1) the currency crisis

(2) the financial systems crisis

(3) the economic crisis

(4) the social and political crisis.

Of these, the currency crisis—and to a lesser extent the financial systems crisis—provide the primary context of the proposed research, i.e. the primary interest of the study resides in the extent to which Australian/Indonesian currency markets have adjusted to IRP and PPP post-floating the rupiah in 1997. To provide an initial overview, it is noted that the Asian crisis commenced in early July 1997 with the floating and subsequent rapid depreciation of the Thai baht. In Indonesia's case, the rupiah came under speculative pressure shortly thereafter. In response, Indonesia widened its exchange-rate intervention band but, effective 14.8.97, crawling pegs were abandoned in favour of a relatively free-floating currency regime (International Monetary Fund News Brief 97/18, 14.8.1997).

As a consequence of freeing-up the value of the currency, Indonesia subsequently experienced a major currency depreciation[5] and, following this event, the largest fall in output of any of the five crisis countries.[6] Investors, and in particular banks with mismatched foreign currency balance sheets, i.e. liabilities denominated in USDs and

[4] Most statistical models that show a normal distribution curve incorporate so called Tail Risks, i.e. statistically extreme or improbable results at each end of the distribution curve. When such extremes occur, speculators and investors alike will find their mathematical-based hedging strategies to be of little value.

5 Immediately prior to the float, the nominal exchange rate was 1 USD = IDR 2441. During the first three quarters of 1998, the rate depreciated to an average of IDR 9100, on occasions reaching IDR 15000. By early 1999, the rate again improved to IDR 8800, fluctuating between IDR 8,000 and IDR 9,000 to the USD.

6 Indonesia incurred possibly the largest single fall in output of any one country in recent economic history.

corresponding assets in local currencies, sustained major currency losses as a result (Singh 2000). Given this context, i.e. the 1997 Asian crisis and subsequent floating of the rupiah, speculations mounted how free the currency actually was to respond to international financial parities, i.e. commercial actors saw parity responses as an important consideration. To this end it was necessary to form an initial working hypothesis that market participants made rational choices that could act both as a prescriptive and descriptive paradigm. That is, a premise that economic agents made logical choices among a range of investment alternatives in accordance with well-defined (portfolio) preferences needed to be formed. Given this assumption, the study's findings proved significant for both commercial agents and public policy implementations (see 6.4).

1.2 Research Questions and Justifications

The research is based on the premise of a degree of dynamic interaction between exchange rates, interest rates, price changes and the balance of payments. It was assumed that changes in relative positions looped back over time to influence the exchange rate and vice versa. Given the absence of risk premiums, IRP for example suggests that similar financial assets denominated in different currencies could be regarded as perfect substitutes and that exchange rates adjust to offset differences between relative interest rates.

Research Questions

The dissertation, in the absence of previous research, provides a preliminary examination of the post-1997 floating convergence of the AUD/IDR exchange rate to various international parities. That is, the research tests parities using statical, computational models of the AUD/IDR exchange rate. Specifically, the study first tests the assumptions of PPP, i.e. the null that the real exchange rate is non-stationary and does not display a tendency to mean reversion is tested. This is followed by a parity test of both UIRP and Covered Interest Rate Parity (CIRP). In detail, Chapter 5 lists and subsequently discusses research findings in the following order:

- Section 5.1 analyses PPP.
- Section 5.2 analyses data relating to UIRP.
- Section 5.3 analyses data relating to CIRP.

- Section 5.4 analyses the impact of trade on the exchange rate.[7]

The effect of GDP on the exchange rate, i.e. that economic growth might be expected to manifest in increased imports and a subsequent depreciation of the currency, was also tested. However, findings proved inconclusive and were therefore excluded from this study.

Research Justification

Closer political ties have renewed trade interests between Australia and Indonesia. However, a current lack of research has made any judgment of the post-1997 floating performance of the Indonesian rupiah (IDR) difficult. The present study bridges this gap, i.e. the study is motivated by the premise that a better understanding of the behaviour of the IDR will lead to an improved analysis of cash flow forecasts at risk from exchange rate variations.

Sydney is expected to host the forthcoming summit of the Asia-Pacific Economic Co-operation Forum (APEC). In an attempt to revive the failed 2006 Doha negotiations, Canberra—apart from environmental issues—is anticipated to use the occasion to push for the greater deregulation of trade in Asia and more specifically Indonesia. A recent study by Lloyd and MacLaren (2004) found that Australia actually stands to gain a great deal in this context in terms of the future removal of barriers to open trade in the region. Indonesia's recent policy reforms and market deregulations have also provided renewed impetus for the expansion of trade between the two nations. This development, reflecting in the presence of some 400 Australian firms in Indonesia and a combined annual trade of approximately AUD 8.5 billion, makes Indonesia Australia's 11th largest trading partner.[8] During the past decade, with the exception of the immediate post-crisis period, Australian exports to Indonesia (in real terms) in fact

7 However, it is generally assumed that the exchange rate influences the trade balance and not the other way around, i.e. that trade is the dependent variable in this association. This premise was tested to rule out trade as an AUD/IDR exchange rate determinant. The association is most likely based on a degree of mutual and dynamic interdependency.

8 On a year-to-year basis, exports to Indonesia, for example, had increased by 11% in 2004 (Department of Foreign Affairs and Trade 2006). Apart from economic relations, strong ties also exist on a range of social issues evidenced by the recent signing of the Australia-Indonesia Partnership for Reconstruction and Development treaty and the existing Australia-Indonesia Development Cooperation Program. These initiatives constitute an AUD 2 billion commitment to assist Indonesia in its reconstruction and development efforts.

grew by an annual average of 7 % (Baird 2001). Given an expanded trade scenario, developments in bi-lateral currency rates can therefore be expected to play a fundamental role. It must at the same time be acknowledged that the rupiah has to date remained volatile. As a consequence, Australian investors may not only be confronted with differentiated yield curves but also risk-adjusted returns[9] that may significantly affect the validity of cash flow projections converted to or from the IDR. For example, corporate treasuries can be expected to balance reward vs. risk increments. Specifically, treasuries must determine the potential for future counter-party or settlement risk and *transaction* and *translation-related* risk exposures, and if necessary select suitable hedging instruments to minimise financial losses (see also 6.4).[10]

The analysis of international financial parities, to this end, provides a basic tool to improve the assessment of risk of future exchange rate changes.[11] For instance, when IRP holds, hedging exchange risk entails much the same cost as offsetting (foreign) borrowing and lending positions. That is, nominal returns, when anticipated changes in the exchange rate are taken into account, yield the same return; when parity holds, risk and opportunity are in equilibrium. Equally, when PPP holds, exchange rate changes will not affect real cost or revenue generations from commercial enterprises (Levich 1998). Summarising, the dissertation's primary justification—although reference is briefly made in Chapter 6 to forecast models—should therefore not be seen as adding to the already considerable store of forecasting models or to provide a longitudinal study of predominantly academic interest. Rather, the dissertation's basic motivation is to provide a preliminary, that is, early statistical analysis of the performance of the

9 For a comprehensive definition of risk within the context of exchange rate variations, see Chapter 5.

10 Over the past 25 years, currencies of developing countries—according to a World Bank survey (World Bank 1998)—lost 72 % of their value relative to the USD and approximately 20 % lost more than 99 % of their value. Sustaining foreign investment and capital transactions therefore depend on adequately addressing such risks (Levich 1998).

11 There are of course numerous statistical, risk-based, systems available to assess exchange rate-related risks. A typical approach to the problem consists of the use of so-called value at risk models (VAR). These models can be applied to any portfolio of assets or liabilities where market values are available on a periodic basis. The approach is based on the probability distribution of price changes using normal distributions and given probability data. For example, an asset valued at USD 6,500,000, i.e. a € 10 million foreign exchange position, given a spot rate of USD 0.65 =1€, suggests that the value at risk will be USD 643,500. This calculation is based on the assumption of a volatility rate of 6 % per month and normally distributed price changes assuming a 90 % confidence level. The value of the position will hence be within the range of USD 5,856,500 - USD 7,143,500 (= 1.65 [*t* distribution] *x* 0.06 x € 10,000,000 x 0.65). There is therefore a 5 % chance that USD 643,500 will be lost over the next month.

recently floated exchange rate of one of Australia's major trading partners of primary interest to commercial agents.

1.3 Dissertation Structure

In order to provide a consistent and clear approach throughout the text, the study adopts a hierarchy based on Levich's (1998) prioritised methodology (see Table 3.1). The text contains both an expositional or interpretive, i.e. a practical, as well as pedagogical component. To this degree, findings are expected to assist commercial agents in the formulation of forward exchange-rate policies. The structure of the dissertation divides into six chapters (see Figure 1.1) and follows the usual format for academic dissertations. The study, post an introductory chapter, discusses mainly contextual issues, i.e. the causes of the 1997 Asian crisis (and impact on Indonesia) and Indonesia's post-1997 regulatory environment. This is followed in Chapter 3 by a literature review, that is: (a) a theoretical examination of international financial parities, (b) the provision of a literature critique and (c) an examination of international parity applications. To this extent, Chapter 3 provides three distinct but interrelated parts that integrate and critique the literature related to the research questions. Chapter 4 explains methodologies and lists delimitations, while Chapter 5 presents research findings. Chapter 6 summarises the content of the study and discusses private and public policy implications.

Finally, the structure of the dissertation, that is, the Table of Contents and associated listings, style, length, format, fonts, margins etc. follows USQ Guidelines for the Preparation of a DBA Dissertation (Doctor of Business Administration Dissertation, Part D, 2004). The format of tables and figures and the general presentation of the dissertation were based on the Style Manual (2002). Moreover, to improve the readability of the document, i.e. to enhance the discussion of frequently difficult material, liberal use of paragraphs and subheadings was made and peripheral issues, for the same reason, relegated to footnotes.

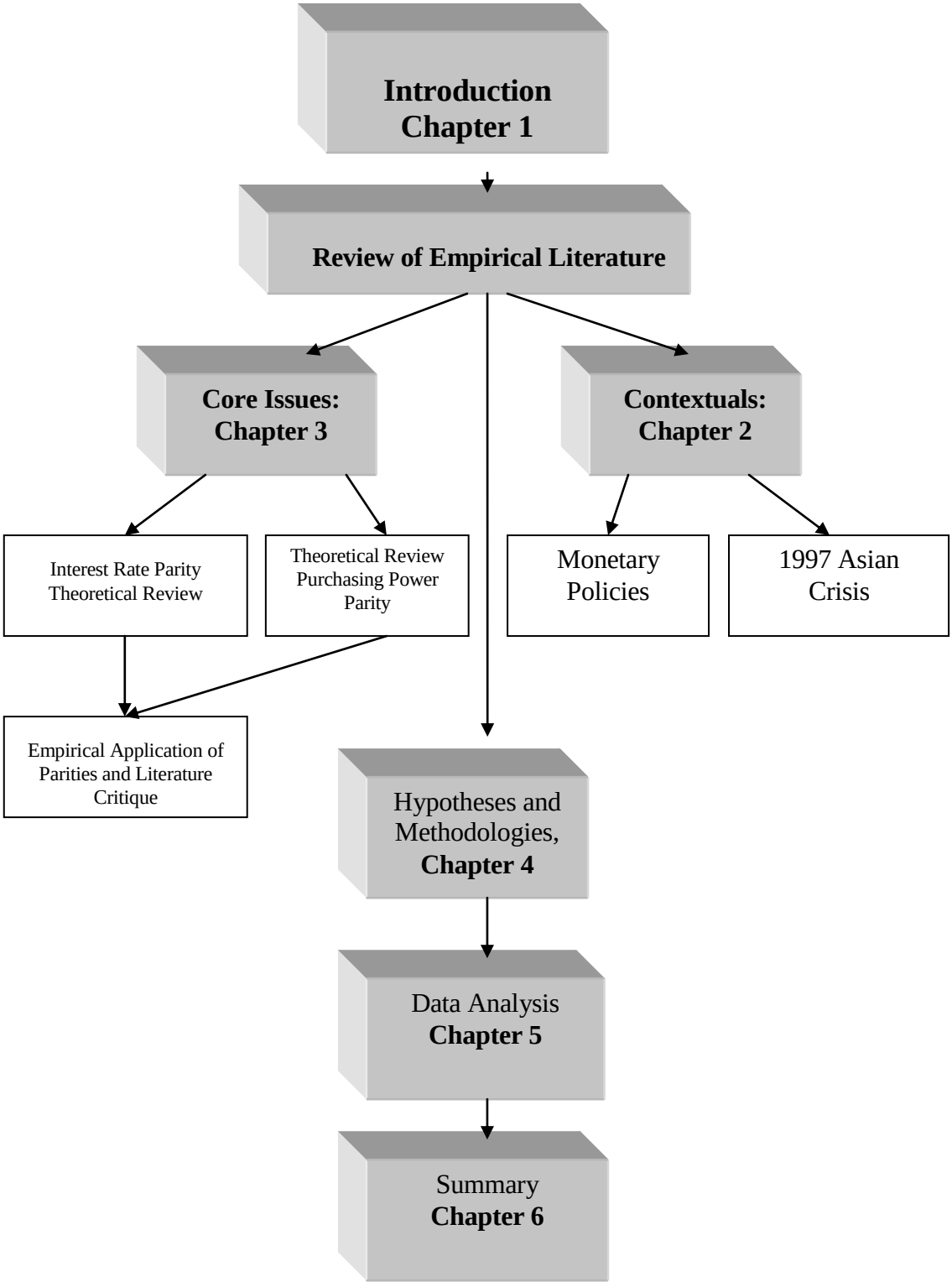
Definitions

Some points must be listed for early clarification. First, for the purpose of statistical examination, Australian and U.S. interest rates are held to be foreign interest rates; this assumption has little practical significance. Second, following the practice adopted by most Australian financial institutions, exchange rates are stated by designating the AUD as the commodity currency priced in terms of the IDR. That is, quotes are expressed in the form: 1 AUD/IDR (Hunt & Terry 1997 p. 363). Third, the term *arbitrage* as used in this study refers to: (a) the buying and selling of currencies in different markets and, unless otherwise indicated, to (b) IRP related transactions. This differentiates the process from transitory differences in spot rates in different spot markets and their immediate buy/sell execution by foreign exchange dealers. Finally, the use of exchange rate terminologies also requires early clarification: so-called *implied* or *estimated* future spot rates describe estimated exchange rates as determined by statistical computations, *forward rates* are market determined and *spot or realised exchange rates* refer to the actual observed exchange rate at a particular point in time. Where the generic term *exchange rate* is used, the term primarily refers to the spot rate—see Chapter 4 for a more detailed account.

Conceptual Map

A conceptual map of the general framework of the dissertation is provided to aid in an early understanding of the study. Both IRP and PPP, due to their centrality, are treated as core issues. Theoretical monetary policy applications and transmissions as well as the 1997 Asian crisis are treated as contextual/parental issues (see Figure 1.1). The structure of the study (Figure 1.1), separating research issues into contextual and core factors, shows the interrelated nature of these components. The map also traces their progression from introductory comments through to research findings.

Figure 1.1 - Concept Map: Literature Review and Research Framework



1.4 Concluding Observations

Chapter 1 introduces the general research context, research questions and the research justification for the study. The chapter also proposes a structure of the dissertation that reflects these aims. That is, in the absence of previous research of the post-1997 floating behaviour of the IDR, the convergence of the AUD/IDR exchange rate to various parities (PPP; UIRP and CIRP) are analysed and tested. To enhance the clarity of predominantly technical material, particular attention was given to the provision of an appropriate structure of the dissertation, i.e. chapters and chapter content closely follow relevant academic standards.

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CHAPTER 2 – CONTEXT: THE 1997 ASIAN CRISIS, EXCHANGE RATE REGIMES AND MONETARY POLICY AND POLICY TRANSMISSIONS IN AN INDONESIAN CONTEXT

2 Introduction

A frequent problem in international financial management concerns the potential for monetary losses due to unanticipated exchange rate changes. Exchange rate variations that result from time-varying risks related to the effect of various factors, both rational and irrational, may be due to either domestic or external influences. Of the latter, the 1997 Asian currency crisis provides a prime example.

This chapter, post a brief contextual introduction to current trade relations with Indonesia, provides the requisite background to reported research findings. Chapter 2 initially examines the causes and extent of the 1997 Asian crisis, mostly in an Indonesian context, and then reviews post-crisis exchange rate regimes and monetary policies and policy transmission channels in Indonesia.

Australian Trade Relations

The extent of Australia's trade links with Indonesia are illustrated by the fact that Indonesia is currently Australia's 11th largest trading partner and 10th largest export market. Indonesia is also Australia's 13th largest source of imports with principal items that include petroleum and gold, while exports consist in the main of cotton and petroleum related products. Recent closer political ties between the two nations have now revived Australia's commercial interests in the region. The 2005 visit by President Yudhoyono, subsequently augmented by the development of a detailed Trade and Investment Framework to improve existing business links, proved a significant step in expanding bilateral trade relations. The visit was subsequently given further expression by The Seventh Australian-Indonesian Ministerial Forum held in Canberra. This Forum was established in 1992 to provide for an accelerated expansion of bilateral trade between the two nations (Vaile 2005).

Signs of the importance of Australian/Asian trade relationship can also be judged by the fact that Sydney is expected to host the forthcoming summit of the Asia-Pacific

Economic Co-operation Forum (APEC) in September 2007. Since Australia stands to gain a great deal from the future removal of barriers in the region, Canberra, on this occasion, can be expected to push for the greater deregulation of trade with Asia and more specifically with Indonesia,.

Moreover, Indonesia's policy reforms and market deregulations have also raised hopes for the expansion of future trade between the two nations. Some 400 Australian firms are currently operating in Indonesia, and a combined annual trade of approximately AUD 8.5 billion makes Indonesia Australia's 11th largest trading partner. On a year-to-year basis, exports to Indonesia, for example, had increased by 11% in 2004 (Department of Foreign Affairs and Trade 2006). In fact, during the past decade, with the exception of the immediate post-crisis period, Australian exports to Indonesia (in real terms) grew by an annual volume average of 7 % (Baird 2001).

Quite apart from economic relations, strong ties also exist on a range of social issues as evidenced by the recent signing of the Australia-Indonesia Partnership for Reconstruction and Development Treaty and the existing Australia-Indonesia Development Cooperation Program. These initiatives constitute an AUD 2 billion commitment to assist Indonesia in its reconstruction and development efforts. In view of these facts, and assuming that Indonesia will continue to develop its democratic institutions, an expanded trade scenario and developments in bi-lateral currency rates can be expected to play a greater role in Australian/Indonesian relationships.

2.1 Causes and Extent of the Crisis

A frequent problem for commercial entities, as already noted, concerns monetary losses resulting from open financial positions due to unanticipated exchange rate fluctuations. The 1997 Asian currency crisis represents an extreme although not necessarily uncommon example of currency volatilities and associated monetary losses. In the space of a relative short period, the average decline in currency values in the five crisis countries amounted to over 50 % of their former par value (see Table 2.1).

Table 2.1 - Impact of the Asian Currency Crisis on the Five Crisis Countries 1997-98

	Currency Decline vs. USD (to lowest point - 7.1997 to 3.1998) %	Decline in Stock Market Capitalisation (1.1997 to 2.1998) %	Interest Rate Peak (three month rate) %
Indonesia	84.3	76.9	27.7
Thailand	55.0	62.8	26.0
Malaysia	46.3	65.3	8.8
Philippines	41.8	N/a	85.0
South Korea	54.6	71.0	25.0

Adapted from: Bank of International Settlements Annual Report 1998

The cause of these losses, although to some extent due to rational forces affecting the external value of currencies, cannot be solely attributed to conventional theory. Rather, a widespread, partially irrational, perception that currencies were incorrectly valued had arisen.[12] Moreover, foreign capital inflows resulting in domestic liquidity booms intermediated through weak financial systems—in Indonesia as elsewhere—had created widening current account deficits in Thailand and Malaysia and inflated asset prices in Indonesia. Weak prudential standards and a lack of sound commercial frameworks, particularly regarding the allocation of credit, had moreover enabled both banks and corporations to gain access to significant amounts of subsequently poorly invested funds. These deficiencies, together with a general easing of capital controls, ultimately forced a number of countries to abandon their *de facto* pegs and adopt floating exchange rates (International Monetary Fund 1998).

In short, perceptions of incorrectly valued currencies, worsening current account deficits and both an emerging asset-price bubble combined with the existence of pegged exchange rates to trigger the crisis.[13] In addition, the effects of political patronage and misallocation of funds due to poor or non-existing screening procedures by banks initially resulted in the restriction of credit and accumulation of excessive

12 Immediately after the floating of the IDR, exchange rates collapsed to an average of USD/IDR 15,000 thus considerably overshooting equilibrium values. However, values subsequently recovered substantially.

13 A general deterioration of balance of payments was in most instances also reflected in a decline in the trade balance/GDP ratio, and deteriorations in both the foreign debt to foreign asset and short-term debt to foreign reserve ratio.

capital and ultimately in sharply increased non-performing loans. This manifest disregard to apply practices in accordance with international prudential regulations in due course combined with a substantially depreciated currency to significantly increase USD denominate bank liabilities that required the closure of a significant number of banks.

Considerable discussions subsequently addressed likely precursors to these events (Corsetti, Pesenti & Roubini 1998). Two major scenarios were generally identified in support of various hypotheses: (a) that currency corrections had become inevitable due to structural distortions and endogenous weaknesses and (b) that the crisis was subsequently accelerated by prevailing financial turmoils and speculations that had ramified into regional spill-overs and a general loss of investor confidence. A view, given these assumptions, may therefore be taken that financial and currency instabilities, precipitated by international capital flows, had combined with national imbalances to trigger the 1997 crisis. The role of financial intermediaries in monetary economics, that is, the hypothesis that intermediaries drive business cycles through reactive risk-pricing, has of course long been recognised—especially during periods of emerging crisis scenarios (Adrian & Shin 2009). The balance sheets of financial institutions therefore serve as a good indicator of risk and the effectiveness of monetary policy transmissions through to capital markets. It suggests that the conventional focus on monetary stocks to judge the conduct of monetary policies should be augmented by reference to the balance sheets of financial intermediaries.

Could the crisis have been prevented? So-called *early warning systems* had long pointed to signs of impending problems. Yet, most systems suffered from a known inability to discriminate between secondary and contingent or primary causes of particular crisis scenarios. Predictive indicator not only require the inclusion of a range of economic[14] parameters to determine embryonic imbalances that have the potential to trigger a crisis event, but should also include the use of various predictive algorisms. A number of probability-based systems are now able to discriminate between these factors (Bank of International Settlements 1998).

14 The IMF now conducts multilateral financial sector risk assessments to determine banks potential risk exposures.

The regional extent of the crisis, indicated by a total GDP decline or negative growth of 6.7 % in 1998, can be judged by reference to Table 2.2. It is clear that the worst affected of the five crisis countries in terms of output losses[15] was Indonesia, followed by Thailand.

Table 2.2 - Impact of the Crisis on the Five Crisis Countries (% change in real GDP)

Country	1998	1999	2000
Indonesia	-13.2	0.8	4.8
Korea	-6.7	10.9	8.8
Malaysia	7.4	6.1	8.3
Philippines	-0.6	3.4	4.0
Thailand	-10.8	4.2	4.3
Total	-6.7	6.8	6.9

Adapted from: East Asia Brief, Sept. 2001

The ensuing economic collapse can also be gauged by reference to Table 2.1 that shows Indonesia as one of the worst affected countries. According to Tanner (2002), while some Asian CBs had initially resisted market pressures to stop the decline of their currencies, currency reserves—in due course—plummeted and capital inflows reduced or ceased. Instead, capital outflows commenced and currency values substantially collapsed. As a result, borrowers, including banks with unhedged foreign currency exposures, incurred significant losses on their foreign liabilities. Banks' domestic asset portfolios concurrently deteriorated due to poor lending practices.

These developments had the predictable effect of shrinking interbank loan arrangements due to remaining doubts about the creditworthiness of counterparties. BI, by using existing discount facilities or in some cases entirely new credit programs, was subsequently forced to initiate a program of direct advances to banks. But these infusions, although intended to replace interbank loans, also increased the reserve balances of individual banks (as well as their liabilities) as a result of offsetting accounting entries. Banks' deposits—due to a residual lack of depositor confidence—

15 The crisis occasioned an unprecedented slowdown in domestic demand, reduced imports by over 50 %, and sharply decreased net private capital inflows across the five crisis countries (IMF 1998). In the span of one year, more than 25 % of the annual change in global output had been lost and crisis countries registered little or negative growth.

remained however at previous levels. Excessive reserves subsequently led to a view although CB injections had increased bank reserves, that BI had failed in its task to increase bank-lendings. This criticism was unjustified. BI's injections had almost certainly prevented banks from curtailing their existing lending rates. A view could therefore be taken, although measures had not resulted in an expected credit expansion, that this lack of response was due to remaining fears of a further collapse by both lenders and borrowers (Bank Indonesia 2001 a).

Research now indicates that financial institutions, particularly in the three former IMF managed countries of Indonesia, South Korea and Thailand, incurred excessive lending exposures. These risks, including lending ratios in excess of 100 % of collaterals and currency and maturity-mismatched balance sheets[16], proved ultimately unsupportable in the face of collapsing currency markets and the emerging currency crisis (Clare & Courtney 2000).

2.2 The Crisis and Post-Crisis Exchange Rate Regimes

For the purpose of definition, Cerra and Saxena (2000) define the term *currency crisis* as an intensive increase in speculative currency transactions as defined by their market pressure index. Gilpin's (2000 p. 139) description of a financial crisis as:

> … risky speculation, monetary (credit) expansion, a rise in the price of the sought-after assets, a sudden and unexpected sharp fall in the price of the assets, and a rush into money or quality investments …

also offers an acceptable definition; the outline in fact contains most of the elements of a financial crisis.

The 1997 Asian crisis commenced in July 1997 with the collapse and subsequent floating of the Thai currency. For research purposes, four separate but linked components of the crisis can be identified (International Monetary Fund 1998):

1. the currency crisis
2. the financial systems crisis

16 In terms of potential risk exposure to non-offsetting currency risks, i.e. lending in local and borrowing in foreign currencies, and maturity-mismatched borrowing vs. loan maturities not covered by forward or swap facilities.

3. the economic crisis
4. the social and political crisis.

Of these, substantially interrelated parts, the currency crisis and to a lesser extent the financial systems crisis provide the primary context for this research. Due to their symbiotic association, the two events may *prima facie* be regarded as one. Currency crises are of course not uncommon when balance of payments pressures combine with overvalued currencies to cause speculative currency attacks. New in the 1997 Asian context was that the crisis resulted from mutually reinforcing external (the currency crisis) and internal factors (the financial systems crisis) that spilled over to involve the whole region. Following some brief, introductory comments, the manifest failure of fixed exchange rates are examined in an Indonesia context. Post-crisis exchange rate regimes are then analysed.

It is initially noted that the flow of (international) speculative or arbitrage-based capital, as opposed to purely trade-based currency flows, had considerably increased by the 1980s (Bryant, Holtham & Hooper 1988). Post-Bretton Woods, capital transactions rather than trade-based currency flows had gradually gained the ascendancy and now made up the majority of international transactions. The Asian currency crisis was to some extent, although not exclusively, caused by an increase in such purely arbitrage-based currency flows base on interest differentials.[17] Global capital flows, particularly to emerging market economies, do of course play an important role in economic developments. But, due to their highly liquid nature, the reversal of these cross-border flows, which include both direct lending and intrabank capital flows, i.e. between headquarters and foreign branches, can also accelerate impending crises scenarios. In Indonesia's case, the contraction of these flows and subsequent trying up of interbank markets, had the predictable effect of causing a severe liquidity shock; Indonesian banks, as a result, drastically reduced their lending rates.

Freixas, Martin and Skeie (2009) find that the ability of interbank markets to assist in the maintenance of systemic liquidity and address emerging liquidity traps assumes a

17 Regression analyses of the five crisis countries show a pre-crisis (1995-96) USD coefficient in the range of 0.86 to 1.00 indicating the existence of a strong peg to the USD (Baig 2001). Such relatively fixed rates came to be regarded as quasi-guarantees of the maintenance of prevailing exchange-rate relativities.

critical role. That is, interbank markets substantially influence the selection by financial institutions of holding liquid assets *ex ante* or acquiring assets in the market *ex post*. The role of CBs in this context is seen as responding to idiosyncratic shocks by lowering interbank interest rates and or by injecting additional liquidity into the banking system. The interbank interest rate, usually determined by open market committees and realised through open market operations, is in this case the average interest rate banks charge each other on interbank markets for their surplus reserves held by BI.

BI's response proved largely inadequate in this regard; specifically, the Bank's response to idiosyncratic shocks should have consisted of lowering interbank interest rates earlier and address an emerging market collapse. When BI finally injected funds into the system, existing fragilities made the impeding shock unavoidable.

Early attention must therefore be drawn to the monetary aspects of exchange-rate determinants, to differentiate this particular model from that of trade-based currency flows. The monetary approach, according to Salvatore (2001 p. 515), represents '… an extension of domestic monetarism … in that it views the balance of payments as essentially a monetary phenomenon'.[18] Trade-based currency flows, as already noted, played a lesser role in the Asian currency crisis (Faruqee 2002).

Second, Cerra and Saxena (2000) note that currency crises result when certain thresholds are exceeded and a number of factors in due course trigger a particular crisis scenario. In the case of Indonesia and South Korea, for example, long-standing structural weaknesses in both their financial and corporate sectors existed. Political uncertainty, compounded by the existence of fixed rather than floating exchange rates, subsequently interacted with these constraints to trigger the crisis.[19] These factors are examined in greater detail next.

18 Under the monetary approach, balance of payments are in equilibrium when an increase in the money supply will cause the currency to depreciate and absorb excesses without requiring capital outflows. This approach is differentiated from the asset market approach, the latter asserting that exchange rates are determined in the process of equilibrating the total demand and supply of financial stocks. Given fixed rates, attempts to increase the domestic money supply will lead to an outflow of the excess supply.

19 Exchange-rate appreciations in line with the USD, together with the rapid expansion of domestic credit relative to GDP and high debt-to-reserve and—in a microeconomic context—short-term debt-to-equity ratios, also contributed to the crisis.

2.2.1 Failure of Fixed Exchange Rates

The implicit belief in the maintenance of pegged exchange rates becomes questionable when severe currency attacks occur (Lyons 2002). The premise of intervention is based on perceptions that CBs are at all times willing and indeed able to maintain the value of their currencies to that of the anchor currency. This belief is manifestly flawed since the premise is based on the belief that CBs hold unlimited currency reserves. Especially where speculative market expectations differ substantially from existing currency values, this is clearly not the case and reserves—as was the case in Indonesia—become quickly exhausted.

Cerra and Saxena (2000) also note that currency crises are frequently preceded by episodes of fiscal deficits and or monetary unrest accompanied by various seigniorage-financed creditor bailouts. Given these fiscal excesses, fiscal deficits typically result in an increase in aggregate domestic demand that negatively impacts on current account balances and inflation rates. Such overt imbalances, given fixed rates, can lead to the expectation of an imminent currency depreciation. To prevent (further) speculative and damaging currency flows, authorities may ultimately have little choice but to permit the devaluation of the currency.

Rankin (1998), noting that countries susceptible to real exchange-rate shocks fare better under floating exchange rates and Lyons (2002) finds when attacks on currencies result in a currency crisis, that exchange rates may simply be allowed to depreciate where private sector demand inelasticity, as was the case in Indonesia, dictate this action. CBs may in fact be either unwilling or unable to absorb arising currency shocks during a developing crisis.

The question therefore arises, what factors determined the selection of an appropriate exchange rate regime, i.e. what makes the national choice of fixed over floating rates a viable option? This issued is considered under the next heading.

Fixed vs. Flexible Rates

Deteriorating terms of trade, given fixed exchange rates, usually constitute a major source of frustration for developing countries (Baird 2001). Indonesia's situation in

1997 and prior to 1997 clearly demonstrates this point. The repercussion of terms-of-trade shocks due to exports predominantly linked to volatile world prices is usually twice as large in developing than developed countries (Tille 2002).[20] Trade-induced shocks are thus likely to explain a much larger degree of GDP volatility under fixed rates. That is, countries with fixed exchange rates must rely exclusively on adjusting growth by contracting domestic investment spending caused by a decrease in the domestic money supply. Specifically, trade deficits require systemic interventions to maintain exchange rates (by reducing the domestic money supply) that result in a reduction in investment and consumer spending. The outcome of the application of these policies are well documented in terms of resulting output gaps and deflationary consequences and need no further elaboration.

What makes the adoption of fixed or floating rates a viable option seems therefore clear. In the case of fixed rates, as was the case in Indonesia, it is largely a nation's propensity to inflationary tendencies. The case of flexible rates is however also well established. The impact of balance of payment variations is primarily absorbed or neutralised by changes in the underlying exchange rate. In the case of fixed rates, this buffer is however lost. The full burden of adjustments falls primarily on domestic growth and currency reserves rather than exchange rates, and result in a contractions in domestic income. The advantages of flexible exchange rates, since the earlier 1950s Friedman findings, have thus been well documented although occasionally disputed. Broda (2002 p. 2), commenting on the result of negative shocks on countries with fixed exchange rates, notes that:

> … output falls until wages and prices are (slowly) bid down at a rate permitted by the nominal stickiness [in prices]. In countries with flexible regimes … [the ensuing] depreciation of the currency … increases the domestic price of exported goods exactly when the international price of these goods has fallen and thereby partially offsets the negative effect of the shock … the currency depreciation reduces real wages at precisely the time when labour demand has fallen, which also contributes to a smoother adjustment.

20 Developing countries typically face larger swings in their export revenues, since their leverage over export prices tends to be minimal. World markets increasingly dictate the price of exports.

Due to the manifest collapse of the five crisis countries, it can hence be argued that: (a) attempts to maintain relative fixed exchange rates had failed or, at least, (b) that fixed rates were shown to be prone to failure when subjected to severe currency attacks. This opinion is confirmed in the extant literature and also accords with the IMF's view that unless supported by adequate currency reserves, fixed rates should not be used (Calvo & Reinhart 2000; Clare & Courtney 2000; Fisher 2001). Post-crisis exchange rate regimes are examined next.

2.2.2 Post-Crisis Exchange Rate Regimes

While the introduction of capital controls in 1997 might have stabilised Indonesia's exchange rate earlier, controls would almost certainly not have prevented the ultimate demise of the parity system. It is argued, *inter alia* by Mussa et al. (2000), that tight exchange rate bands lead to the erroneous assumption of constant rates. This belief, in turn, tends to encourage excessive risk-taking, especially during periods of highly differentiated interest rates, and leads to excessive speculations. For this reason, various recommendations—including IMF requirements—now mandate the adoption of floating exchange rates (Baig 2001). Despite warnings, around 90 countries still use some version of fixed rates and this number has not changed greatly post 1997. Although the five crisis countries have now adopted most of the Fund's recommendations, recent stable currency environments had also led some researchers to conclude that authorities may have returned to their former practice of managing exchange rates. McKinnon (2000 p. 3), for instance, notes:

> … in the year 2000, both the crisis and non-crisis countries of East Asia (with Japan remaining the important exception) have returned to formal or informal dollar pegging … indistinguishable from what they were doing before the crisis.

Other researchers, e.g. Baig, have come to less certain conclusions. Baig (2001 p. 1) notes that '… movements in the Asia-5 currencies … were significantly influenced by the USD's day-to-day movement before the crisis and have indeed continued to do so post-crisis', but then significantly adds '… results from the post-crisis data do not support the view that Asia-5 currencies presently have the same characteristics as they did before the crisis'. While Baig's observations may sound like having 'a bet each way', he is not alone in this position (Hernandez & Montiel 2001). What is not in

doubt, however, is that as a result of IMF directives and the consequences of the 1997 crisis, a greater polarisation of exchange regimes occurred (Fisher 2001). This trend, the adoption of either bilateral pegs within very narrow bands (+/-2.25 %) or floats, led to a belief that the middle ground of currency valuations had disappeared—the hypothesis of the so-called *lost hollow middle* (Hernandez & Montiel 2001).

Theoretically, in the case of clean floats at least, this might be expected to lead to increased exchange rate volatilities. However, Calvo and Reinhart (2000), like Baig (2001) cited above, note that the currencies of the five crisis countries—post-1997—exhibited relatively small variations compared to a pre-crisis period of 24 months to June 1997. They speculate that certain countries may have therefore returned to some form of informal USD pegging, i.e. that the countries in question sought to reclaim the 'lost hollow middle'. In the case of Indonesia, currency changes were shown to be volatile during the research period, particularly during episodes of social and political unrest, and interventions, although they undoubtedly occurred, were less than successful in arresting some of the larger gyrations.

Hernandez and Montiel (2001) conclude, although changes in exchange regimes occurred, that crisis countries—consistent with the Calvo and Reinhart (2000) view—had nevertheless not moved to the position of clean floats. However, Hernandez and Montiel did not augment their methodologies by including a post-and pre-crisis regression to disprove Indonesia's alleged return to currency pegging suggested by Calvo and Reinhart and their conjectures must remain in doubt.

2.3 Post-1997 Monetary Policy Transmissions

The 1997 Asian crisis represents an extreme example of exchange rate-related losses due to unexpected changes in the value of currencies. As a result, Indonesia, one of the five crisis countries, was forced to abandon its fixed rate regime in August 1997 and adopt floating exchange rates. Because of this move, Indonesia was able to adopt relatively independent monetary policies.

Section 2.3 commences with a brief description of Indonesia's present economic environment to provide the requisite background to subsequent discussions. It is initially noted that a strengthening of the (trade-weighted) effective exchange rate and

evidence of the greater macroeconomic stability[21] of the Indonesian economy had translated into a general fall in interest and inflation rates. Improved balance of payments and the successful rescheduling[22] of Indonesia's foreign debts were further factors that had contributed to this outcome. Moreover, various financial restructures had assisted in a general reduction of gearing ratios in the commercial sector and resulted in improved loan and capital adequacy ratios in the banking sector. Consequently, a more positive view of the country's credit rating was adopted by most international rating agencies.[23]

The further improvement of Indonesia's economic performance now clearly depends on: (a) the maintenance of the external value of the rupiah, (b) the sustainability of low inflation rates and (c) a reduction in Indonesia's foreign debt balances. If, for example, a significant depreciation of the currency should occur—depending on present pass-through rates of import costs to domestic prices—a weaker rupiah would inevitably translate into higher inflation and foreign debt rates. This in turn may trigger an increase in interest rates and thus, inevitably, a renewed cycle of depressed demand and falling GDP rates.

Second, it is noted that the involvement of the IMF[24] had improved Indonesia's general economic environment and especially assisted in controlling inflation rates. For instance, Indonesia's new *Central Bank Act 1999* now mandates:

21 Real economic growth rose from 3.7 % in 2002 to 4.1 % in 2003. Growth is expected to reach approximately 5 % in 2004. Nevertheless, growth rates were insuffient to reduce existing unemployment rates. Inflation rates have also declined to a low of approximately 5 % in 2003, but per capita income remains below USD 1,000 per annum; this statistic should not be misinterpreted, since the amount does not take into consideration the domestic purchasing power of the rupiah. The economic impact of the 2004 so-called Tsunami disaster is also difficult to quantify at this stage of writing.

22 One of the reasons contributing to the relative speed of recovery in Asia was because governments generally assumed a crucial role in this process, inter alia nationalising private debts and—in so doing—recapitalising failed financial institutions. The outcome of these practices nevertheless left statutory bodies with little liquidity and required offshore loans. The danger of lending to sovereign entities by finance providers is presumably well known in the event of a default, i.e. sovereign entities are immune from the legal recovery process (Khoo 2000).

23 Ratings nevertheless remain below neighbouring countries due to the relative volatility of the rupiah: Thailand's Baa3 and the Philippine's Ba1 rating for example (Bank Indonesia 2002).

24 The IMF became involved in Indonesia through the granting of a significant stand-by credit facility (Executive Board Approval 5.11.1997) during the 1997 currency crisis. The involvement constituted a substantial IMF commitment. As the Indonesian economy continues to improve, the Fund can however be expected to play a less dominant role in the economic affairs of Indonesia.

1. the maintenance of monetary growth through the setting of specific target rates. BI uses base money[25], a condition imposed under standard IMF requirements, as the operational base to address inflation targets and maintain the stability of the exchange rate,
2. the enhanced independence of BI, e.g. the provision of goal and instrument independence, and
3. the greater accountability and transparency of BI's operations.

It remains to be seen whether disciplined fiscal and monetary policies are maintained after the exit of the IMF in 2003, i.e. to what degree international confidence in the Indonesian economy can be sustained. If the country should slip back into its former cycles of excessive growth and borrowing patterns followed by a rise in inflation, such cycles must inevitably weaken the prospect of Indonesia's further recovery.

2.3.1 Monetary Policy Transmissions

Given market-based financial systems, both banking and capital market channels are virtually indistinguishable as credit providers, with both being linked to fluctuations in their leveraged funding structures. For example, declining balance sheet ratios can serve as an important macroeconomic precursor to a general decline in real economic growth and the effect of monetary policies. The 1997 crisis had clearly demonstrated Indonesia's fragile bank structures and their effect on the real economy. Post-crisis monetary policies were subsequently redirected from a predominant use of overnight interest rates to other monetary transmission channels. That is, although conventional monetary targets previously focused on interest rates, recognition that liquidities affected the quality of banks' balance sheet ratios redirected policy attention. The greater use of credit channels and *lender of last resort* facilities has indeed eased the strain on intermediaries' balance sheets while their use, at the same time, successfully targeted excessive spreads on credit markets (Bank Indonesia 2001 b).

25 Base-money is defined as the demand for money from CBs to meet currency circulations, clear inter-bank balances and meet minimum reserve requirements. The equation suggests that changes in the money stock = changes in nominal transactions, i.e. changes in real GDP + changes in price levels. In December 2002, base-money amounted to IDR 132.2 trillion or IDR 6 trillion below IMF guidelines. In view of various difficulties associated with base-money targeting, a new framework of monetary policy application—similar to Australia's—with interest rates as the major operational target, is currently being considered.

Monetary policy objectives in Indonesia may therefore be broadly described as the provision of an efficient and liquid monetary system consistent with price stability and stable economic growth. The outcome of these objectives are seen in: (a) the prevention of undue price shocks and associated loss of real economic rent, (b) the adequate provision of bank liquidity in line with economic growth, and (c) the external balance of the economy including stable exchange rates (Pugel & Lindert 2000).

It is self-evident that monetary policies are most effective when least constrained. In the case of former crisis countries, frequent difficulties were encountered in this regard to address macroeconomic objectives, e.g. the conflicting goals of smoothing business cycles vs. exchange rate-based concerns. Indeed, one of the principal arguments against the maintenance of fixed exchange rates in Indonesia's case was based on the fact that pegged rates inevitably limited monetary policy applications. Political interference in the conduct of monetary policies had added a further dimension of monetary incompetence to the arising crisis scenario in Indonesia.

Apart from the control of base money and the use of credit channels, one of the more important monetary instruments in the Indonesian context is the setting of short-term interest rates consistent with inflationary aims that involve the establishment of interest rate ceilings and specific cash rate targets (Fry 2000). The policy is based on the assumption that rates will work their way through to capital and financial markets and to this extent presumes the existence of an efficient financial sector. The premise, while possibly valid for developed countries, is however questionable in most developing countries. At any rate, to the degree that the process fails, authorities must fall back on using base money to influence monetary directions. Desired policy outcomes or monetary reactions —even given a relative open economy—are therefore not always certain, i.e. their response on capital markets are not always clear in the Indonesian context.

Any examination addressing monetary policy applications in Indonesia must therefore take account of the efficacy of policy transmissions, i.e. examinations must address the impact of exchange rate related changes on monetary policies and monetary shocks. The analysis, moreover, should include a detailed examination of the pass-through

effect of imported costs to domestic prices, e.g. domestic price changes resulting from a change in the exchange rate (see Figure 2.1).

During the nominated research period to March 2003, changes in the value of the rupiah showed a relative high pass-through coefficient to domestic prices. However, these pressures can be expected to lessen when the exchange rate strengthens and BI continues to sterilise excessive foreign currency flows to assist in the maintenance of base-money targets (Bank Indonesia 2002). In the long run, government securities should of course be considered as an alternative and efforts made to develop a viable secondary market. Meanwhile, the exchange rate must be regarded as a significant channel for monetary policy transmissions in Indonesia.

Siregar and Ward's (2000) paper, dealing with the efficacy of Indonesian monetary transmissions, notes the response of various macroeconomic variables to both monetary and spending shocks.[26] Major findings are summarised in Table 2.3.

Table 2.3 - Forecast Error Variance Decomposition (Selected Shocks) Indonesia

	Shocks					
Impact	**Domestic Monetary Policy**		**Spending[1]**		**Foreign Monetary Policy**	
	M^2	LR^2	M	LR	M	LR
	%		%		%	
Output	2.8	2.8	59.0	55.9	2.2	2.0
Real Exchange Rates	5.5	4.2	87.7	68.0	3.7	3.7
Real Money	1.9	1.9	49.6	38.8	35.5	35.5
Domestic Interest Rates	93.0	9.7	74.8	57.4	13.1	13.1

Adapted from: Siregar and Ward 2000
1 Demand, e.g. fiscal tightening, balance of payment deficits etc.
2 M = maximum level, LR= long run

The data suggest that monetary shocks, with the exception of their impact on domestic interest rates, account for only minimal variations in both output and real exchange rate changes. In the long run, the maximum share of output variability is no more than 2.8

26 The authors use the Mundell-Fleming model, and utilise structural vector autoregressions for the Indonesian macro-economy, to arrive at their conclusions.

% and that of explaining exchange rate-related changes 4.2 %. On the other hand, spending shocks due to fiscal tightening etc., both in the short and long run, account for a much higher percentage of fluctuations across all variables. Real exchange rates, in particular, are significantly affected by spending shocks. This is not altogether surprising since the deflationary effect of spending shocks, i.e. Indonesia's domestic demand, is highly income elastic. Error decompositions show the effect of these events to be larger and more persistent than the effect of monetary-induced shocks (see Table 2.3).

These findings are consistent with the characteristics of a small and open economy and suggest that variations in the exchange rate due to spending shocks play an important role as a channel for monetary policy transmissions.[27] The outcome also suggests that the application of monetary policies without, for example, the application of fiscal policies may not be effective in addressing a future Indonesian crisis scenario.

At any rate, declining deposit interest rates indicated that BI's accommodative stance had been largely successful. However, matching lending rates proved to be inflexible and did not decline to any measurable degree. This suggested: (a) the presence of a significant time lag (typically) associated with poorly developed financial markets and or (b) the perception of possible lending risks associated with longer-term credit provisions. Both factors, given the country's recent financial history and especially its profit-strapped banking sector, are plausible and serve as a likely explanation for the lack to date of lower Indonesian interest rates in line with the real money demand. The ever-present prospect of an inflationary outbreak may be another reason why interest rates had not declined. This topic is examined next. Indonesian post-1997 monetary policies are discussed in further detail under 2.3.3: Monetary Policy Pillars.

2.3.2 Monetary Transmission Channels and Inflation

The recognition that inflation is essentially, although not exclusively, a monetary-induced phenomenon, e.g. that periods of excessive monetary growth tend to be followed by periods of inflation, now largely rationalises Indonesia's monetary

27 Despite the fact that interest rates showed a negative correlation to U.S. interest rates during the sample period (see Figure 5.10), Indonesia's economy possesses the classical characteristics of a small and open economy. Domestic macro-variables are affected by changes in exogenous variables, e.g. world interest rates have a measurable effect on the holding of domestic assets and interest rates, but endogenous factors do not affect exogenous variables.

policies. Authorities, however, had not always appreciated this point, and monetary targets were frequently exceeded (Nasution 2002). Moreover, successful inflation targeting, particularly in relation to output gaps and financial markets etc., required an extensive information platform. These structures are (still) only partially realised in Indonesia.

According to Enoch et al. (2001), Indonesia's economy may be categorised as inflation-prone and subject to regular bouts of inflationary expectations.[28] Price increases, apart from excessive monetary growth, are basically ascribed to four inflation drivers: (a) cost-push type price increases due to the withdrawal of various food and energy subsidies, (b) supply related factors, i.e. wage increases granted for political rather than productivity reasons, (c) exchange rate-related pass-through effect on prices—including cost increases resulting from foreign price rises—and (d) slow progress in structural reforms that had delayed needed productivity gains (Nasution 2002). Demand-related cost increases had played a lesser role in this scenario but changes in the exchange rate, due to Indonesia's near perfect pass-through coefficient, almost immediately reflect in higher import prices. However, the news is not all bad.

A depreciating rupiah, in the long run, will also assist Indonesia's import competing industries to become more cost competitive. It is an important consideration in the Indonesian context since required growth to absorb unemployment numbers is predominantly determined by export rather than domestic, that is, demand-related increases. Equally, in the case of an appreciation of the currency, the high pass-through rate will have a beneficial impact on inflation. Although the outcome on Indonesia's trade balance may be negative, the effect of an appreciating currency on Indonesia's foreign debts will also be positive.[29] The overall pass-through effect to aggregate costs, while obviously different across products depending on the nature of domestic competition and the elasticity of demand, is high and near perfect. Major components

28 Inflation rates ranged from 12.55 % in 2001 to 5 % respectively in 2002 and 2003, but inflation again increased in subsequent periods. In excess of 50 % of Indonesia's output, e.g. primary and agricultural production, including energy exports, are subject to world pricing

29 Given the low pass-through effect for most developed countries, an appreciating rupiah should not necessarily cause a loss of Indonesian export markets.

of the CPI are thus indeterminable and remain outside the direct control of authorities (World Bank 2001 b).

The maintenance of price stability therefore remains central to achieving long-term improvements in Indonesia's living standard.[30] As noted, the value of the currency—both the direct and indirect pass-through effect of changes in the value of the exchange rate—plays an important role in this process. The exchange rate in fact acts as a major conduit through which cost changes are passed through to domestic prices (Cushman & Zha 1995). This tendency is characteristic of most developing economies. The Indonesian exchange rate records relatively short time lags (of four to seven months) during which imported cost increases are passed through to domestic prices, i.e. a relative high pass-through coefficients of 0.13-0.23 applies; the coefficient measures the inflation response to changes in the exchange rate (Nasution 2002). Aspects of Indonesia's monetary policy application, i.e. the exchange rate acting as a channel for monetary policy transmission, are discussed more specifically below.

The Exchange Rate and Monetary Transmissions

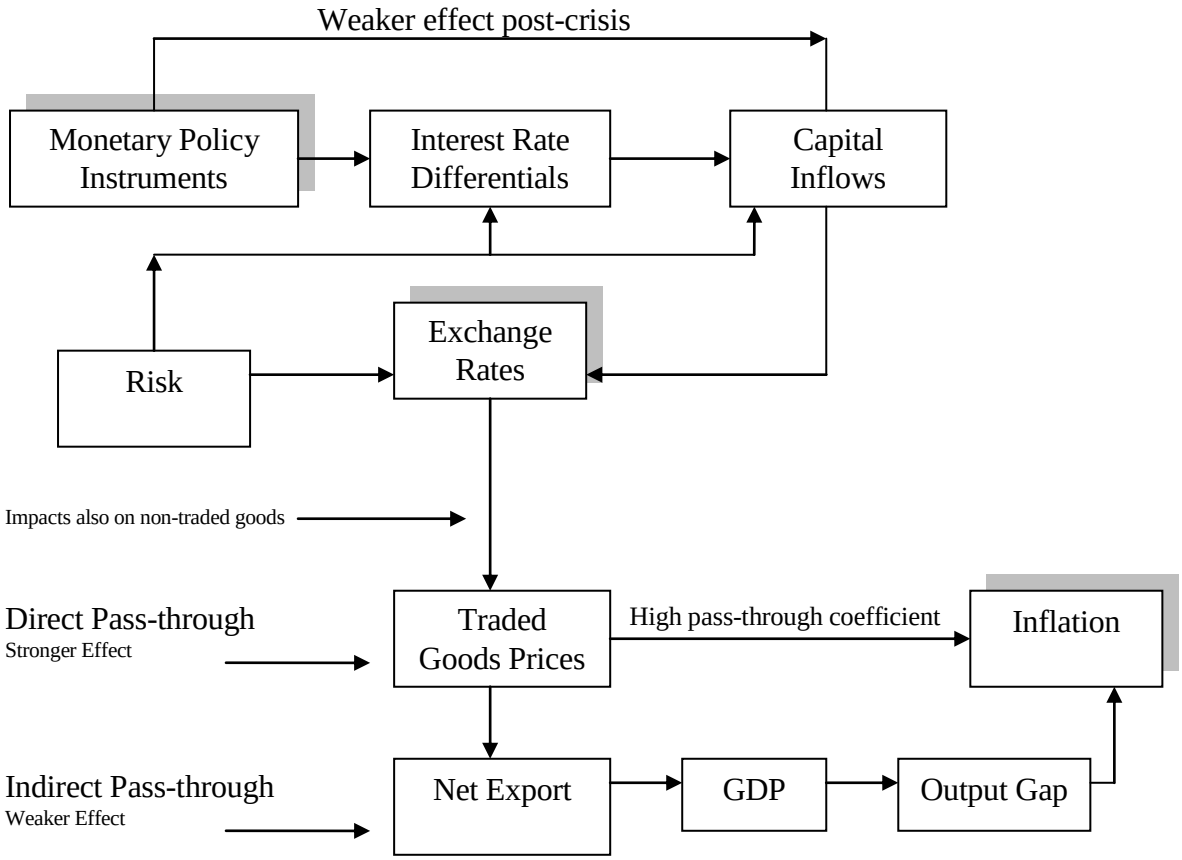
According to Nasution (2002), exchange rates are considered to be one of the more effective monetary transmission channels in Indonesia. Nasution (pp. 14-15) notes:

> … the exchange rate is currently the most powerful transmission mechanism of monetary policy in Indonesia … the exchange rate also influences prices through its effects on prices of traded goods, whose prices are set in international markets, as well as prices of a wide range of non-traded goods in domestically produced and consumed goods. Because of this, the exchange rate policy can be used to pursue inflation targets …

The dynamics of these associations are shown in Figure 2.1. Two channels, the direct and indirect pass-through effect—with the former showing a higher pass-through coefficient to inflation rates—is particularly noteworthy in this context.

30 Increases in cost of living expenses predominantly affect lower income households sensitive to fluctuations in the price of basic commodities, e.g. food and energy prices.

Figure 2.1 - The Exchange Rate as a Channel for Monetary Policy Transmission in Indonesia



Adapted from: Warjijo and Hutabarat 2002

As volatilities continue to decline, Indonesia can be expected to reduce its present policy focus on the exchange rate. Warjijo and Hutabarat (2002 p. 17) note that '… exchange rate pass-through coefficients tend to decline as the floating exchange regime [in Indonesia] becomes more stable and exchange rates stabilise.' As a counterpoint it must be noted that BI may have lapsed back into some form of soft pegging of the rupiah despite Indonesia's *de jure* status as a floating currency (Warjijo & Hutabarat 2002). According to Nasution (2002), Indonesia's monetary policies may be viewed from three different policy angles: policies designed to:

1. cushion the volatility of the rupiah through: (a) periodic currency interventions[31] to achieve inflation targets and (b) the prevention of speculative expectations and damaging currency flows,
2. achieve an appreciation in the real, effective, exchange rate to reduce domestic inflation,
3. prevent an increase in both public and private foreign currency denominated debts due to an excessive depreciation of the currency.

Nevertheless, the last two points are open to challenge. It is in fact more likely that Indonesia is *prima facie* pursuing policies not so much to strengthen but limit the appreciation of the rupiah. This point is further explored elsewhere (see 5.1.1: Conclusions). Indonesia's overriding goal remains to achieve export growth rates that will stimulate domestic growth. Concerns over foreign debts remain secondary with approximate half of the current amount of Indonesia's debt being public USD denominated borrowings subject to long-term rollover agreements.

In summary, the rupiah, quite apart from balance of payments related impacts on the exchange rate, continues to be influenced by political and social unrest and bauds of excessive imports. In addition, the twin factors of declining private sector confidence in the value of the rupiah and shallow exchange markets had caused exaggerated, volume driven, gyrations in the value of the currency. Nevertheless, a gradual return to political stability reflected in an appreciating and less volatile trend in the currency. Both interest and inflationary difference in fact narrowed, reflecting declining *Sertifikat Bank Indonesia* interest yields.[32] Next, Indonesia's post-crisis monetary policy framework or monetary policy pillars are examined.

2.3.3 Monetary Policy Pillars

Past episodes of excessive currency volatilities indicated that the use of interest rates (alone) to restore equilibrium exchange rates was not effective in smoothing

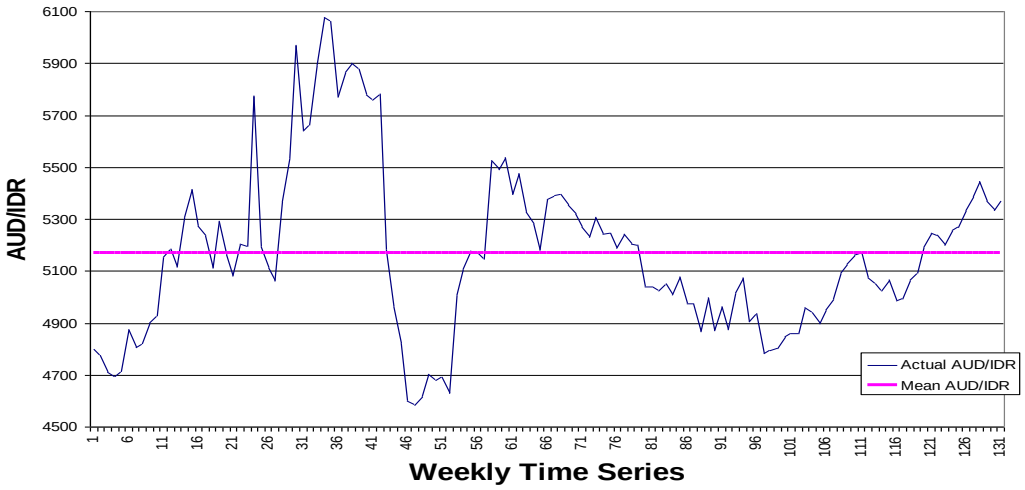
31 Indonesia also introduced limited capital controls, i.e. regulations limiting access by non-residents to rupiah denominated currency transactions. This measure, together with the implementation of prudential rules and guarantees of deposits, dampened foreign exchange speculations to some degree.

32 As measured by the difference between the Australian Bank Accepted Bill and Sertifikat Bank Indonesia interest rate.

instabilities. Figure 2.2 compares the mean nominal AUD/IDR exchange rate over the period (IDR 5169) to actual exchange rates to illustrate the point.

As evident, the range of variances vs. the mean (+18 %; -11%) is significant. Statistics not only illustrate the level of risk attached to IDR denominated transactions and show the tendency of the currency to frequent extremes, but also indicate the relative shallow nature of Indonesia's foreign exchange markets. For example, after an initial loss in the value of the currency of nearly 30 % early in the period, the IDR gained an equal amount over a subsequent 10 weeks period (see Figure 2.2).

Figure 2.2 – Actual vs. Mean AUD/IDR Exchange Rates, Oct. 2000 – March 2003



Appendix 1

Volatilities of such magnitudes are clearly of concern and illustrate the acute sensitivity of the Indonesian exchange rate to political and or social unrest. To correct an overshooting of the IDR, the use of interest rates should have been augmented by fiscal or other more appropriate interventions to smoothen variations. The neglect of these measures may have been due to the fact that Indonesian monetary authorities, until 2003, were still under the effective control of the IMF. At any rate, details to determine the extent of any market interventions by BI, since BI does not specifically publish this information, were not available.

Given concerns, Indonesia's monetary agenda is presently dominated by two basic policy objectives to restore and maintain confidence in the Indonesian economy: (a) to maintain stable exchange and inflation rates—without resorting to the excessive use of interest rate changes—and (b) to restructure Indonesia's ailing banking and, in a wider context, economic[33] system, the latter chiefly through interventionist policies (Bank Indonesia 2002). Monetary policy priorities are based on a three-tiered structure to control prices—see Table 2.4 (Nasution 2002). Most of these issues have previously been discussed.

Table 2.4 - Major Policy Components of Indonesia's Post-Crisis Monetary Policy Framework

Money Supply	Limited Discretionary Actions	Central Bank Transparency and Governance
* Limits of growth in base-money. IMF stipulations ranged from 12-18 % during the 1998 – 2002 period. Limits are basically determined by reference to the quantity theory of money where $M \times V = P \times Q$. * Variations in credit, i.e. the domestic component of the monetary base. * BI is not permitted to finance government deficits. * Bank credits are in the main limited to intra-day facilities and BI's role as a lender of last resort. * Quarterly limits of domestic credit expansion in line with base-money growth. * Control of International Reserves. * Adequate bank capital and supervisory review.	Intervention signalled by excess reserves in the commercial banking sector. *Open market operations are used to control base-money.[34]	Increased disclosure and market discipline by banks enforced through Central Bank Act (1999) regulations. *Mandated reporting requirements. Greater accountability and release of policy rationales etc.

Adapted from: Nasution 2002

The third component of importance in the Indonesia context is BI's mandated powers and responsibilities under Indonesia's new Central Bank Act (1999) that address transparency and governance issues. Prices, apart from decisions by profit maximising agents, are substantially influenced by inflationary expectations. Indonesian markets, in

33 Indonesia's recovery process has now broadened, from an initial dependency on domestic consumption, to prospects of increased exports and domestic investments.

34 BI has been able to sterilise liquidities and managed to keep base-money broadly in line with inflation rates and real growth.

this regard, are extremely sensitive to misinformation and asymmetric policy releases. The transparent and timely release of (proposed) monetary policies, therefore, is seen as central to the process of moderating inflationary expectations.

To this end, BI's operational practices to achieve assigned inflation targets are based on the release of (proposed) policy implementations to: (a) aid in the learning process of private agents and prevents irrational expectations, and (b) reduce the volatility of interest rates that aid economic stability. On the other hand, a lack of transparency reduces the effectiveness of monetary policies and results in overshooting interest rates followed by destructive boom and bust cycles (Eusepi 2005).

In addition to voluntary policy disclosures, policy releases are also required under the Basel II Accord. The Accord is of importance in Indonesia's case. Due to past bouts of inflation, private sector agents continue to hold significant doubts about BI's commitment to control inflation (Bank Indonesia 2002). Given this context, negative market perceptions, rationally or otherwise, rapidly transmit through to investment and pricing decisions and start inflationary spirals difficult to stop once commenced. The transparent release of all relevant policy and data models used by BI to control inflation, a test of BI's inflation-fighting credibility, is therefore important.

Under the so-called *Markov equilibrium*, monetary authorities are expected to select inflation rates that maximise welfare (Armenter & Bodenstein 2005).[35] Rates set too low, depending on the internal dynamics of the economy, may well starve the economy, reduce real GDP and result in destructive deflationary spirals. Market perceptions are seen as especially important in this context. For example, tests of the effect of monetary news on euro-yields showed a high credibility rating of the European Central Bank. In the wake of each monetary tightening, the Bank's inflation averting credential seemed to advance. In contrast, tests based on the response of Indonesian financial yields[36] offered little evidence that the market's perception of BIs'

35 The choice of the inflation rate is bounded by the implied arbitrage condition between nominal bond rates and cash. However, the choice is exogenously constrained by exchange rate policies.

36 BI's reputation as an inflation-averting agent, e.g. the market's sensitivity in response to proposed policy implementations, may partly be judged by reference to the effect of public disclosures on the slope of various investment yields. The conventional measure consists of $q_{t}+-q_{t-}= \alpha+y\ (x_{t+}-E_{t-}\ x_{t+})+\varepsilon_{t+}$,. where $q_{t+}-q_{t+}$ is the change in an asset price between $t-$ and $t+$, $x_{t}+$ represents the announced value of a variable, E_{t-} and x_{t+} equal the expected

inflation averting commitment had changed (Goldberg & Klein 2005). Nevertheless, BI's claim to prevent inflation through appropriate and timely policy implementations is here not under dispute; this topic was examined elsewhere (see Chapter 5) and increases in the money supply could not be linked to inflationary consequences (Bank Indonesia 2002).[37] Rather, it is the lingering view that BI lacks requisite inflation fighting credentials that is the cause of negative market sentiments.

Policy and Operational Transparency

In addressing some of the above concerns, the question what governs BI's monetary intervention t_0 to achieve assigned inflation targets is therefore of some importance. Changes in interest rates—depending on the interest rate sensitivity of debtors—tend to empirically exhibit significant response lags. BI's operational transparency is seen as critical in reducing this lag (Warjijo & Hutabarat 2002).

To enable markets to judge proposed monetary actions, the release of economic forecasts and how these were arrived at are important factors of CB transparency (Eusepi 2005). If, for instance, models do not include all known risk factors, a likely outcome will challenge the constancy of interest rates. On the other hand, if only selected risk factors are taken into consideration, the question arises what risk factors were included and what factors were excluded when setting interest rates?

However, in the Indonesian context, it is largely unclear what form policy rules take, i.e. what economic variables are considered as subjective or reactive by BI and what weight is given to each. Indeed, it is not clear what specific forecast models BI uses or what countervailing interest rates or optimal policy horizons exist over which deviations from inflation targets are expected to return to a given target range.[38] The

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value of that variable before the announcement so that $x_{t+} - E_t - x_{t+}$ is the surprise component (Goldberg & Klein 2005).

37 Indonesia's base money requirements are significantly influenced by a demand-driven cash based economy. To support price stability, the Bank uses OM interest rates without seeking to unduly increase interest rates—a difficult balancing act. The apparent reduction in interest rates in the last quartile of the sample period, in the face of a declining inflation rate, was primarily achieved through cuts in overnight and SBI rates to stimulate growth.

38 Given the welfare mandate of most CBs, Banks are not only required to quantify inflation targets of acceptable price growth, but CBs must also specify their tolerance to deviations from target objectives. A target of zero inflation is of course not acceptable for two reasons: (a) problems associated with the accuracy of measuring results, and (b) problems associated with possibly deflationary consequences, i.e. deferred spending due to falling

Bank does not quantify, at least not specifically, any macroeconomic concerns it may hold in this regard. Questions of how asymmetric risks are treated; what exchange rate parameters—at least broadly—trigger interest rate and direct interventions, or to what degree target rates are influenced by endogenous and exogenous factors (i.e. how tolerant rates are in allowing target deviations to accommodate temporary economic shocks), are mostly left unanswered.

In summary, questions as to what governs BI's *ex ante* monetary intervention protocols to achieve agreed policy objectives are not easily answered. BI's own expositions suggest that the Bank, besides open market (OM) operations—as a rule repo transactions[39]—primarily uses: (a) overnight FASBI and SBI rates[40] and (b) operational plans based on growth and exchange rate forecasts, to set policy rules (Bank Indonesia 2002). While these outlines may seem appropriate for the purpose of general policy expositions, explanations are deficient in addressing broader market concerns. To the degree that deficiencies cause market distortions, BI's transparency is obviously compromised—even accepting that CB policy committees are obviously not in a position to release certain sensitive information that may give rise to undue market speculations.[41]

2.4 Concluding Observations

The literature review in this chapter principally addressed contextual issues related to this study, i.e. monetary policies and policy transmissions against a background of the 1997 Asia currency and financial crisis were examined in an Indonesian context. The assumption that timely and credible information, free from undue political influences, aids in the effectiveness of markets assumes a pivotal role in the efficacy of CB operations. Research suggests that a contributing factor to the 1997 failure of exchange regimes in crisis countries could in part be traced to a lack of these attributes.

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asset prices, loss of output, and problems associated with liquidity traps where monetary policies become largely ineffective due to low or zero interest rates.

[39] The buying or selling of securities by CBs (to banks) to regulate the money supply reflected in the accounts of CBs and payed for by printing money. For example the *Federal Funds Rate* in the U.S. is the average interest rate that banks charge each other on the interbank market for their surplus reserves held by the Federal Reserve.

40 Fasilitas Simpanan Bank Indonesia; Sertifikat Bank Indonesia.

41 Exact parameters of the consistency of policy rules, for example, cannot be released, but variables to which CBs can be expected to respond must be published.

Adjustable currency pegs, unless backed by transparent and independent CB operations, are for this reason no longer regarded as acceptable by the International Monetary Fund (IMF). Due to the manifest collapse of the five crisis countries, it is argued by most that attempts to maintain relatively fixed exchange rates had failed or that rates could be shown to be prone to failure when subjected to severe currency attacks. Despite IMF reservations, the number of countries that maintain fixed-rate regimes, however, has not declined post the 1997 Asian crisis.

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CHAPTER 3 - REVIEW OF EMPIRICAL RESEARCH – THEORY AND APPLICATION OF INTERNATIONAL PARITIES

3 Introduction

Given perfect or near perfect substitutability of assets denominated in different currencies and that the demand for assets is interest elastic and relative price levels directly affect exchange rates, exchange rates are substantially determined by asset and or goods markets. While these conditions in their entirety do not apply to the Indonesian economy, e.g. a limited range of capital controls apply, conditions were nevertheless robust enough to obtain meaningful test results.

The previous chapter chiefly addressed contextual issues, i.e. Chapter 2 examined and reviewed monetary policy transmissions and the 1997 Asian crisis in an Indonesian context. Chapter 3 reviews the theory related to the two core parities addressed by this study, i.e. PPP and IRP, and then provides a literature critique. The chapter also reviews the empirical application of parities (see 3.4). That is, Chapter 3 provides a literature review and integrates and critiques the literature related to the research questions.

The chapter commences with a brief introduction to major international parities—see Table 3.1. The chapter then proceeds to review these parities and, for consistency, adopts Levich's sequence as listed in Table 3.1.

Table 3.1 - Parity Applications in International Finance

Theory	Description	Symbols
Purchasing Power Parity		
Absolute	When the exchange rate is multiplied by the price of a foreign market basket, it will equal the price of a domestic market basked of goods.	P = P* x Spot
Relative	The percentage change in the exchange rate equals the percentage change in domestic less the percentage change in foreign goods prices.	Δ Spot = Δ P - ΔP*
Interest Rate Parity	The forward exchange rate premium approximates the domestic minus the foreign interest rate.	(F-S)/S = i-i*
Intern. Fisher Effect	The domestic interest rate minus the foreign interest rate equals the expected percentage in the exchange rate.	i-i* = E (Δ Future Spot)
Forward Rate Unbiased	The forward premium (for future delivery) equals the expected percentage change in the future spot rate.	$(F_t-S_t)/S_t = (E(S_{t+n}) – S_t)/S_t$

Adapted from: Levich 1998
Explanation of symbols: P = the domestic and P* the foreign price index
Δ in front of a variable means the percentage rate of change
i and i* = respectively domestic and foreign interest rates
E = the expected percentage change in the future spot rate
(F-S)/S = the forward premium.

As evident from Table 3.1, the fundamentals of exchange rate behaviour rely to a substantial degree on economic theory. For example, when UIRP holds, i.e. differences between domestic and foreign interest rates equal the market's expected change in the exchange rate, parity obviously implies the equalisation of real returns. There seems therefore little point (at least not on a pre-tax basis) to borrow in a foreign currency when, for example, domestic interest rates are higher than foreign rates. Interest rate advantages are likely to be offset by a depreciation of the domestic relative to the foreign currency; a point frequently overlooked by novice traders and the cause of much litigation in the 1980s against Australian commercial banks (Wilde & Islam 1993). In addition, since the value of a given foreign liability increases with each currency depreciation, banks may also call-up additional securities where existing collaterals are deemed insufficient to cover original securities.

3.1 Purchasing Power Parity

Self-balancing market forces, i.e. international goods-arbitrage markets, provide the basic dynamics that drive PPP. The notion of LOP, given this context, assumes a critical role in determining equilibrium prices. Numerous studies, however, have also shown that deviations from the LOP are frequent, volatile and memory persistent (Baig 2001); these issues are further examined under 3.1.2 below.

Despite limitations, PPP is one of the more important forecasting components. The absolute version of the theory, given an identical and equally weighted basket of goods, suggests that equilibrium exchange rates are equal to the ratio of the domestic to foreign prices—when the exchange rate is multiplied by the foreign price index, the rate equals the domestic price of the basket. The relative version of PPP, on the other hand, merely requires that proportional changes in exchange rates are equal to periodic price differentials. PPP is thus premised on a belief that the real exchange rate is stationary and only deviates from its long-term equilibrium by temporary shocks (see Table 3.1). Nevertheless, in the short term, international goods arbitrage has only a limited effect on equating international prices (Rogoff 1996)[42].

While long-run PPP, depending on the type and sample size, can empirically be shown to yield better results, convergence is often slow and deviations tend to only dampen out at a rate of approximately 15% per year. It is generally argued that this lack of empirical evidence supporting PPP may be due to a number of reasons. The existence of transaction costs, taxation levies, trade restrictions, non-traded goods, imperfect competition and government interventions on foreign exchange markets or even differences in the composition of market baskets are all factors that cause the general failure of PPP (Lestari, Kim, & Silvapulle 2005).

42 International arbitrage has only a limited effect on equating international goods prices in the short term. Rogoff (1996 p.664) describes this phenomenon by reflecting '…how is it possible to reconcile the extremely high short-term volatility of real exchange rates with the glacial rate (15 percent per year) at which deviations from PPP seem to die out?'

The PPP Equation

Theoretical expositions are sufficiently covered in undergraduate texts to warrant further detailed treatment here. Comments are therefore brief and referenced. PPP may be expressed in the form of equation (1). The PPP spot rate is derived from the nominal exchange rate *S* and price-level relativities between *P** and *P* representing foreign and domestic price indices (Levich 1998), i.e.:

$$S_1 = S \times \frac{1+P}{1+P^*} \qquad (1).$$

Equation (1) may also be expressed in terms of percentage changes in these variables:

$$s_r = s + p^* - p \qquad (2),$$

where s_r represents the real value of the exchange rate, *s* the nominal exchange rate and *p** and *p* foreign and domestic price levels. Accordingly, where the nominal value *(s)* of the domestic currency depreciates *(s>0)*, the value of s_r *ceteris paribus* increases. For example, a domestic price increase *(p>0)* can be expected to cause a decline while a foreign price increase *(p*>0)* improves the competitive value of the domestic currency. (Reilly & Norton 1995).

Given the assumed homogeneity of goods, the empirical literature notes where the rate of domestic exceeds foreign inflation rates *(p>p*)*, changes in demand will tend to favour the price competitive foreign domicile (Hunt & Terry 1997); the change results in the appreciation of the foreign currency. Hence, where the nominal value of the exchange rate, i.e. changes in relative currency values respond to price relativities, the real exchange rate remains stationary. The change of the real exchange rate is qual to *0* and a competitive price advantage or disadvantage therefore equalised through changes in the value of the nominal exchange rate—when the nominal value of the exchange rate changes in accordance with PPP, the real exchange rate remains stationary (Frankel & Rose 1995). These issues are further explored below.

3.1.1 Constant Nominal and Real Exchange Rates

If the nominal exchange rate remains constant, a rise in domestic prices has the same effect on exports as if the domestic currency appreciates, i.e. a real appreciation of the currency occurs. In this case, constant nominal exchange rates do not reflect domestic price increases. The currency gains in relative purchasing power. Equally, a rise in foreign prices, given constant nominal exchange rates, has the same effect on import costs as a depreciation of the domestic currency. That is, a real depreciation of the currency occurs. The domestic currency has lost purchasing power vs. foreign price parity (Juettner 1997).

Reilly and Norton (1995) note whereas PPP implies that the exchange rate is the dependent and price levels the independent variable that a reversal of these variables results when a change in the real exchange rate occurs. For instance, a depreciation of the currency can lead to inflationary tendencies due to import-induced price increases. Conversely, a appreciation of the currency might trigger bouts of deflation due to a slow-down in economic activity and the exposure of the economy to increased import competition (Tanner 2002). The extent of these movements obviously depends on the existence of accommodating monetary policies. Price impacts on the exchange rate are further examined under the next heading.

3.1.2 The Law of One Price

In the absence of transport and other barriers to trade, i.e. given perfect markets, the LOP, as noted, provides the foundation for PPP. The law suggests that like goods should sell for similar prices once prices are converted to a common currency. That is, the law applies provided baskets of goods are homogenous and their composition is equally weighted (Juettner 1997).

However, deviations from the norm occur and international trade arbitrage is far from perfect. As a consequence, research has focused on the actual application of the LOP. Rogoff (1996 p. 654) observes that:

> ... overall it is hard to read the empirical evidence without noting that outside a small range of homogenous goods, short run international arbitrage has only a limited effect on international goods market prices.

In the short-run it is therefore the real exchange rate that shows volatility. This is not surprising. Currency values are not only influenced by prices but numerous other factors (Pugel & Lindert 2000). Moreover, price-stickiness in the buyer's currency for goods not subject to market pricing[43]—apart from weakening the expenditure-switching effect of monetary policies—can also distort exchange rate values (Cumby & Obstfeld 1984). For example, the depreciation of a currency, theoretically, should correct a trade deficit due to a change in price relativities; foreign suppliers may be expected to adjust their prices in the domestic currency. Nevertheless, consistent with empirical evidence, price stickiness tends to generate deviations from PPP due to a general failure of the LOP. It follows, when movements in nominal exchange rates are not fully passed through to international costs, delays lead to an imperfect pass-through to consumer prices. Data applicable to the U.S. economy relating to the underlying cross-sectional distribution of price stickiness (derived from aggregate data on nominal and real output) infers that their distribution is fairly consistent. That is, results suggested that distributions are similar to the empirical distribution derived from the microeconomic evidence of U.S. price setting practices (Carvalho & Dam 2009). Moreover, the examination, the comparison of aggregate time series to microeconomic data that relate to the distribution of price rigidities and that allows for this type of heterogeneity, also sheds some light on the joint dynamics of output and prices; the approach assists in reconciling the extent of nominal price rigidities implied by aggregate information to the available evidence from microeconomic data.

Dedola and Leduce (2002 p. 3) note '… there is overwhelming evidence that, since 1973, large swings in nominal and real exchange rates have been closely correlated while price indices have been fairly stable.' This indicates, they suggest, that price rigidities are a contributing factor to economic fluctuations. Klitgaard (1999), examining the pricing practices of Japanese exporters, finds that most firms adopt a middle course. A 10 % rise in the yen, for example, reduces export profits relative to domestic margins by 4 %. This result, moreover, is confirmed in U.S. markets where the pass-through effect from a USD depreciation is estimated to be approximately

43 The pricing of goods subject to managerial discretion tends to empirically exhibit so-called price stickiness due to prevailing competitive pressures. This is particularly the case where the price elasticity of a particular good or service is high.

60 %. The outcome suggests that U.S. import prices tend to increase by only 60 % and exporters subsidise the remainder by accepting lower profit margins (Bryant, Holtham & Hooper 1988).

3.1.3 PPP and Exchange Rate Stationarity

The relative version of the PPP hypothesis tested in this study mandates that changes in exchange rates are proportional to relative, periodic, differences in inflation. In so far as this applies to short-term results, the assertion is not generally supportable (Rogoff 1996). The literature notes that short-term PPP tends to however apply where excessive inflation (gaps) exist. Nevertheless, outcomes also depend on the periodicity of tests, the size of a particular sample and or the use of a particular methodology (Taylor 2002).

The literature, moreover, notes (Bessec 2002) that econometric tests using unit root co-integrative tests such as the Dickey-Fuller test, offer an improved method to validated results. The validity of the PPP hypothesis depends on whether the real exchange rate, post-random disturbances, can be shown to return to its equilibrium value over time. McKenzie (1997) notes that autoregressive and standard unit-root tests enable meaningful results of the mean-reverting property of real exchange rates to be obtained. A random shock, for example, should not permanently affect the real exchange rate. If, on the other had, the real rate can be shown to be non-stationary, the rate is said to perform a random walk. Where the non-stationary null cannot be rejected, the process contains a unit root and deviations from parity may be cumulative and memory persistent rather than mean-reverting. PPP cannot be supported in the long run. Equally, if the null is rejected, it suggests a tendency of the real exchange rate to be mean-reverting consistent with PPP. Levich (1998) importantly notes that a meaningful analysis of PPP must also include an examination of: (a) the actual magnitude and (b) length of PPP deviations from parity based on time series to improve the value of PPP-based evaluations for managerial decisions. This imperative has been adopted in this dissertation (see Chapter 5).

3.1.4 Critique

To avoid discontinuity, points of the literature critique are listed monographically:

[I] Post-1973 developments in exchange rates had dictated a refocusing of the entire exchange rate debate. Although evidence existed for some time that PPP, in the long-term, could claim validity (Kravis & Lipey 1978)—particularly during periods of excessive inflation—Frankel (1981) points to the reduced applications for shorter periods. The empirical literature, for a period, seemed to therefore be split. Nevertheless, a number of empirical studies subsequently confirmed the validity of the theorem during periods of hyperinflation and over shorter periods (Bessec 2002).

[II] Despite shortcomings, capital and operating budgets of foreign firms remained dependent on the assumptions of PPP—at least in the long run. The literature notes (Dornbusch 1987; Levich 1998) that the long-term examination of PPP deviations, rather than being based on regressions, should hence be more appropriately focused on the actual dimension and periodicities of deviations. That is, the length of time and magnitude of deviation should be examined to reveal the response to competitive shocks. When these issues are taken into consideration, outcomes can frequently be shown to support the stationarity of a given time series (Frankel & Rose 1995). It could in this sense be argued, rather than confirming a random walk, that PPP in fact held. These aspects had been ignored by earlier research that tended to predominantly focus on regression-based analyses that failed to examine the specific dynamic behaviour of the real exchange rate over time.

[III] In summarising results, empirical evidence, according to Pugel and Lindert (2000), confirmed that PPP played a disproportionately greater role in exchange-rate determinations where:

- relative (hyper) inflation causes significant price differentials and the composition of the CPI is identical,
- internationally-traded goods represent a substantial component of the price index,
- the presence of an open economy and homogeneity of goods exists, and
- time horizons are longer.

Lothian and Taylor (1996) note, particularly in relation to the last point, that the real exchange rate may periodically return to PPP and therefore that mean reversion occurs when a series crosses the PPP equilibrium intermittently. This implied that PPP held in the sense that parity divergences were either negative or positive and that divergences averaged out over longer periods; a fact supported by present findings. It had, moreover, long been recognised that the PPP hypothesis was relatively well supported in the case of heavily traded goods provided that free trade prevailed (Mundell 1968). The latter issue in particular tended to be insufficiently explored and it was frequently assumed that an open economy existed when in fact informal, that is, covert restrictions applied that hindered free trade—especially in agriculturally based products.

[IV] Longer-term studies could also be challenged on grounds that observations frequently included an indiscriminate mix of floating as well as 'target-rate' regimes that did not provide empirical evidence on which to base either a confirmation or rejection of PPP. A large number of analyses simply ignored the non-linearity of pegged exchange rates (Miller2006). In the face of the frequent rejection of PPP where CBs had in fact adopted target zone exchange rates, this issue constituted a major research shortcoming. Where rates were generated by some non-linear transformation, the non-linearity of the data subsequently called into question the integration of observed exchange rates and tests could be seen as miss-specified.

[V] The PPP hypothesis requires that the real exchange rate remains stationary over any given period. PPP, given this form, only allows for periodic deviations from their long-term equilibrium due to transitory shocks. A less restrictive form of the PPP hypothesis, however, only requires that exchange rates evidence a degree of mean reversion. That is, the less restricted form of PPP, although requiring that long run variances should be finite, allows for some compromise and persistence in memory. The term *mean reversion* was in this context frequently and imprecisely defined and used. Both stationary and non-stationary time-series could in fact be shown to be mean-reverting (Fisher & Park 1991).

[VI] Rogoff (1996) observes that tests based on unit roots frequently implied that even longer-term exchange rates deviated from their equilibrium, i.e. that deviations tended to be cumulative with little evidence to mean reversion. Empirical judgment, since the speed of convergence was slow and deviations only dampened out in the long run, was therefore dismissive of PPP (Meese & Rogoff 1983). However, a problem with earlier examinations had been that selected time-series were predominantly focused on developed countries with low inflation rates that substantially biased results. Moderate inflation rates could subsequently be shown to be more influential in their impact on exchange rates.

[VII] Deficiencies, combined with a lack of sample size and the poor methodological treatment of the data, were to eventually cause a shift of the research focus. For example, longer-term tests could not always be shown to be mean-reverting, at least not in the strictest sense—even where trade arbitrage was vigorous and relative inflation differences significant—nor did deviations persistently exhibit non-stationary tendencies. Failure to find consistency seemed to therefore imply that nominal exchange rates and prices showed little inclination to cointegration and that variables were inclined to limitless drift. Jacobson and Nessen (2004) note that a general failure to reject or confirm random walk could under these circumstances frequently be traced to the absence of powerful statistical models.

[VIII] Rogoff (1996), in examining basic PPP defects, notes two basic points of agreement: (a) that real exchange rates converge only over prolonged periods (> 10 years with the midpoint occurring around 4-6 years) and (b) that in the short run, deviations from PPP can be substantial. The validation of short-term PPP required a level of constancy or stationary of the real exchange rate that was empirically not observable. A possible explanation for this slow decay, Rogoff (1996) notes, may be found in high transport costs and other such impediments to free trade including low labour mobility. Nevertheless, such explanations were not entirely convincing. Transport costs had actually declined by the mid 1980s due to the increased use of containerised freight on all major shipping passages. Tariff rates, also, had significantly reduced under the agency of former GATT arrangements and labour become more mobile. A likely explanation suggested that international markets were

therefore not as integrated as commonly supposed. This aspect of the research had in fact attracted little research attention. Although a high level of integration, particularly in intra-industry based trade between industrialised nations could be observed, whole regions, predominantly Latin America, the Middle East and the Sub-Saharan region, were less well integrated in the global economy (Broda 2002). Moreover, Rao (1995) notes that the assumptions of a common price index and homogeneity of goods had also restricted the absolute form of PPP. In reality, the majority of internationally traded goods were heterogeneous and merely similar in configuration. Both assumptions were however required to substantiate PPP's basic assertion of the agreement of international prices.

3.2 Interest Rate Parity

Early theoretical developments of the IRP theorem can be traced to Stein and Glahe (Guin & Maxwell 1996). Compared to PPP, which is goods-arbitrage based, IRP substantially focuses on capital arbitrage to account for exchange rate relativities. That is, in the absence of risk and monetary interventions, IRP postulates that exchange rates can be expected to adjust to offset differences between interest rates. Interest differentials determine *ex ante* changes in exchange rates, e.g. potential gains due to existing interest rate differentials are offset by a depreciation of the currency. The validity of the IRP theorem is however not empirically established (Pugel & Lindert 2000). Guin and Maxwell (p. 295) surveying historical evidence for instance note although numerous empirical tests of the IRP had been carried out, that tests of earlier studies '… suffered from a lack of experience with flexible rate systems' while studies from later periods '… reported only mixed support for the IRP'. Their article concludes with the general observation (p. 310): '… whether the theory of interest rate parity matches the practice of the theory is quite apparent among some nations but less obvious among others'.

Section 3.2 first reviews different IRP expositions (see 3.2.1) and then examines the empirical evidence relating to UIRP (see 3.2.2) and CIRP (see 3.2.3). Factors that link PPP to IRP are subsequently also analysed.

3.2.1 Rationale

IRP points to a linkage between currency rates and international capital markets (Levich 1998). However, before parity occurs, well-developed financial markets must exist that possess the required liquidity and functional efficiency to accommodate large-scale international transactions and the domestic structures that efficiently transmit monetary polices to capital markets. In addition, IRP requires: (a) the absence of barriers to arbitrage (perfect capital markets), (b) the absence of (default) risk and in the case of UIRP, (c) the predominant risk neutrality of investors. CIRP, on the other hand, is based on the premise that forward premiums/discounts are equal to the expected change in the future observed exchange rate; UIRP relates the expected change in future spot rates to interest rate differentials; risk accrues and speculative investments are possible (Gregory 1987).

The two theories, notwithstanding, are consistent. For instance, both covered and uncovered parity holds when the expected exchange rate is equal to the forward premium. It must however be noted that future exchange rate expectations are not always observable in markets due to the absence of forward currency facilities. This, in the case of the rupiah, also applied to Australian foreign exchange markets. But even when market expectations are freely available from financial institutions or traders, short-term expectations tend to be often inconsistent or biased. Longer-term outlooks, on the other hand, frequently evidence regressive tendencies, i.e. a view prevails that current volatilities are temporary and rates will return to equilibrium.

Nevertheless, foreign exchange markets[44] are held to be efficient when forward rates exceed future spot rates as often as they fall below it and rates do not record exploitable patterns. Consequently, a price efficient market[45] exists when investors are unable to systematically exploit markets; investors cannot consistently profit from existing interest rate differentials.

44 The use of this term or the term ‘forex’ denotes transactions occurring on inter-bank markets, i.e. an informal market comprising electronic networks between market participants.

45 Efficient markets are defined by Levich (1998 p. 213) to mean that ‘… on average errors of the formulation of expectations about prices or returns are zero and [that] these errors follow no patterns that may be exploited…’.

MacDonald and Taylor (1989) broadly support these observations but find, although markets may act quite efficiently in limiting arbitrage returns from short-term maturities, that profitable opportunities due to certain market dysfunctions are observable in longer-term instruments (> 12 months). Distortions, for instance, arise from perceived counter-party risk, i.e. the presence of credit restrictions or existence of dealer limits between banks. These limitations can cause covered arbitrage (preferences) to cluster at the short-end of the maturity spectrum. For example, so called *liquidity hording* by banks, i.e. the retention of reserves beyond cautionary provisions and increased interest rate volatilities of CB issued funds, had disrupted interbank (loan) markets due to perceptions of counter-party risk. Estimates based on overnight data relating to funds traded by BI, i.e. data based on interbank transactions, suggested a progressive build-up of banks' precautionary holdings in the face of an increase in the rate of non-performing loans. Increases indicated a general reluctance by financial institutions to provide credit. That is, the balance sheets of Indonesian financial intermediaries came to increasingly reflect concerns over of an emerging liquidity crisis; intraday CB funds indeed spiked above discount rates (Bank Indonesia 2001 b).

The notion of CIRP is more fully explored under 3.2.3 below. The next heading addresses UIRP.

3.2.2 Uncovered Interest Rate Parity (International Fisher Effect)

UIRP is premised on the assumption that market participants are risk indifferent and act rationally and that differences between relative interest rates govern market expectations of future realised exchange rates (Pugel & Lindert 2000). Gregory (1987 p. 292) expresses this relationship as '… UIRP relates the expected change in the level of spot rates to the interest rate differential'.

However, the methodological treatment of this test[46] frequently suffers from difficulties, i.e. in the absence of market expectations, as in Australia, UIRP may not

46 UIRP is the basic arbitrage opportunity underlying the International Fisher Effect. Levich (1998 p.140), referring to the International Fisher Effect, notes that '… the interest rate differential … embodies information … about likely exchange rate changes'.

be directly testable.[47] But even where market expectations are available, the literature, as previously noted, suggests that surveys can always be challenged on the ground of manifest bias (Cumby & Obstfeld 1984). Expected exchange rates can therefore not be stated with any degree of authority to determine whether resulting errors are: (a) the consequence of time varying currency-risk premiums, or (b) the result of poor or subjective survey data.[48] The premise that future realised spot rates equal estimated or implied future rates based on interest differentials has therefore received mixed reviews in the literature. Gregory (1987 p. 303), testing the UIRP for rate-deterministic qualities based on rational expectations, notes that '… the evidence presented … suggests that … there is little support for the joint hypothesis of the interest rate parity and rational expectations for Canada and the United States over the 1970s'. Gregory (p. 302) nevertheless concedes that '… meaningful results occurred if variables are defined in first order differences', i.e. where the expected rate of change in the spot rate is equal to changes in nominal interest rate differentials. Flood and Rose (2001 p. 3), perhaps less emphatic than previously quoted research, note that:

> … while the uncovered interest parity still does not work well, it works better than it used to, in the sense that high interest rate countries, at least, tend to have depreciating currencies (though not equal to the interest rate differential).

The relationship prompts the question under what conditions investors may actually be inclined to maintain open foreign currency positions and thus incur an exchange rate risk, e.g. sell their investments t_{+1} at the (then) prevailing spot rate, rather than transact a forward contract at point of purchase t_0.[49] The decision may not be based on notions of rational expectation but on a speculative element entering transactions. It follows, in

47 The IDR is not quoted for forward delivery on Australian markets. Testing for IRP requires reliable and credible consensus data that represent widely held opinions of the market's expected future exchange rate. This information, in the absence of forward prices for the rupiah (and therefore market information relating to market expectations on Australian forex markets), is not available. Neither interbank forward rates nor retail transaction data are quoted for delivery on Australian markets. A search of both the IMF financial statistical database and various Australian sources, including the RBA database, proved fruitless. Major Australian financial intermediaries contacted to obtain future rate expectations were not able to assist (see Appendix 11).

48 Levich (1998 p. 145) noting that '… obtaining data on expected exchange rates is difficult because expectations are usually not directly observable in the market place … [and that] these forecasts need not represent widely held views', proposes the use of an equation base on interest rate differentials to determine deviations between exchange rate changes and interest differentials.[48] The study adopts this approach, i.e. the study tests for UIRP by computing a so-called *implied* future spot rate based on interest differentials (Levich 1998 p. 143).

49 A covered currency transaction.

the case of the expected depreciation of a given currency, that an interest differential in favour of the domestic economy must exist to prevent net capital outflows. Equally, a country whose currency is expected to appreciate is able to isolate itself from the impact of foreign interest rates. In the absence of relative interest differentials, the anticipated appreciation of the currency would occur instantly (Pugel & Lindert 2000).

However, existing market expectations can also increase dynamics between variables. If, for example, an interest differential in favour of a foreign domicile exists, an equal inference that the domestic currency will appreciate prevails. If this was not the case, the spot rate would indeed overshoot its equilibrium, in turn setting up expectations of the subsequent depreciation and then imminent appreciation of the spot rate. Moreover, Siregar and Ward (2000) note that deviations from UIRP in favour of a domestic (currency) investment, the so-called *forward discount puzzle*, can also occur. Deviations may be due to restrictive monetary policies or large interest rate differentials, causing a significant and persistent appreciation of the domestic currency.[50]

3.2.3 Covered Interest Rate Parity

Covered forward transactions are linked through the interest rate differential to forward premiums and thus the forward exchange rate (Pugel & Lindert 2000). A test of the unbiased forward rate requires a series of forward rates and data relating to theoretical estimates of expected spot rates, i.e. a test for CIRP requires a comparison of forward rates to theoretical estimates. If deviations are small and cluster around zero, estimates can be regarded as an unbiased predictor of forward spot rates and CIRP prevails. For example, if the stochastic relationship between forward and expected future spot rates equals $F_{t1} = S^{e}_{t+1}$, so-called *speculative efficiency* prevails. Forward rates are at parity with expected future spot rates and speculative gains through arbitrage transactions do not occur (Juettner l997).

50 The premise of UIP's risk-neutrality and market-rationality has also been questioned (MacDonald & Taylor 1989). MacDonald and Taylor, testing interest differentials as optimal predictors of the depreciation of a given exchange rate conclude (p. 263) that '… the UIRP is easily rejected for the recent floating experience'. Recasting their methodology utilising error orthogonality tests and related survey data, they subsequently admit, however, (p. 265) that '… our overall results are generally supportive of the UIRP condition'. This suggests that the rejection of the parity condition may be linked to time varying risk premiums rather than irrational market behaviour.

Levich (1998 p. 149) expands the analysis by also comparing '… the forward rate [to the] realised future spot rate'. If the mean deviation between the quoted forward rate and realised future spot rate is near zero, the forward rate can be regarded as an unbiased predictor of future spot rates. Salvatore (2001) notes although forward rates exceed future realised spot rates as often as they fall below it (and variances may be either large or small) that forward rates nevertheless provide a good predictor of future spot rates. These observations are in substance confirmed by this research. In the case of efficient exchange markets, CIRP thus implies that relative interest differentials cause changes in both spot and forward rates (Hunt & Terry 1997). Rao (1995 p. 277) notes that '… forward and spot rates adjust to reflect parity between similar risk investments in different countries'.

An example may illustrate the point. When investors seek to maximise returns, net capital flows commence when returns from domestic vs. foreign investments are disproportionate to each other. For example, when a given sum of capital *(x)* is invested for a period *(t)* at an interest rate *(i)*, the aggregate at the end of the period = $x\ (1+i_t)$; if the sum is invested in a foreign currency at an interest rate *(i*)* and the transaction converted at the prevailing spot rate e_t to the foreign currency x/e_t, the aggregate at the end of the period = $(x/e_t)(1+i^*)$. Re-conversion of the sum at the prevailing forward rate (e_T) to the domestic currency (swap) yields $x\ (e_T/e_t)(1+i^*)$. If returns from foreign investments exceed the sum of $x\ (1+i_t)$—the aggregate from domestic earnings—the event, given similar risk profiles, must trigger capital outflows. Thus, if foreign interest rates are higher than domestic interest rates, funds will exit domestic markets. Domestic capital outflows result in an increase in the value of the foreign currency in terms of the domestic currency.

3.2.4 Critique

To avoid discontinuity, individual points of the literature critique are listed separately: [I] A basic IRP requirement dictates that financial assets are identical and that factors, such as credit and liquidity risk, are in all respects comparable. These conditions can rarely be established. For example, even-though earlier tests of IRP, dating back to the 1960s, used risk free government securities, foreign investors perceived these to contain elements of risk. Foreign governments, it was thought, could always impose

exchange or capital controls and investors, therefore, face a latent risk when engaging in currency-based arbitrage (Porter 1979). Conditions changed in the late 1960s with the introduction of a Euro-Currency market that made it possible to compare two in all respects similar securities differentiated only by their denominated currency. It was now possible to test for IRP by stipulating that a high percentage of the analysed data should fall within the boundaries or bandwidth set by transaction costs (Clinton, 1988). If a proportion of the observed data fell inside a neutral band set by transaction costs (the percentage points outside the band were small), IRP held in the sense that there were now no profitable arbitrage transactions possible. Deviations from IRP did however not only occur due to transaction costs but a number of other factors, *inter alia* differing market liquidities and in particular a failure to respond to arbitrage incentives biased research outcomes (Frankel & Levich 1975).

[II] Tests to determine the systematic behaviour of exchange rate risk premiums were frequently miss-specified or resulted in inconclusive outcomes (Tryon 1983). Almost all tests relied on the premise that rate expectations were static or the assumption of perfect foresight. Under the latter, the expected spot rate was simply specified as the realised spot rate plus an error term. Conjectures were formulated independent of any revisions that addressed future values in expected exogenous variables. The static assumption, for example, could be criticised on grounds that it ignored possible inferences about the expected value of exogenous variables. Reliance on the prefect foresight assumption, too, could always be challenged on the basis that no attempt was made to take account of the type of news that could be expected to induce revisions in expectations about exogenous variables. That is, it was difficult to reconcile this assumption to the fact that much of the variation in asset prices could be attributed to news—rational or otherwise. More to the point, the approach assumed that revisions in expectations about future levels of asset stocks and wealth variables did not influence the terms on which portfolio holders under the existing distribution of wealth remained willing to hold asset stocks.

[III] The question remained, to what degree, if any, evidence supported IRP? Early research (Alibert 1973), typically using Euro-Currency deposits, seemed to suggest that deviations were tightly distributed around zero and, therefore, that IRP held. These

results however depended to a large degree on the specification of a viable bandwidth within which deviations could be judged to be acceptable in terms of parity. Although boundaries were created, for example, by transaction and other such costs, these could always be challenged, i.e. the narrower the definition of a neutral band, the more points could be shown to fall outside the band thus invalidating IRP. The outcome of this type of research, in the absence of empirically acceptable benchmarks, therefore depended on prior often subjective assessments of transaction costs. Even if risk profiles and economic fundamentals were correctly specified, transaction costs of engaging in international portfolio selections for example could be challenged since these could always be shown to vary from one period or region to the next and therefore make it difficult to fulfil parity conditions (Chatterjee, S. 2007, pers. comm. 14.12).

[IV] More recent studies, using deviations between U.S. and U.K. treasury papers for example showed more attractive arbitrage opportunities (Levich 1998) but failed to establish empirical validation. Differentials in country premiums, for example, can be generated by different tax rates or risk uncertainties relating to relative yields. Yields, in turn, may be affected by either future changes in taxes or other political or macroeconomic developments.

[V] The empirical literature further notes that currencies with excessive and positive interest differentials tended to depreciate faster when compared to currencies with only minimal differences. McCormick (1979) notes that although both positive and negative deviations occurred, failure to sufficiently identify these arbitrage opportunities represented an earlier oversight by researchers predominantly focused on regression-based analyses.

[VI] In a broader context, the belief that changes in exchange rates reflected prevailing macroeconomic conditions of internal and external balance[51] was also questioned. Faruqee (2002 p. 3) for example notes that '... higher exchange-rate volatility accompanying a move toward more flexible rates occurs without an underlying increase in the volatility of macroeconomic fundamentals'. But Faruqee's findings can

51 The economy operating at maximum potential output (full employment and price stability) and external (balance of payments) equilibrium.

also be challenged. The deregulation of exchange rates intuitively suggests an initially greater degree of freedom to respond to market conditions. This occurs without necessarily evidencing any macroeconomic variability.

[VII] Lyons (2002) hypothesises if exchange rates are not affected by underlying macroeconomic factors, that other determinants might be involved. Lyons, however, was not quite as categorical in his belief that exchange rate movements were entirely unrelated to macroeconomic fundamentals and allowed for such influences over periods > 2 years. Still, other researchers saw the issue as relatively uncomplicated. Chari, Kehoe and McGrattan (2002 p. 1), for example, come to the rather interesting conclusion that '… the most popular story to explain exchange-rate fluctuations is that they result from the interaction of monetary shocks and sticky prices'. Although these factors undoubtedly influenced exchange rates, little empirical evidence was offered in support of these assertions and findings were seen as too limiting in the face of existing exchange rate complexities. Frankel and Rose (1995 p. 55), in a more general research context, observed that:

> ... no model based on such standard fundamentals as money supplies, real income, interest rates, inflation rates and current account balance, will ever succeed in explaining or predicting a high percentage of variations in the exchange rate, at least at short or medium term frequency.

[VIII] Although deviations from parity occurred regularly, these, nevertheless, seemed to cluster at the lower end of returns and typically involved some element of credit or sovereign risk factor difficult to specify or include in any model. Existing capital controls, for instance, were of course known risk factors and markets reflected these elements; unknown intentions, however, represented potential but less overt risks that were frequently ignored (Dornbusch 1976). What ultimately emerged from the debate was a mixed picture of influences acting on parities, i.e. long vs. short-term effects and potential, not realised, risk elements all impacting on exchange rates.

[IV] Finally, spot rates of countries that sustained favourable interest differentials frequently showed a propensity to depreciate. This occurred despite the fact that

normative expectations, *ipso facto,* suggested an increase in the current spot rate. The evidence pointed to structural weaknesses associated with higher interest rate countries. These deficiencies exerted downward pressures on exchange rates that were not taken into account (Juhn & Mauro 2002). But, here too, the research was far from conclusive and other researchers found little evidence to support the hypothesis (Nasution 2002). In fact, the classical response to tighter monetary policies to defend a depreciating currency could be seen as the reason for the use of such policies (Rankin 1998). Given this scenario, investors can be expected to actively exploit interest differentials rather than passively stand by to see their gains diminish by an equal currency depreciation. Feldstein (1991), for example, concluded that unless such gaps existed to enable profitable arbitrage transactions to take place, monetary policies designed to effect specific macroeconomic outcomes, e.g. foreign capital inflows, were condemned to failure.

3.3 Purchasing Power vs. Interest Rate Parity and the Fisher Effect

According to the PPP theorem, exchange rate relativities are determined by expected inflation rates. According to IRP, relativities depend on interest rate differentials. Given this context, the Fisher parity postulates that nominal interest rates are the product of real interest rates (r) plus anticipated inflation rates (i_f), where:

$$1+i=(1+r)(1+i_f) \qquad (3).$$

Investors demand and receive compensation for anticipated inflation losses in interest rates. Real Interest Rate Parity (RIRP) is therefore achieved and the Fisher parity met where:

$$1+i^*=(1+r)(1+i_f^*) \qquad (4).$$

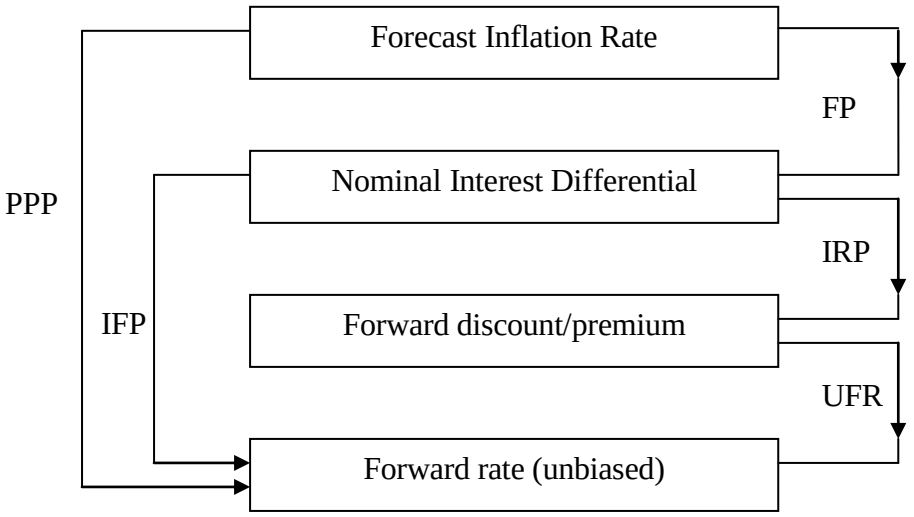
Dividing equation 3 by equation 4 yields the International Fisher parity:

$$\frac{(1+i)}{(1+i^*)}=\frac{(1+i_f)}{(1+i_f^*)} \qquad (5),$$

where i and i* respectively equal the domestic and foreign interest rate. The Fisher parity hence provides the link between inflation and interest rates. If perfect markets

are assumed, real interest rates are therefore internationally differentiated by inflationary expectations. There is hence a measure of agreement between the two theorems evidenced. Given the validity of these associations the literature notes that exchange rate related risks diminish and changes in the exchange rate resulting from changes in inflation and interest rates are seen as compensatory. It is argued that changes in nominal exchange rates can therefore not be regarded as representing a *real* risk (Levich 1998). Various theoretical relativities and their linkages are shown in Figure 3.1.

Figure 3.1 - Reciprocity: Purchasing Power vs. Interest Rate Parity



Legend: PPP: Purchasing Power Parity, IRP: Interest Rate Parity, FP: Fisher Parity, IFP: International Fisher Parity, UFR: Unbiased Forward Rate.

The Fisher effect thus provides the theoretical link between inflation and nominal interest rates (see Figure 3.1), i.e. nominal interest rates are the sum of real, investor required, returns plus a compensatory inflation factor (Hutchinson et al. 1994). Relative real rates of return tend to equalise through capital arbitrage. Rao (1995) notes that this trigger occurs when foreign exceed domestic returns that set off capital outflows. Covered capital transactions post this event typically result in an increase in the spot rate and a decrease in the forward rate of the foreign currency (see also Figure 4.1). Concurrently, transactions reduce interest differentials and lead to the theoretical equilibrium:

$$X(1+i) = X\left(\frac{e_T}{e_t}\right)(1+i^*) \qquad (6),$$

where X = capital , i = the domestic interest rate, i^* = the foreign interest rate, e_t = the prevailing spot rate and e_T = the forward rate.

The combined effect of: (a) the impact of capital flows on interest rates and (b) their impact on the exchange rate—the International Fisher effect—results in parity (Hunt & Terry 1997). The International Fisher effect therefore predicts that interest differentials on similar assets are equal to expected changes in the exchange rate. The Fisher parity, however, should not be regarded as an *idée fixe* (Bryant, Holtham & Hooper 1988). Tight monetary policies, for example, can cause interest rates to exceed anticipated inflation rates—inflationary expectations may even reduce—resulting in a rise in real interest rates and an appreciation of the currency. Since tighter monetary policies affect goods markets more gradually in comparison to capital markets, exchange rates and price changes can become de-synchronised leading to a real exchange-rate appreciation (Engel & Rogers 1995).[52]

3.4 Application of International Parity Relationships

Finally, Section 3.4 reviews the empirical application of international parity relationships. Some overlap with earlier observations proved unavoidable. Although parity failures had been acknowledged for some time, the extent of these failures was not always fully recognised until the completion of a benchmark study by Meese and Rogoff (1983) in the early 1980s. After reviewing various models of systematic exchange rate behaviour, they found that most models could not outperform naïve random-walk models or forward exchange rates in post-sample forecasts. Even when forecasts were based on realised values of explanatory variables, several models of systematic exchange rate behaviour performed little better than random walks. This was not altogether surprising. A wide range of factors during any sample period, including news and other events—anticipated or otherwise—substantially affects

52 In the case of expansionary monetary policies, interest rates can fall dramatically causing a real depreciation of the exchange rate. Monetary-induced changes in currency values, all things being equal, may therefore result in real exchange rate changes, and the Fisher parity does not always apply (Salvatore 2001).

parity performance. Parity conditions of the AUD/IDR exchange rate, for example, were considerably influenced by Indonesian political and social disturbances during the whole of the research period.

Other studies called various assumptions supporting the application of IRP into question (Dornbusch 1976). UIP, the assumption that forward exchange rates equalled the expected future value of corresponding spot rates, received particular attention in this context. Insofar as expectations could not be directly observed, tests looked for indirect evidence by relying on the premise of expectational rationality. Qualified rejections of UIP applications subsequently redirected research efforts to determine whether the actual magnitude of UIP deviations, or indeed existing exchange risk premiums, could explain parts of observed exchange rate behaviour. This possibility emerged as one conceivable explanation for large differences between changes in spot rates and the *ex ante* level of forward premiums (Faruqee 2002). Yet other papers found parity applications deficient on a number of levels. These findings suggested that researchers tended to ignore the fact, although variations occurred in underlying uncertainties that mattered to markets, that CBs—in contrast—held interest rates and hence forward premiums relatively constant (Alibert 1973). When expected changes in the exchange rate declined (increased) and risk premiums increased (decreased), these variances generated larger changes in the actual exchange risk than in forward premiums.

In focusing attention on relations between real exchange rates and real interest differentials in the application of parities, other issues also emerged. It was for example found, although theoretically anticipated signs applied in most applications, that a lack of statistical significance and insufficient explanatory power resulted in little improvement over random walk models when forecasting real exchange rates. The association between real exchange rates and real interest differentials, by subjecting time series to cointegration tests independent of any structural hypotheses, was also investigated (Fama 1984). These tests seemed to imply that much of the variability of real exchange rates could not be associated with the variability of real interest differentials.

Empirical studies generally also failed to support the application of portfolio-balanced models (Porter 1979). Deviations from UIP—exchange risk premiums—were related to relative asset stocks denominated in different currencies and the distribution of financial assets among countries with different currency preferences. The application of these models could and were criticised on a number of levels, e.g. that they adopted unrealistic assumptions about exchange rate expectations, that they failed to treat the degree of risk or uncertainty as a variable and or that they failed to sufficiently differentiate for country risk.

For example, models, given large U.S. budget and current account deficits and associated wealth transfers, failed to convincingly explain why the USD periodically appreciated. Researchers, moreover, relied on the assumption that only one type of asset could be traded internationally, that is, models simply assumed that all internationally traded assets were perfect substitutes when they were not. In addition, tests relied on the questionable premise that asset preferences by investors were derived from the fact that transactions for goods and services required or were settled with different currency units in different countries. In view of these difficulties, i.e. the absence of robust associations between variables in the application of parities, research increasingly pointed to changes in other, exogenous, factors that were thought to generated co-variances in real exchange rates or the real interest differential (Woo 1985). An exogenous fiscal expansion, for example, can generate co-variances in both exchange and interest rate differentials. The short run response to a decline in US government spending for instance—assuming both Indonesian and US economies to be in initial equilibrium (income; price levels; interest rates)—will produce a new equilibrium.[53]

Historical evidence of the periodic value of the USD, for example, suggested that the real value of the currency was indeed affected by other, exogenous factors, e.g. the increased competitiveness of U.S. trading partners. Nevertheless, the evidence was also ambivalent. Other researchers found that applications linking the exchange rate to

[53] The reduction in G typically shifts both the IS (IS/LM) and AD (AD/AS) curve left in their respective interest rate/GDP and price/GDP planes and reduces interest rates and prices. Given capital mobility, the USD depreciates and improves US competitiveness, thus in part offsetting the original left-shift of IS and AD. It follows that policy shocks, given the interlinked nature of both economies, reciprocally reflects in the economic outcomes of Indonesia.

prices and the current account did not provide conclusive prove of different asset type preferences (Kravis 1978). That is, models did not provide reasons for changes in the application of either the expected long-run real exchange rate or premiums attached for accepting exchange rate risk.

Finally, following crises events and associated perceptions of increased counterparty credit risk, market uncertainties can become a major cause of CIP deviations (Coffey, Hrung & Sarkar 2009). Swap facilities, reciprocal CB currency lines that act to reduce divergences, are largely ineffective under such circumstances, that is, margins and the cost of capital become major determinants of deviations from CIP. Results as a rule manifest in the diminished application of CIP, i.e. a breakdown of arbitrage conditions on international capital markets due to a general lack of capital and perceptions of increased counterparty credit risk occurs.

PPP Applications

The literature notes that PPP parity predicts better over longer rather than shorter periods. Since deviations, as a rule, only gradually diminish, the longer the period the closer the results to PPP (Rogoff 1996). That is, PPP deviations tend to die out between three to four years over their half-life, and typically by approximately 15% per annum (Salvatore 2004). A possible explanation for this slow decay, Rogoff (1996) notes, may be found in high transport costs and other such impediments to free trade including the low mobility of labour. Pugle and Lindert (2000) offer further empirical insights into this particular aspect of parity applications. Pugle and Lindert list the average annual rate of change of exchange and inflation rates of major industrialised countries (vs. the USD) over a 23-year period to 1998 and compare differences to average U.S. data. PPP suggests that a higher U.S inflation differential should correlate to a depreciation of the USD over the period examined. This outcome could be observed for 20 major industrialised countries listed in the analysis; for industrial countries, the slope of the line was not significantly different from *1* and the intercept not different from *0* thus strongly supporting the relationship. For developing countries, however, results were distinctly differentiated from developed countries and a much greater divergence from parity application could be observed.

PPP tests, in particular, sought to determine whether the real exchange rate returned to its equilibrium value over time (Fisher & Park 1991). Other tests used the correlation coefficient of deviations of the real exchange rate from an assumed equilibrium represented by the sample mean or trend line (Dornbusch 1984). Although tests rejected the stationary hypothesis in the short term, research could not conclusively reject the time invariance of the data examined. Moreover, tests suffered from bias when equilibrium PPP levels were represented by an in-sample mean or trend line, i.e. when the statistic took its centre of gravity from the sample data. A particular mean or trend line should have been established by drawing on observations from outside the sample from which the mean was generated.

The literature also notes that certain macroeconomic factors limit the application of PPP (Taylor 2002). For instance, deviations from PPP are greater in countries where per-capita income is relatively high or at any rate where deviations show an increasing trend, thus causing a bias in consumption patterns. For example, services generally consist of non-traded activities that lead to a greater measure of deviations from PPP. MacDonald and Ricci (2002) list a number of macroeconomic variables that explain deviations from PPP. Relative real interest rates, the terms of trade, net foreign assets or even productivity differences, e.g. the so-called *Balassa-Samuelson effect*, are factors that account for deviations from PPP.[54]

While it may be correct to say that heavily traded goods tend to evidence approximately similar prices when expressed in a common currency, this phenomenon, however, does by no-means fully explain individual links in the chain. Exchange rate changes may in fact be due to any number of reasons and PPP applications offer only one such explanation, i.e. exchange rates are subject to a broad range of forces affecting the demand for and supply of a given currency. A significant challenge to the predictive application of PPP, for example, arises from the fact that demand or supply

54 Exchange rates are subject to a broad range of forces affecting the demand for and supply of a given currency. A significant challenge to the predictive power of PPP, for example its relatively slow rate of convergence, also arises from the fact that demand or supply shocks frequently cause real exchange rate changes (Pugel & Lindert 2000). The latter infringement of the PPP theorem requires of necessity the surrender of the supposed homogeneity of goods. Contrary to PPP postulates, it posits the more realistic assumption of differentiated consumer preferences.

shocks often cause real exchange rate changes that evidence significant memory retention (Pugel & Lindert 2000). Price equality, by itself, can therefore not be taken as prove of the application of PPP or indeed how equilibrium exchange rates are determined. Various assumptions undergirding PPP were from time to time also challenged (Bessec 2002). The hypothesis of continuous or short-run PPP for example is no longer taken seriously. However, long-run PPP, (> 10 years) in particular the hypothesis that long-run real (price-level adjusted) exchange rates were time invariant, had not been rejected as convincingly. Nevertheless, in the case of hyperinflation, the short-term application of the PPP hypothesis could generally be affirmed.

To sum, although the application of parity models historically focused on some of the more important variables in explaining exchange rate changes, research data typically failed to establish an empirically defendable positions; parity models only partially explained observed variations in exchange rates and, in some cases, performed little better than random walks. Given the broad range of exchange rate determinants, the need for models to correctly identify variables and channels of influence is essential to an understanding of exchange rate behaviour. Much of the variability of real exchange rates could not be linked in any straightforward, consistent, manner to the variability of real interest differentials or the efficient market hypothesis. Testing the application of parities for their rate-deterministic qualities in the Indonesian context suggested that there was some but not overwhelming evidence in support of the joint hypothesis of interest rate parity and price equality. For instance, in the case of IRP, approximations seemed to apply during periods of economic and political/social calm. Where parities were most obvious, they occurred very likely in circumstances of collusive practices by financial institutions. Findings of this study may be generalised by noting that parities yielded only approximate outcomes. That is, parity applications should only be taken as a broad indication of projected forecasts.

3.5 Concluding Observations

Chapter 3 integrates research questions, that is, the chapter reviews the literature pertaining to each of the two core research components of this study and provides a critique of the empirical literature. The chapter also provides a review of the application of international parities.

The literature notes although research data indicates some support for PPP as a long-term determinant of exchange rates, that the evidence rejects PPP as a short-term continuous model. It prompted Rogoff (1996 p. 654) to conclude that '… given the abject failure of the law of one price … it is little wonder that tests based on aggregate price indices overwhelmingly reject purchasing power parity as a short run relationship'. Exchange rate modelling, post-1973, experienced a substantial change in direction with the transition from the former Bretton-Woods regime of fixed to generalised systems of floating exchange rates. Under the previous standard flow model, exchange rates equilibrated at a level consistent with achieving balanced trade or current account balances during a single specified period. Net capital flows were negligible or predetermined and exchange rates predominantly set by supply and demand variables that determined export and import volumes. Ultimately, however, the size and frequency of exchange rate variations defeated the notion of maintaining fixed rates, i.e. the notion of single-period equilibriums based on the international flow of goods. Research attention, post-1973, commenced to focus on the equilibrium of asset or portfolio-based stock models. Subsequently, attention shifted to the integration of goods market flows and asset stock equilibriums and the (their) dynamic interaction between the exchange rate and current account. In the case of both UIRP and CIRP, much of the variability of real exchange rates could no longer be linked in a straightforward fashion to anyone variability.

At any rate, the exchange rate, in the short term, was now seen as being consistent with asset stocks and as influencing trade and the current account and thus changes in net foreign asset positions. These changes, in turn, cycled back over time to influence asset market equilibriums and model interactions between exchange rates and current account balances. That is, supply and demand conditions in goods and factor markets led to a semireduced-form equilibrium between the current account and relative prices. Concurrently, the link between the current account and nominal exchange rates of course also depended on the time path and extent of money supplies and other variables that influenced the absolute level of national price indexes. The association between the current account and nominal exchange rates was therefore primarily seen as being dependant on the separate link of each to relative price levels.

Moreover, research began to increasingly focus on the simultaneous determination of exchange rates, prices and the current account. Such endeavours provided further insights into factors that determined and generated variability in the expected long run real exchange rate. For example, solutions for the long-run stationarity of the real exchange rate, given perfect foresight, were for the most part consistent with the stationarity of net foreign asset positions and hence balanced current accounts. Nevertheless, problems with some of these new models *inter alia* included model size, the empirical validity of findings, inappropriate or poorly specified tests and methodologies and biased test procedures etc. Failures also occurred in examining changes in either the expected long-term level of the real exchange rate or the premium for bearing default risk vs. optimal international borrowing and lending levels. Researchers, moreover, failed to correctly specify the dynamic interaction between exchange rates and interest rate differentials and, in particular, failed to differentiate between preferences in different types of assets. The link between prices and the current account, and in a more general context the failure to address some of the fundamentals that determined parity, were further gaps that could be identified in the research. (Juhn & Mauro 2002)

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CHAPTER 4 – METHODOLOGIES, DATA AND DELIMITATIONS

4 Introduction

Previous chapters reviewed core and contextual issues. This chapter lists basic assumptions and clarifies/documents preliminary points, introduces hypotheses and lists appropriate methodologies and data sources. Chapter 4 also states a number of fundamental delimitations applicable to this dissertation.

4.1 Preliminaries

Some clarifying comments are initially required. First, theoretical market equilibriums are briefly defined, i.e. the structure of the research is based on the premise of open markets given by the conventional equation for goods markets: $Y = C(R,Y,T) + I(R,Y,T) + G + X(EX*PF/P,YF) – Q(EX* PF/P,Y)$.[55] Four prior assumptions are also required to validate the research, i.e. that countries examined: (a) are free from pre and post exchange rate variations associated with exchange rate regime changes (b) do not suffer from imminent political threats, (c) posses sufficient economic freedom and power to minimise variations from IRP and PPP and (d) maintain comparable statistical data. The study follows the usual practice of using the term *monetary models* to denote a set of models that impose assumptions of UIRP. The following points provide further basic notations:

The use of linear regressions has been limited. While the process serves as a useful statistical tool, its informative content in the context of this research is restrictive. Levich (1998 p. 110) notes that '… the results of regression tests can be completely misleading', since correlation does not necessarily demonstrate the essential characteristics of the data examined. For example, an examination based on the conventional equation $(F_{t+1} - S_t)/S_t = \alpha + \beta\ (i_t - i_t^*)/(1+i_t^*) + \varepsilon_t$ to determine whether $\alpha = 0$ and $\beta = 1$, does not yield useful insights. A meaningful test for IRP must not only determine error rates and plot returns as a time series, but also establish the

55 Where *Y* is real income, *C* is consumption, *R* is the real interest rate, *T* are tax and transfer parameters, *I* is investment, *G* government spending, *X* exports, *EX* the exchange rate, *PF* and *P* foreign and domestic price indices, *YF* foreign income, (*EX*PF/P* = terms of trade) and *Q* are imports. However, in the case of Indonesia, certain restrictions on capital flows and the exchange rate must be acknowledged.

number of observations that fall within or outside certain boundaries and show their length and magnitude of divergence.[56]

The data are ungrouped. Where time series are used, numbers shown on the X-axis denote weekly averages. As is usual for this type of analysis, variables are predominantly expressed as an index relative to a base period. Where interval or ratio-based data are presented, central tendencies are expressed in terms of their mean; in the case of excessive variations, medians are also quoted.

Data, where appropriate, are analysed to determine breaks or changes in trends using *t* tests for equality of means (the mean error term of the two sub-periods was tested for equality) and *F* tests for equality of variances (the variances of the two error terms were tested for equality) to establish the homoscedasticity of the data. The data are also evaluated for model errors using different error measures and the *Theil U-statistic*.

Where the term *risk* is used, the term primarily applies to timing risk. However, given a particular context, the term may also apply to instrument, political, country and or counter-party risk. Risk, wherever appropriate, is expressed in terms of a definitive number. In most cases, this value is implied by the error and standard deviation from the error term, i.e. the statistical dispersion around a mean over time.

Following the practice adopted by most Australian financial institutions, exchange rates are stated by designating the AUD as the commodity currency priced in terms of the IDR, i.e. quotes are expressed in the form: 1 AUD/IDR (Hunt & Terry 1997 p. 363). Quoted exchange rates represent the weekly mean between bid and ask quotes. To provide a more accurate test of IRP, data for both interest and exchange rates should be recorded at the same and exact instant of time. This information was however not available.

For the purpose of comparison, Australian and U.S. interest rates are designated as foreign interest rates. In the case of PPP, the Australian CPI is held to be the foreign price index. The following exchange rates are used in this dissertation:

1) Spot rates—the buying or selling of a currency now for delivery in two working days.

56 IRP, for this purpose, is defined as a position where a high percentage of error rates fall within transaction-cost parameters. Over a large number of transactions, the actual error rate should be random and on average close to zero.

2) Forward rates—the buying or selling of a currency now for delivery in more than two working days. For example, if company A sells USD 50,000 one month forward, A agrees today that it will deliver USD 50,000 one month forward.

3) Swaps—the simultaneous buying and selling of currencies for different value dates.

4) Options—the right, but not obligation to buy or sell currencies for an agreed price on an agreed future date.

5) Implied or estimated spot rates—rates established by statistical computations.

6) Future spot or realised spot rates—the actual observed rate at a particular point in time.

7) Estimated forward rates—theoretical (cross-rate derived) forward rates based on Australian/U.S. and U.S./Indonesian interest rate differentials,

In the case of the UIRP, the implied or estimated future rate is considered the *benchmark* against which future spot rates are compared to establish error rates. Variations are described as either positive or negative, e.g. if the actual spot rate is below the implied or estimated future rate, a negative variance results. The description of variances as negative or positive is merely a mathematical notation and does not imply a qualitative relationship. The statistical mean of the error term **(** *ME* **)** for both UIRP and CIRP, unless otherwise stated, may also be expressed by the general equation:

$$ME = 1/n \sum_{t-1}^{n} \left(S_t \cdot S_t^e \right) \qquad (7),$$

where S^e_t equals the estimated value of the exchange rate, S_t equals the value of the realised future spot rate *t*, and *n* describes the number of observations included in the sample.

Statistical calculations covering the period October 2000 to March 2003 inclusive are presented by listing research data in weekly intervals. For purpose of identification, weeks are numbered consecutively. Details of statistical computations are attached to the dissertation in the form of appendices (see appendices 1-10) .

4.1.1 Measures of Accuracy

Both uncovered and covered interest parities are tested for accuracy. Measures adopted are standard and in line with tests of this nature. Numerous methods are available to analyse model accuracy for a given time series. In measuring performance, the usual econometric approach begins with defining the error rate. If it is assumed that S_t denotes the actual exchange rate at time *t* and $S^e{}_t$ the implied (or estimated) rate of S_t, then the error is defined as $e_t = S_t - S^e{}_t$. Most commonly used scale-dependent measures are based on squared or absolute errors (Gooijer & Hyndman 2006), i.e.:

Mean Squared Error (MSE) $= mean\left(e_t{}^2\right)$
Root Mean Squared Error (RMSE) $= \sqrt{MSE}$
Mean Absolute Error (MAE) $= mean\left(\left|e_t\right|\right)$.

Squaring each error to a positive value and averaging squared errors derives the MSE. A similar concept applies to the definition of MAE. Errors are made positive by taking their absolute value and then averaging results. The use of absolute or squared values prevents negative and positive errors from offsetting each other. Since the MAE measure is easier to understand and compute, the measure performs better when assessing the accuracy of a single series. However, the measure should not be used to compare data between series, since the measure is scale dependent (Bunn & Taylor 2001).

The percentage error is given by $p_t = 100\hat{e}_t / S_t$. Percentage errors have the advantage of being scale independent. Hence, they are frequently used to compare model performance between different data sets. The most widely used unit-free measure is the Mean Absolute Percentage Error (MAPE) where MAPE $= mean\left(\left|p_t\right|\right)$.

Although measures have some desirable properties that include reliability, ease of interpretation and clarity of presentation, these advantages are somewhat offset by the fact that the measure often overstates the error represented by most of the observations (Tayman & Swanson 1999). Difficulties also arise when the time series contains zero values, since the percentage error rate cannot be computed.

Theil developed the first statistical tool for the evaluation of model errors (Theil 1966). The measure, the *U statistic*, is related to the root mean squared error group, scaled such that it will always fall between zero and one. It is given by:

$$U = \frac{\sqrt{\frac{1}{n}\sum_{t=1}^{n}\left(S_t - S^e{}_t\right)^2}}{\sqrt{\frac{1}{n}\sum_{t=1}^{n} S^e{}_t{}^2}\ \sqrt{\frac{1}{n}\sum_{t=1}^{n} S_t{}^2}}$$

If $U = 0$, then a perfect fit results with $S_t = S^e{}_t$ for all *t*. On the other hand, if U = *1*, then either $S_t = 0$ when $S^e{}_t$ is non-zero or vice-versa and the estimation is very poor.

4.2 Methodologies and Hypotheses

The research in turn tests for PPP (see 4.2.1), UIRP (see 4.2.2), CIRP (see 4.2.3) and trade parity (see 4.2.4). Each item is addressed below. Proposed methodologies to test the stationarity of the real exchange rate are in line with conventional practices (see also 3.1.3).

4.2.1 Purchasing Power Parity

Absolute PPP, provided CPIs assign a common weight to measurement baskets, is premised on the equality of national price levels. However, the relative PPP tested here merely requires that periodic higher rates of domestic inflation reflect in a depreciation of the domestic vs. the foreign value of the currency.

The research initially examined the role monetary aggregates played in causing inflation in the Indonesia context, that is, to what degree, if any, a permanent increase in monetary aggregates may have caused nominal GDP to exceed real growth. For this purpose, theoretical postulates that changes in inflation are due to variations in the money supply are accepted (Juettner 1997). The efficacy of the model therefore depends on the association between the money supply, prices and GDP growth (see Figure 5.2). It is this association[57], e.g. the correlation between these variables, that is tested here. For instance, to test for GDP growth, assuming approximate linearity, a final form equation for GDP (y) and a policy variable (M) can be postulated as:

57 Expressed by the equation $MV = PY$, where M = the money supply, V = the velocity of circulation of M ($V = PY/M$), P = the price level (*[V/Y]M]*) and Y = real GDP.

$$dy_t / \bar{y}_t = a_0\left(dM_t / \overline{M}_t\right) + a_1\left(dM_{t-1} / \overline{M}_{t-1}\right) + \ldots + a_j\left(dM_{t-j} / \overline{M}_{t-j}\right).$$

The research then moves on to examine PPP. Levich (1998) notes that a meaningful analysis of PPP should include an examination of: (a) the actual magnitude and (b) length of PPP deviations from parity and cautions (Levich p.110), '… while regression testing of parity conditions are commonly observed in the literature, we will argue that the regression method of testing is useful in only a few special cases'. This argument is accepted and the analysis adopts an alternative method to a regression-based examination of the behaviour of the real and nominal exchange rate that uses time series to show the length and magnitude of deviations from PPP. Two models are commonly identified in the literature for this purpose (Levich 1998; Salvatore 2004; Schreyer & Koechlin 2002). A third method to determined stationarity uses autoregressive and standard unit root tests to establish the stationarity of the exchange rate. Each of these methods is used and in turn documented below.

First, real and nominal exchange rates are plotted as a time series (see Figure 5.3). Both are shown to equal *1* at commencement. Cumulative inflation differentials are then applied to the nominal exchange rate to calculate the real exchange rate. The approach to this degree adopts OECD recommendations that address PPP computations (Schreyer & Koechlin 2002).

Second, the real exchange rate was also shown as an index represented by the ratio of the nominal exchange rate over the PPP rate—see Equation 8,

$$Spot(\mathrm{Re}\,al, t) = \frac{Spot, t}{Spot(PPP, t)} \qquad (8).$$

The presentation of the data graphically shows the degree of mean reversion, i.e. the time series shows to what extent the real exchange rate, post random shocks, returns to stationarity (see Figure 5.4). If the real exchange rate is non-stationary, i.e. the rate does not show a tendency to return to PPP, it is said to perform a random walk.

Test for Stationarity of the Real Exchange Rate

Third, to test the stationarity of the real exchange rate, autoregressive tests followed by standard unit root tests were also used (see Figure 5.5, 5.6 and 5.7). The null hypothesis was for this purpose stated as:

> the real exchange rate is non-stationary against the alternative that the real exchange rate is stationary.

PPP holds in the long run when the real exchange rate is stationary, i.e. a stationary series is a series generated by drawings from the same underlying probability distribution. This hypothesis was tested by examining whether the real exchange rate performs a random walk. The following first order autoregressive *[AR(1)]* model illustrates the association:

$$S_t = \alpha S_{t-1} + \varepsilon_t,$$

where ε is white noise with a mean *0* and finite variance. If the null hypothesis of $\alpha = 1$ is rejected, then S_t is stationary and a propensity to mean reversion exists; PPP holds in the long run (Glen 1992). First order differences are then tested for confirmation of stationarity, i.e. the coefficient of the *AR(1)* model for the series is estimated using the Dickey-Fuller test (Dickey, Bell & Miller 1986).

The test indicates more accurately whether PPP holds, that is, the Dickey-Fuller model—instead of using conventional *t*-statistics—proposes a more appropriate method for testing the hypothesis that the *AR(1)* coefficient equals *1* in *AR(1)* regression. It should however be noted that the use of data characterised by unit roots can also lead to erroneous inferences (McKenzie 1997). To compute a regular Dickey-Fuller test based on S_t, the regression is stated as:

$$S_t - S_{t-1} = \Delta S_t = \alpha_0 + \alpha_1 S_{t-1} + \varepsilon_t$$

and the $\alpha_1 = 0$ hypothesis is then tested. If the null hypothesis cannot be rejected, i.e. the real exchange rate is in fact non-stationary, the process contains a unit root. Nevertheless, models have several drawbacks; first, models are linear. No attempt to

account for the possible non-linearity in the underlying data was made.[58] The serial correlation of the model was also not considered (Makridakis, Wheelwright & Hyndman 1998).

4.2.2 Uncovered Interest Rate Parity (International Fisher Effect)

UIRP, the premise that exchange rate changes equal interest differentials, is differentiated from CIRP in that the latter uses four variables, i.e. the forward and spot rate and the two interest rates are all known at the time of the transaction. In the case of UIRP, market expectations may exist which are not realised until the termination of the investment, i.e. an uncovered exchange rate risk during a given investment period exists (Levich 1998).

Due to the absence of forward markets of the IDR, market expectations are not available in an Australian context. A pilot to obtain data from market participants proved unsuccessful and supports the adopted position (see Appendix 11). But even where market expectation are available, the literature notes that surveys can always be challenged on the grounds of alleged bias (Cumby & Obstfeld 1984). Levich (1998 p. 145) suggests that UIRP tests should therefore be based on interest rate differentials. The study adopts this approach and computes an *implied* future spot rate based on interest rate differentials.

For the statistical part, a modified version of the *Guin and Maxwell (1996)* model is used to determine to what extent interest differentials provide a good forecast of future spot rates. Justification for the use of the model is provided by the fact that Guin and Maxwell supply the closest predecessor to this research. Since their model also indicates both the magnitude and duration of deviations from parity, a further advantage of the model is its ease of interpretation.

Parity occurs when implied future spot rates equal future realised spot rates. The association is maintained by arbitrage (Pugel & Lindert 2000). However, arbitrage is unlikely to result unless deviations are expected to exceed so-called *transaction or trading costs*. This restraint creates what Levich (1998 p.133) refers to as a 'neutral

58 Nonlinear models used are: Threshold Auto-Regression (*TAR*), Exponential Transition Auto-Regression (*ESTAR*) and Logistic Transition Auto-Regression (*LSTAR*) models.

cost band' within which trading is not profitable. Levich describes transaction costs as an estimated percentage cost on either side of the parity band of approximately ± 1% based on the value of a given transaction. These costs cover business related transaction expenses[59]. Guin and Maxwell (1996) confirm this definition and imply that transaction costs within the range of 0.5 % to 1 % can be expected.

Interest rate parity holds as long as a significant percentage of observations fall at or within this cost band, i.e. the percentage of points falling outside the band is minimal. Arbitrage ensures that the exchange rate remains at this level. A hypothesis to test UIRP may hence be stated as follows, that:

> the mean error term (ℓ) for the sample period—the difference between the implied and future spot rate of the AUD/IDR exchange rate—is expected to exceed transaction costs, that is: H_0: ℓ is > *±1 %*. The alternative hypothesis H_1: ℓ is = to or < ± *1 %*.

Parity holds when the future realised exchange rate equals the current spot rate adjusted for cross-border interest rate differentials as per equation (9), i.e. the implied rate is conditional on the spot exchange rate and interest rate differential as expressed by the equation:

$$I_{t+1} = S_t + S_t\left(\frac{r - r^*}{1 + r^*}\right) \qquad (9),$$

where I_{t+1} is the implied future spot rate, r, r^* respectively equal domestic and foreign interest rates and S_t is the spot rate. A numerical example using actual data (see Appendix 1, p.1.1) where: (a) Indonesian and Australian (foreign) interest rates r and r^* equal 3.26 % and 1.55 % and (b) the AUD/IDR spot rate S_t equals IDR 5331 demonstrates the point. The implied future exchange rate I_{t+1}, using equation (9), equals IDR 5421 or:

$$I_{t+1} = 5421 = 5331 + 5331\ (0.0171/1.0155).$$

Securities used to determine interest differentials should be identical, e.g. the date to maturity and credit and liquidity risk should be as near as possible identical. On this

59 The cost of buying/selling securities and foreign exchange.

count, instruments selected for this test cannot be considered entirely satisfactory; nevertheless they represent the closest correspondence available.

Once the implied spot rate is determined, the rate is compared to the realised future spot rate per the *Guin and Maxwell* model.[60] Error rates and standard deviations from error rates, both expressed in terms of percentage variations, are then calculated to summarise pricing gaps. The error term (ℓ) is given as:

$$\ell = S_{t+1} - \left(S_t + S_t \frac{r - r*}{1 + r*} \right) \qquad (10).$$

Again, a numerical example may assist in clarifying the use of equation 10. The error term (ℓ) using actual data (see Appendix 1, p. 1.1) equals IDR - 645 or,

$$\ell = -645 = 4776 - (5331 + 5331\ (0.0171/1.0155)).$$

The term may also be described as the realised minus the implied spot rate established by statistical computations. A positive variance denotes the future realised AUD/IDR spot rate to be above the implied spot rate—the exchange rate has depreciated vs. the implied rate. To the extent that errors result, i.e. the mean exceeds transaction costs, an incentive for arbitrage trading exists.

To sum up, the research, taking interest rate differentials as given, tests for UIRP by determining the degree of variation of implied from future realised spot rates and by establishing an error term. These values are then plotted as a time series to examine their trend and magnitude over time.

4.2.3 Covered Interest Rate Parity

The methodology to test for CIRP, that forward premiums/discounts for future delivery equal expected percentage changes in the future spot rate, is based on the *Guin and Maxwell (1996)* model. The test requires the comparison of forward rates to theoretical estimates established by reference to relative interest rate differentials.

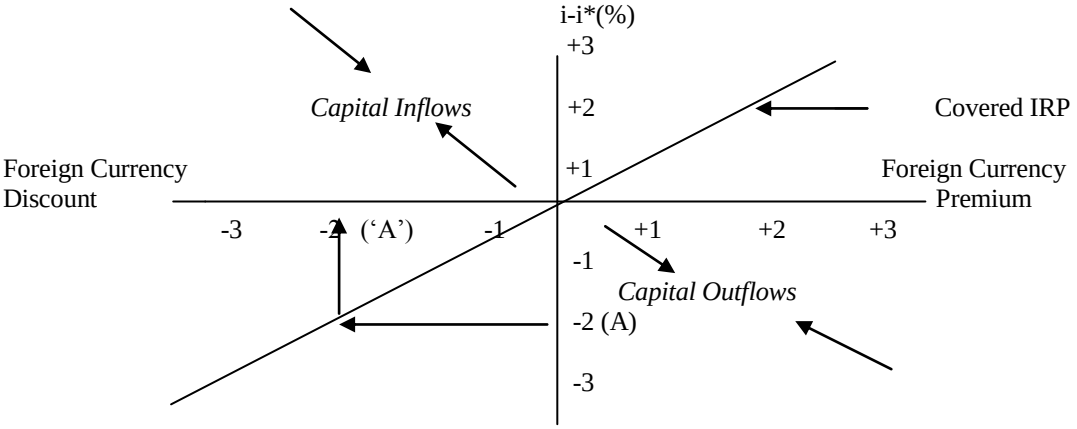
Due to the rupiah's volatility and associated risk to dealers, forward exchange rates are currently not quoted for forward delivery on Australian markets. Instead, cross-rate

60 Although Guin and Maxell test for CIRP, the same basic methodological approach may also be used to test for UIRP. The difference between covered and UIRP is here of little methodological concern.

based forward rates (based on the USD/IDR exchange rate) are used and compared to theoretical estimates to determine to what extent estimates can be regarded as an unbiased predictor of forward rates. An error term is then established.

Figure 4.1 illustrates the CIRP process. If, for example, an interest rate differential in favour of a foreign country prevails, the currency will be at a forward discount equal to the interest rate differential (see Figure 4.1,'A', A).

Figure 4.1 - Covered Interest Arbitrage Transactions



Adapted from: Salvatore 2001

The resulting theoretical relationship can be expressed as:

$$i = i^* + \frac{F - S}{S} \qquad (11),$$

where S = the spot and *F* the forward exchange rate of the currency. The expression *(F-S)/S* also describes the swap rate (Reilly & Norton 1995). Levich (1998 p.373) expresses this relationship as:

$$F_{t,n} = S_t \frac{1+r_t}{1+r_t^*} \qquad (12),$$

An example clarifies the use of equation (12). U.S. interest rates, it may be recalled, are held to be foreign interest rates for the purpose of this study. The example uses actual data to illustrate the application of the equation, e.g. the forward rate $(t,n) = F_{t,n}$ = IDR 9163 = IDR 9003 (1+ 0.0326/1+0.0146)—see Appendix 4, p. 1.10. That is, the estimated forward rate (IDR 9163) denotes a depreciation in the value of the currency (from a spot rate of IDR 9003) due to positive Indonesian interest rate differentials.

It is evident from equation (12) that CIRP thus links four rates, i.e. the forward and spot rate and the two interest rates; when one variable changes other values of the equation must also change to retain equilibrium. For example, if the spot rate increases the forward rate must also rise to keep premiums at their current level. If changes in monetary policies trigger capital flows, these, although not affecting global interest rates, will *ceteris paribus* lead to both variations in interest and exchange rates. Since parity occurs comparatively earlier on capital vs. goods markets, the theory plausibly explains short-term exchange rate volatilities (Engel & Rogers 1995).

Although not part of testing for CIRP, forward rates were subsequently also compared to future realised spot rates to determine to what degree arbitrage trading may be profitable, i.e. to what extent forward rates can be regarded as an unbiased predictor of realised future spot rates. If the mean deviation is close to zero, the forward rate can be regarded as an unbiased predictor of future realised exchange rates (Levich 1998).[61]

CIRP Test

The CIRP test determines to what extent theoretical estimates can be regarded as an unbiased predictor of forward exchange rates. A more stringent version of the CIRP test uses interest rates of closely comparable assets issued by different institutions in separate national markets. The study adopts this approach.

61 For the purpose of this research, the notion of uncovered and covered parity is defined by reference to error rates being contained within transaction cost bands (Salvatore 2001 p. 491).

First, cross-rate based forward rates (based on quoted AUD/USD and USD/IDR exchange rates—see Appendix 4) are compared to theoretical estimates (based on Australian/U.S. and U.S./Indonesian interest differentials), and an error term is established; due to the rupiah's volatility and associated risk to foreign exchange dealers, direct forward rates are currently not quoted for forward delivery on Australian markets. Parity holds when forward rates approximate theoretical estimates.

For example, given a three month quoted forward rate of 1 AUD/0.5990 USD and 1 USD/9125 IDR, the cross-rate based forward rate of the AUD/IDR is 1 AUD/5466 IDR (see Appendix 4). If the average deviation between forward and theoretical estimates of forward rates is near zero or at least falls within the range of normal trading costs, the estimated rate using equation (13) below can be regarded as an unbiased predictor of forward rates. That is, if parity holds, the forward exchange rate should equal the current spot rate plus a premium determined by the interest rate differential as expressed by equation (13).

Various methodologies are available to establish theoretical estimates. A methodology adapted from the *Guin and Maxwell's (1996)* model will be used since their model is conceptually closest to the proposed research. Guin and Maxwell describe their research objective as determining the degree to which currency markets of industrialised countries have adjusted to parity. They note (p. 298):

> … the study is a straightforward test of theory vs. practice. For the theoretical side we use the formula shown above (Eq.3) [see equation 13] to solve for the expected forward exchange rate as predicted by the IRPT. This expected rate was then compared to the actual (or observed) forward exchange rate that prevailed at the time. The percentage difference between the expected and actual rate (called the error term) was then calculated and plotted on a graph to examine its behaviour over time.

According to an equation provided by Guin and Maxwell (1996 pp. 297-8), the theoretical estimate of the forward exchange rate equals:

$$F_{t+1} = S_t + S_t\left(\frac{r - r^*}{1 + r^*}\right) \qquad (13),$$

where F_{t+1} = the estimated forward exchange rate, S_t = the spot rate and r,r^* = the domestic and foreign (three-month) interest rate. This equation is basically the same as the equation used to test for UIRP (see Equation 9). The error rate[62] is defined as the (cross-rate based) quoted forward rate minus the estimated rate *t+1* expressed as a percentage variance against theoretical estimates. A positive variance, for example, denotes the forward rate to be above the estimated rate.

In addition, although not part of testing for CIRP, quoted forward rates were also compared to future realised spot rates to determine to what degree forward rates can be regarded as an unbiased predictor of realised future spot rates. If the mean deviation is close to zero or falls within the normal range of transaction costs, the forward rate can be regarded as an unbiased predictor of the future realised exchange rate. Specifically, an error term (ℓ) will be established—the rate by which quoted cross-rate based forward rates (*FR*) either exceed or fall below future realised spot rates. The error term (ℓ) is expressed as:

$$\ell = \frac{FR_{t+1} - S_{t+1}}{S_{t+1}} \qquad (14).$$

A negative error rate denotes FR_{t+1} to be below the spot rate S_{t+1}, i.e. the forward rate is understated vs. the future spot rate; the spot rate has depreciated.

4.2.4 Trade Parity

It is generally assumed that the exchange rate influences the trade balance and not the other way around, i.e. it is assumed that the exchange rate is the independent variable in this association (Juettner 1997). However, others have come to different conclusions and suggest that the exchange rate is in fact the dependent variable (Levich 1998)—a classic 'chicken and egg' dilemma. The test initially uses a regression-based analysis to establish whether a *prima facie* case in defence of the dependency hypothesis exists. If this not the case and the relationship displays a reverse association, i.e. the trade balance proves to be the dependent variable, further examinations will be omitted; the exchange rate is not the dependent variable required by the IRP.

62 Since both CIRP and UIRP use interest differentials to establish error rates, assuming that market providers base their forward point margins on term structures of interest rates, the CIRP error rate can be expected to be close to the UIRP error rate (Levich 1998).

4.3 Data Sources

Statistical models used approximately 35 variables. Variables were recorded on a mean weekly real time basis, i.e. computations involved 130 observations per variable equal to approximately 5,000 computations and or extrapolations.

1. The statistical data to test for PPP consisted of three time series: the AUD/IDR spot rate and two (CPI-based) price indices[63]—one each from Australia and Indonesia. CPI indices were only available in monthly increments and converted *pro rata* to weekly data. The AUD/IDR spot rate was extracted from the Reserve Bank of Australia database (Reserve Bank of Australia, online database, available: www.rba.gov.au/statistics/, accessed 20. 4. 2003). Inflation rates were respectively obtained from the Reserve Bank of Australia and Bank Indonesia database (Bank Indonesia, online database, available: www.bi.go.id/bank_indonesia, accessed 1. 12. 2004). Base money values were obtained from Bank Indonesia's Annual Reports (Bank Indonesia 2002; Bank Indonesia 2003). Statistical computations provided the following output:

   - PPP spot rates
   - real exchange rates
   - nominal exchange rates.

   Statistical calculations covering the period October 2000 to March 2003 are presented in the appendix by listing research data in weekly intervals. The actual presentation of the data commenced from and is inclusive of July 2000 to enable initial three-month forward calculations to be undertaken. For the purposes of identification, weeks are numbered consecutively.

2. The statistical data to calculate UIRP consisted of three variables: the AUD/IDR spot rate and for both countries the three-month interest rate. Various interest rates were available to establish nominal interest rate differentials. Selection required that interest rates not only reflect a common periodicity, but that underlying assets, as near as possible, evidence similar risk profiles. Accordingly, Australian 90-day Bank Accepted Bill rates and matching *Sertifikat Bank Indonesia* interest rates

63 When tests for the stationarity of the real exchange rate are based in the wholesale index rather than the CPI, a faster reversion to PPP due to the higher weight of tradeable goods in the wholesale price index is likely to result.

were selected[64] (Reserve Bank of Australia, online database, available: www.rba.gov. au/statistics/, accessed 20.4.2003; Bank Indonesia, online database, available: www.bi.go.id/bank_indonesia, accessed 12.5.2003). Indonesian interest rates were only available on a monthly basis and assumed to apply to each week in each of the respective monthly cycles. The AUD/IDR exchange rate was extracted from the Reserve Bank of Australia database (Reserve Bank of Australia, online database, available: www. rba. gov. au/ statistics/, accessed 20.4. 2003). Statistical computations provided the following output:

- estimated exchange rates
- variations of estimate from future realised spot rates (error rates)
- the mean error rate
- standard deviation from the mean error rate.

Statistical calculations covering the period October 2000 to March 2003 are presented in the appendix by listing data in weekly intervals. The actual presentation of the data commenced from and is inclusive of July 2000 to enable initial three-month forward calculations to be undertaken. For the purpose of identification, weeks are consecutively numbered.

3. The statistical data to test for CIRP comprised the following variables:

   (3.1) Quoted forward AUD/USD and USD/IDR rates were obtained from ANZ Banking Corporation (David de Garis Senior Treasury Economist, pers. comm. 27.08.2004) and the Royal Bank of Canada (Alex Schuman Manager Foreign Exchange Strategy, pers. comm. 13.09.2004). Respective banks require source confidentiality of the data provided.

   (3.2) The three-month Australian Bank Accepted Bill Rate (Reserve Bank of Australia, online database, available: www.rba.gov.au/statistics/, accessed 20. 4. 2003), the three-month U.S. Treasury Bill Rate (Federal Reserve Bank of New York, online database, available: www. newyorkfed.org/research/ current issues, accessed 21.3. 2005) and the three-month Indonesian *Sertifikat Bank Indonesia* interest rate (Bank Indonesia, online database, available: www.bi.go.id/bank indonesia, accessed 12.5.2003). The Indonesian interest

64 The adopted approach is in line with Guin and Maxell's (1996) rationale for the selection of securities.

rate was only available on a monthly basis and assumed to apply to each week in each of the respective monthly cycles.

(3.3) AUD/USD spot rates (Reserve Bank of Australia, online database, available: www. rba. gov. au/statistics/, accessed 20. 4. 2003) and USD/IDR spot rates (Federal Reserve Bank of New York, online database, available www newyorkfed.org/reseach/current_issues, accessed 21.3. 2005). Statistical computations provided the following output:

- estimated and forward (cross-rate-based) AUD/IDR exchange rates
- variations of forward from estimated rates (error rates)
- variations of forward from future realised spot rates (error rates)
- mean error rate for variations from estimated and future spot rates
- standard deviation from the mean error rate.

Statistical calculations covering the period October 2000 to March 2003 are presented in the appendix by listing data in weekly intervals. The actual presentation of the data commenced from and is inclusive of July 2000 to enable initial three-month forward calculations to be undertaken. For the purpose of identification, weeks are consecutively numbered.

4. The test for trade parity used three time series: spot exchange rates and merchandise export and import data at FOB prices. Trade statistics were only available in monthly increments and converted *pro rata* to weekly statistics. Details were obtained from the Australian Bureau of Statistics and the Reserve Bank of Australia (Australian Bureau of Statistics, online database, available: www.abs.gov.au accessed 12.12.2004; Reserve Bank of Australia, online database, available: www.rba.gov.au/statistics/, accessed 20. 4. 2003). It is noted that for most of the sample period a trade surplus in favour of Indonesia prevailed.[65]

   Statistical calculations covering the period October 2000 to March 2003 are presented in the appendix by listing research data in weekly intervals. For the purposes of identification, weeks are numbered consecutively.

65 A negative trade balance shown on the graph denotes an Australian trade deficit.

4.4 Scope and Delimitations

The dissertation provides an initial, that is, early assessment of the post-floating behaviour of the AUD/IDR exchange rate. The study, although categorised as long term (Levich 1998), does not seek to provide a longitudinal analysis of exclusive academic interest. Rather, the dissertation provides a practical study of commercial relevance in line with DBA objectives.

The commencement date of the sample, July 2000, was selected to allow for a three-year post-floating adjustment of the Indonesian exchange rate. That is: (a) given the necessity to allow for a post-1997 cooling-off period and (b) time limits imposed on this study, limitations imposed a maximum time span of three years for the collection of data.

The dissertation analyses the application of various parity conditions. Given this context, the influence of interest and inflation rates on the AUD/IDR exchange rate is therefore of primary interest. Secondary factors impacting on the exchange rate, except as these arise in a contextual-relevant situation, are excluded from examination. These do not form part of parity tests. For example, although fiscal policies—US fiscal policy shocks for instance—impact on the value of the rupiah, fiscal policies, other than a brief discussion of their theoretical effect on interest rates, have been excluded from analysis. Other models, such as the Fundamental Equilibrium Exchange Rate model (FEER)—the rate consistent with both sustainable current account balance and internal balance—except in so far as the response of the exchange rate to trade balances was examined, were for the same reason excluded from discussions. It is actually likely that of the major economic variables that compose FEER, *inter alia* productivity growth, net foreign assets and the trade balance, the latter had influenced the AUD/IDR exchange rate more significantly.

Australian monetary policies, with the exception of tracking Australian interest rates, were also excluded from consideration since the study primarily analyses the post-1997 floating behaviour of the Indonesian currency. At any rate, Australia's monetary environment remained relative stable during the whole of the sample period, the management of the exchange rate did not undergo fundamental changes and the Australian economy was not subjected to major structural adjustment programs as

occurred in Indonesia. In contrast, marked post-1997 changes in both the conduct of Indonesian monetary policies and the management of the Indonesian exchange rate occurred.

4.5 Concluding Observations

Chapter 4 provides an outline of assumptions, methodologies and data sources used in addressing primary research questions. The chapter also formulates hypotheses to be tested and outlines specific delimitations applicable to the research. Based on these details, research findings are presented in Chapter 5.

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CHAPTER 5 - RESEARCH FINDINGS

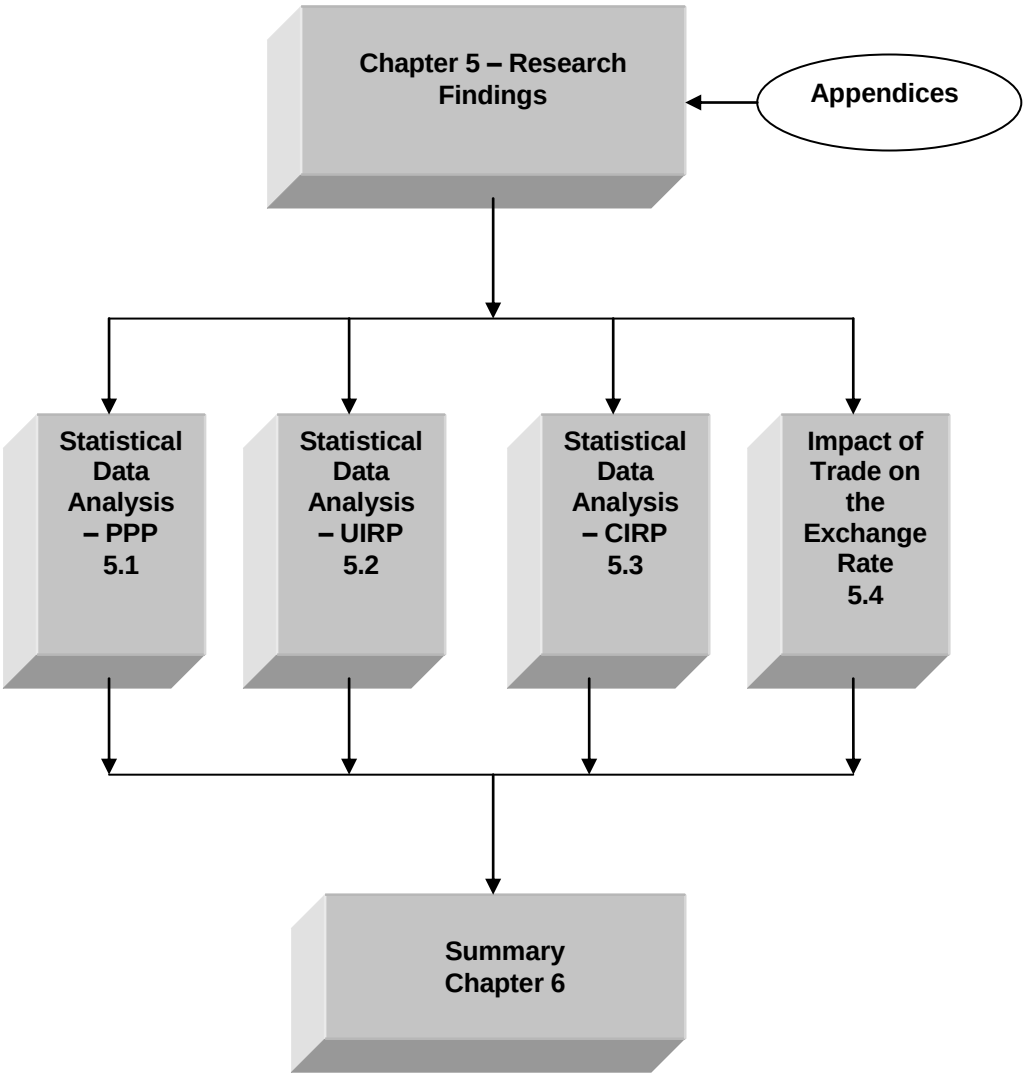
Chapter 5, using methodologies reviewed in the previous chapter, presents research findings. Where graphs are used, the appendix containing the underlying data is listed below the chart. Numbers below the X-axis designate weekly data points, i.e. the research period divides into 130 weekly intervals covering the period October 2000 to March 2003.

An initial overview of this chapter is provided in the form of a conceptual chart (see Figure 5.1). Chapter 5 addresses the four principal research findings of this dissertation, specifically:

- Section 5.1 analyses PPP.
- Section 5.2 analyses data relating to UIRP.
- Section 5.3 analyses data relating to CIRP.
- Section 5.4 tests for the influence of trade on the exchange rate.

Section 5.4, although not part of parity testing, was included because of the interlinked nature between trade arbitrage, PPP and prices. The impact of GDP growth on the AUD/IDR exchange rate, e.g. that growth empirically manifests in increased imports and a consequent depreciation of the currency was, for the same reason, also examined. However, findings proved largely inconclusive and details were therefore omitted from this study. Before providing a detailed analysis of PPP under 5.1, BI's claim that increases in the money supply did not result in inflationary outcomes is initially examined.

Figure 5.1 - Conceptual Chart - Research Findings



Inflation and the Money Supply

Indonesia's money supply was examined to substantiate BI's claim that increases in the money supply had not resulted in inflationary outcomes, i.e. that nominal GDP did not outstrip real output during the period examined (Bank Indonesia 2003). For the purpose of this examination, theoretical expositions based on the price and quantity model[66], i.e. that inflation *ceteris paribus* equals growth in the money supply minus

66 In the logarithmic form expressed as $p = m\text{-}y$ assuming the constant velocity of money.

growth in real GDP, were accepted (Juettner 1997).[67] Exchange rates in terms of these variables are described by the conventional equation $s = m^* - m-(y^*-y)$, where s = the spot exchange rate. Application indicates that both demand and supply variables (demand-pull and cost-push inflation) are affected by monetary policies. For example, supply related costs, i.e. cost-push inflation, typically result from wage claims not reflected in productivity gains.

To advance the argument from theoretical observations, it is initially noted that BI—as a matter of operational procedure—establishes annual base money targets linked to inflationary goals (Bank Indonesia 2003). The Bank *ex post* controls the money supply in line with these objectives. The efficacy of the model therefore depends on the association between the money supply, prices and GDP growth (see Figure 5.2). It is these associations[68] that are examined.

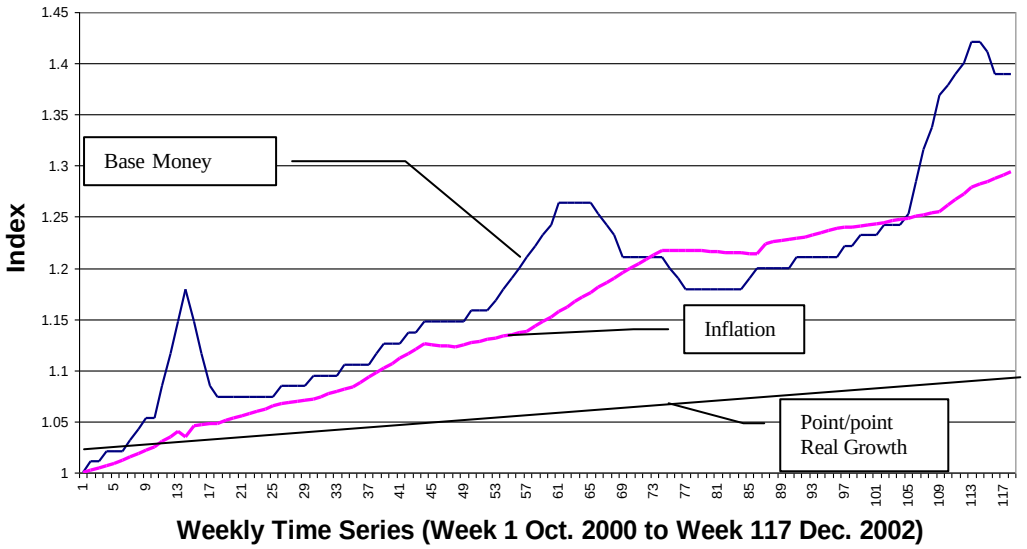
Results, assuming that deviations reflect approximate base line linearity, generate tentative evidence that supports BIs' claim. Reference to Figure 5.2, showing trends in inflation, the money supply and real growth, suggests that variables in fact track each other closely; monetary growth, on average, only slightly exceeds inflation. Where periodic spikes occur, these obviously relate to seasonal variations in the demand for money and excesses are subsequently corrected. Except for a brief period in the last quarter to December 2002[69], monetary growth generally tracks inflation, i.e. increases in base money respond to increases in real GDP without causing inflation.

67 Apart from any theoretical considerations, the practical justification for the proposed examination of variables arises from the fact that BI does not *per se* provide an analysis of the correlation between base money and the CPI. It is, for example, not clear to what degree increases in the money supply can be regarded as being consistent with non-inflationary growth.

68 Expressed by the equation $MV = PY$, where M = the money supply, V = the velocity of circulation of M ($V = PY/M$), P = the price level ($[V/Y]M$) and Y = real GDP.

69 Base money in the subsequent period returned again to average levels.

Figure 5.2 – Indonesian Base Money and Inflation Rates - Oct 2000 – Dec 2002



Appendix 10

Apart from visual reference to Figure 5.2, reference to the underlying statistical data that link growth to increases in the money supply also confirm present observations. For instance, when the mean increase in the money base is expressed as a ratio to real GDP, periodic variations are of little significance[70], i.e. base money increases are mostly in line with real GDP.[71]

However, tests were not able to confirm to what degree, if any, permanent monetary increases cause nominal GDP to exceed real growth in the long-term. Further, and although mean inflation rates were tracked, the information to carry out a within-sample test to estimate future inflation rates was also not available. For example, periodic data required to carry out an exponential smoothing[72] incorporating economic slack and the pass-through effect to import prices is not published by BI. Moreover, data to show the sensitivity of short-term interest rates to baseline variations of (M), i.e. to what degree base money changes fundamentally influence interest and GDP

70 Over the period examined, the increase of the CP index amounted to 29.38 % and GDP real growth to 8.2 % or a total of 38%, compared to an increase in base money of 38.95 % (CPI mean = 15.30 %; base money mean = 18.14 %) (Bank Indonesia 2002).

71 The 2001 ratio = (*MS*) Rp. 122 trill./ (GDP) Rp. 412 trill. = 29.61 %; 2002 = (*MS*) Rp. 130 trill./ (GDP) Rp. 427 trill = 30.44 %.

72 With the smoothing constant α being assigned a greater weighting to more recent data.

rates was also not available. This information shortfall indicates a lack of operational transparency by the Bank addressed elsewhere in this study. However, an approximate final-form equation of GDP projections may be postulated by assuming coefficient consistency and the linearity of the data. That is, if baseline percentage deviations of (y) can be shown to be related to percentage deviations of (M) from baseline, the long-term association between real GDP (y) and policy variables are simply:

$$dy_t / \bar{y}_t = a_0\left(dM_t / \overline{M}_t\right) + a_1\left(dM_{t-1} / \overline{M}_{t-1}\right) + \ldots + a_j\left(dM_{t-j} / \overline{M}_{t-j}\right).$$

In the case of short-term interest rates (r), it may however be more appropriate to relate absolute rather than percentage differences in (r) to baseline deviations of (M):

$$dr_t = a_0'\left(dM_t / \overline{M}_t\right) + a_1'\left(dM_{t-1} / \overline{M}_{t-1}\right) + \ldots.$$

Other variables for which absolute differences (expressed in percentage points) may be used in the Indonesian context include budget and current account balances. These, in the past, had shown significant tendencies to vary from assigned balances. However, given conclusions already reached, the examination of additional data is not warranted.

Although BIs' claim that monetary (M) growth (aggregates) had not resulted in inflationary outcomes, on the evidence examined, is not disputed, the lack of basic information concerning future projections, i.e. longer-term estimates by the Bank, is of concern. Projections are of interest to commercial agents in assessing alternative policy scenarios and their financial impact on operations; BI's (lack of) transparency was previously discussed in Chapter 2 (see 2.3.3).

In summary, when real growth and inflation rates are taken into account[73], liquidity seemed to match increments. Changes in base money were not followed by a rise in inflation and confirmed BI's claim to periodically absorb excess money, i.e. base-money increases responded to rather than initiated inflationary outcomes. Where excessive provisions occurred, these clearly related to seasonal responses and variations were subsequently corrected (see Figure 5.2).[74] However, correlations were

73 *BM* = *RG* + *X* + *I* - *E*, where *BM* = increase in the money base over the period (38.5 %); *RG* = real growth (8.2 percent); *X* = an effective exchange rate depreciation (5 %); *I* = CPI increase (29.38 %) and *E* is a resulting error term (- 4.1 %).

74 Base money decreased by March 2003 to IDR 120 trillion.

not perfect. It should be remembered that inflation is influenced by a number of factors *inter alia* the flow-on effect of changes in the exchange rate. The PPP theorem is examined next.

5.1 A Test for PPP

Theoretical details relating to PPP were previously set out in Chapter 3 and more particularly in Chapter 4. However, centralities are here briefly recapped to assist the interpretation of the text. PPP, in its basic form, suggests that changes in exchange rates reflect price differentials between the domestic economy in the domestic currency and the foreign economy in the foreign currency where $E = p/p^*$. If open markets and product homogeneity is assumed, the equation represents the Law of One Price, i.e. the maxim results from trade arbitrage based on existing price differences.

When domestic prices exceed foreign prices, $p>p^*$, demand can be expected to transfer to foreign markets, resulting in an appreciation of the foreign and a depreciation of the domestic currency $e>0$. When changes in the nominal exchange rate reflect inflation differences, the real exchange rate is said to be equal to *1,* that is, changes are equal to *0.* Significantly and of commercial interest, a price-based competitive disadvantage/advantage is annulled by changes in the exchange rate.

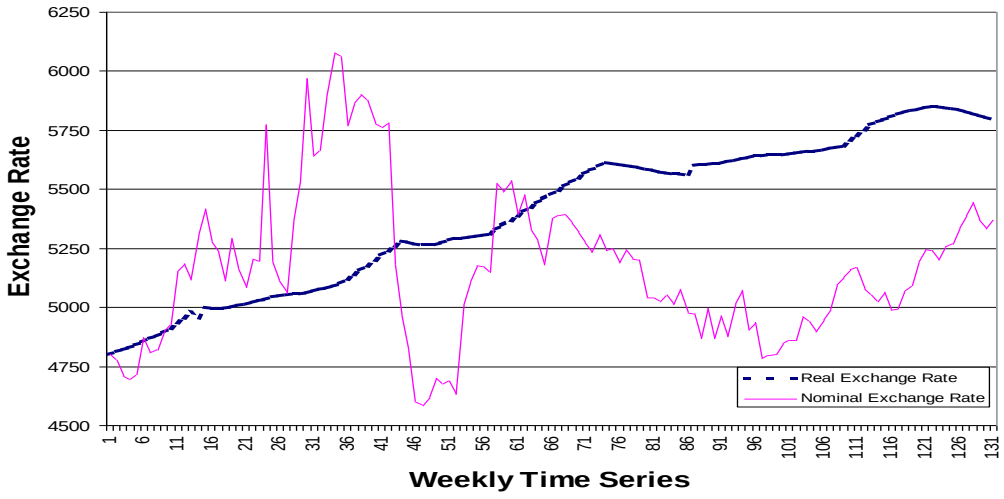
The validity of the PPP theorem thus depends on the nominal exchange rate, post disturbances, returning to its *real* value. Random shocks are not expected to permanently affect the real value of the exchange rate. Alternatively, if the nominal rate is non-stationary, i.e. the rate does not show a tendency to return to its real value, the exchange rate is said to perform a *random walk* (see Figure 5.3).

Two basic methods are usually identified in the literature (Levich 1998; Pugel & Lindert 2000; Salvatore 2004; Schreyer & Koechlin 2002) to test the stationarity of the exchange rate, i.e. tests: (1) based on time series (see Figure 5.3 and 5.4) and (2) tests using unit-root analyses to determine stationarity (see 5.1.1). Figure 5.3 represents two time series that track both the real and nominal exchange rate; the real exchange rate is represented as the rate that establishes PPP relative to the base period, that is, Figure 5.3 compares the nominal exchange rate to the value of the nominal rate adjusted by inflationary differences—the real exchange rate.

For example, if it is assumed that the nominal base period spot rate was 1 AUD/4800 IDR and the price differential period t_{+1} = 10 %, i.e. Indonesian inflation rates exceed Australian rates by 10%, the PPP or real spot rate = 4800 IDR x 1.10 = 5280 IDR. The nominal exchange rate has depreciated, and the real exchange rate 1 AUD/5280 IDR re-establishes PPP in comparison to the base period. When both nominal and PPP (adjusted) exchange rates are equal, PPP prevails; nominal exchange rates respond to and reflect inflation differentials. This equilibrium occurred on six occasions over the period examined by this study—see Figure 5.3.

As can also be seen from Figure 5.3, deviations of the nominal exchange rate from its assumed PPP value were large and persistent, i.e. the IDR was substantially undervalued vs. its implied PPP value and remained overvalued during the second half of the period. Nevertheless, a trend to parity convergence becomes evident in the last quartile of the sample period when an appreciating phase of the currency comes to an end.

Figure 5.3 - Nominal and Real Exchange Rates – 30 Months to March 2003



Appendix 7

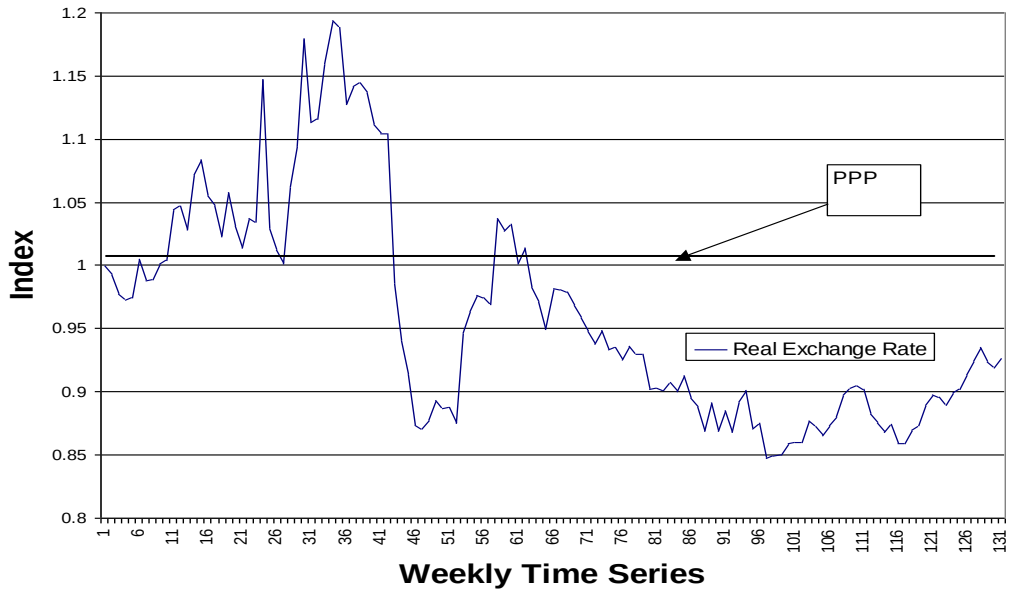
The degree of convergence to PPP can also be judged by reference to the underlying statistics represented by Figure 5.3, i.e. the extent to which real mean exchange rates equal mean nominal values. To eliminate statistical bias, the equilibrium PPP level (as represented by the mean or trend line) should not be selected from the in-sample data. Visual reference to Figure 5.3, as already noted, shows that the nominal exchange rate

experiences equal and opposing trends in the first and second half of the sample that nearly average out against the real exchange rate. Juettner (1997 p.108) suggests, in this case, that a return to PPP is indicated by reference to the 'average value [coefficient] over time of the real exchange rate'. This coefficient is given by the ratio of the nominal mean over the real mean exchange rate[75] (see Figure 5.3).

Levich (1998), in addition, also analyses the extent to which the actual exchange rate deviates from PPP by defining the real exchange rate as a ratio of the nominal exchange rate to its PPP value as shown in Figure 5.4. Like most real magnitudes, the real exchange rate is expressed as an index relative to a base. If the nominal value of the exchange rate is equal to its PPP value, the index is *1*. Relative PPP prevails. If the nominal rate exceeds its PPP value, the index is *>1*.

Using this approach, Figure 5.4 presents the previous data on prices and exchange rates but in an alternative, perhaps more informative way. The series commences at parity and progresses on the basis of cumulative inflation rates since the base period October 2000.

Figure 5.4 – The Real AUD/IDR Exchange Rate and PPP – 30 Months to March 2003



Appendix 8

75 Mean nominal *SR/Mean Real SR* = 5169/5400 = 0.96.

If PPP holds, the real exchange rate can be expected to return or fluctuate closely around *1*. Visual reference to Figure 5.4 clearly indicates the absence of any clustering, i.e. continued parity is not evidenced. The exchange rate in fact experiences a series of long-term real appreciations and depreciations, not uncommon in developing countries, due to frequently excessive variations in interest rates. These, for the first quartile of the series, show the relativity of the exchange rate to its PPP value to be above its PPP value or *1*. The series actually crosses PPP a number of times over a span of 30 months, i.e. a periodic drift of the exchange rate to and from its starting point implies that PPP reasserts itself over time. It may thus be argue that PPP holds in the sense that deviations from PPP are both positive and negative and average out over the sample period (Levich 1998). However, such observations, given the sample, are mere conjectures and premature[76]; although the exchange rate displays contemporaneous and intermittent inclinations to return to PPP, the series *prima facie* shows little or no preference to continuous stationarity.

To firm up these observations, the real exchange rate was also tested for stationarity using autoregressive and standard unit root (the Dickey-Fuller) tests (see 5.1.1 immediately below). For this purpose, the null hypothesis was formulated as:

> that the real exchange rate is non-stationary against the alternative that the real exchange rate is stationary.

5.1.1 Test for Stationarity

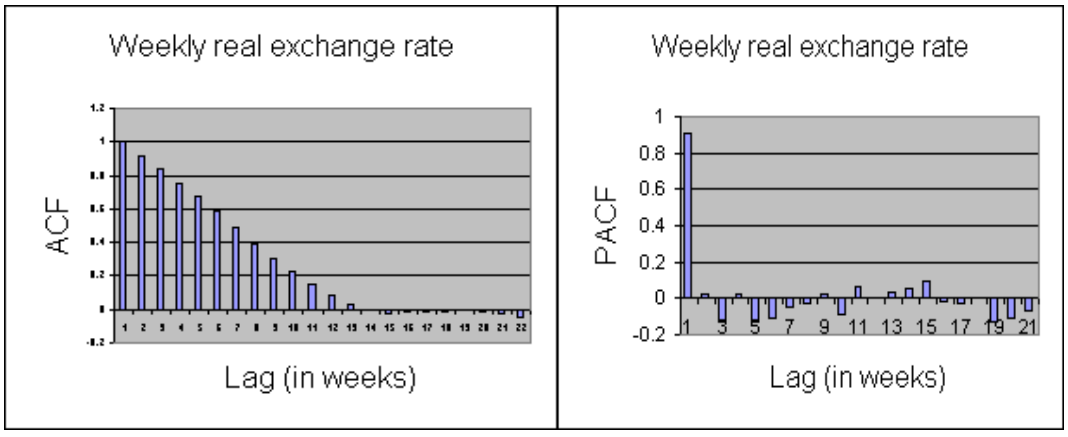
The stationarity of the exchange rate, i.e. the mean-reverting property of real exchange rates, can also be tested by using unit-root tests. If the real exchange rate can be shown to be non-stationary, i.e. the null hypothesis cannot be rejected, the process contains a unit root or random walk component. That is, deviations from parity are cumulative rather than mean reverting. PPP cannot be supported in the long run. On the other hand if the null is rejected, the real exchange rate is mean-reverting consistent with PPP. In

76 A substantial amount of data, over an extended period of time, is required to observe whether the real exchange rate in fact experiences enough cycles to measure the average length of one cycle with precision.

its strictest form, PPP mandates that the real exchange rate exhibits continued stationarity. This premise was tested.[77]

A few basic plots for each data set are examined first, i.e. both the estimated autocorrelation function (ACF) and partial autocorrelation function (PACF) of the time series are analysed to determine stationarity. Preliminary findings, after the first lag, suggest that the exponential decay of ACF and a basically zero PACF indicate an AR(1) process or non-stationarity of the data series—see Figure 5.5.

Figure 5.5 - Stationarity of Weekly Real Exchange Rates



Moreover, it may also be hypothesised from Figure 5.4 that the plotted series is non-stationary. The mean is not the same over the sub period, i.e. PACF and ACF are almost *1* at lag *1*. The series was then examined for first order differences, i.e. Figure 5.6 shows first order differences of the weekly real exchange rate. As evident, rates are closer to stationarity and Figure 5.7 shows that there is no exponential decay in the ACF or spike in the PACF at lag *1*[78], i.e. when variables are defined in first order differences, meaningful results occur and difference between nominal and real exchange rates reduce.

77 In a more general sense, as noted, the long-run hypothesis of PPP merely requires that the real exchange rate can be shown to be mean-reverting.

78 The null hypothesis assumes that the real exchange rate contains a unit root and that the first difference of the real exchange rate is stationary, i.e. if the real exchange rate has one unit root, the first difference must be stationary though not necessarily serially uncorrelated as in the random model.

Figure 5.6 – Stationarity of Weekly Real Exchange Rates - First Order Differences

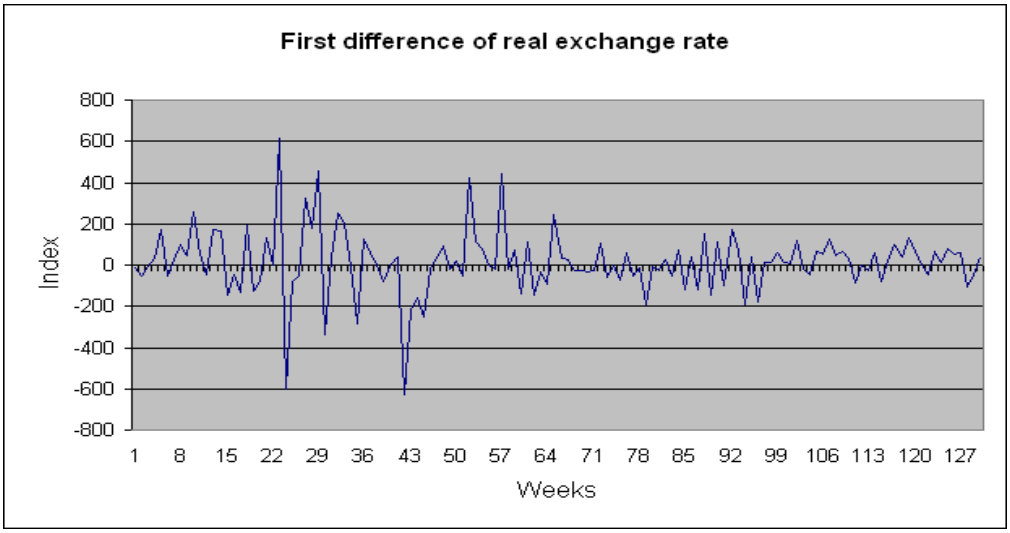
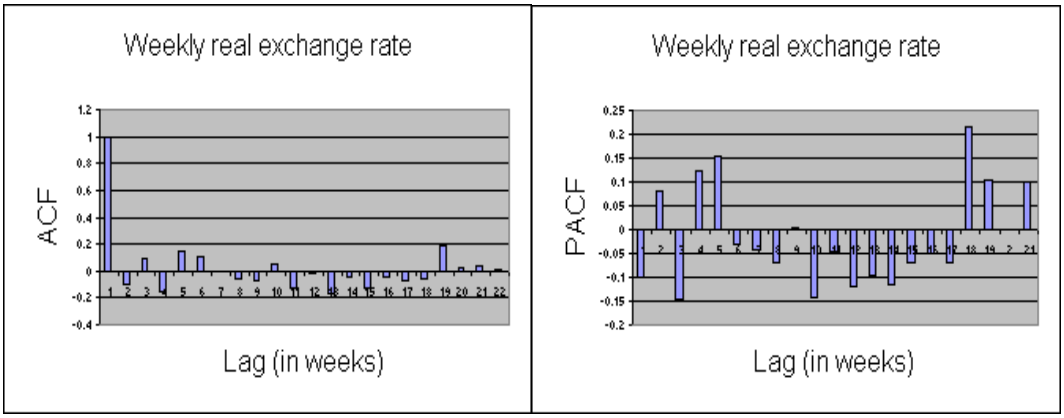


Figure 5.7 – Stationarity of Weekly Real Exchange Rates (ACF; PACF) - First Order Differences



Finally, findings were tested for confirmation of stationarity, i.e. the coefficient of the *AR(1)* model for the series was estimated using the *Dickey-Fuller* unit root test. Table 5.1 shows the estimated coefficient of the autoregressive model for the series.

Table 5.1 - Dickey Fuller Test

	Variable	Coefficient	Standard Error	t-stat.	p-value
Model	Intercept	421.66	174.21	2.42	0.01
	AR(1) variable	-0.07	.030	- 2.35	0.02

The estimated slope coefficient $(\hat{a}_1)$ from the regression is -0.07 and the *t*-statistic -2.35. Since the *p*-value (p = 0.02) is smaller than the 5% level of significance, the smaller *p* value suggests that first order differences are stationary. The real exchange rate (shown in Figure 5.4) is non-stationary, that is, the rate shows random walk with drift and long-term deviations are cumulative rather than mean-reverting.

Summarising, the dynamic processes of real exchange rates were examined by a conventional AR(1) process. Preliminary data indicated the series to be non-stationary while first order differences suggested the series to be stationary. The subsequent Dickey-Fuller test confirmed that the process contained a unit root random walk component. Moreover, the real exchange rate, using time series (see Figure 5.4 and 5.5), could clearly not be shown to be mean reverting[79], that is, the exchange rate strayed from *1* (the value consistent with PPP) by large numbers and confirmed the null. It is however noted that a tendency to intermittently return to PPP manifested in that the real series crossed the PPP line a number of times over the span of the sample. For example, the visual impression gained from Figure 5.4 suggests a tendency to mean reversion in the sense that deviations from parity are both positive and negative and variations average out to zero over time.

The fact that the null could not be convincingly rejected was not surprising. The lack of support may have been due to the low statistical power of the sample period since it can take a > 10 year period to reliably reject the existence of a unit root in the real exchange rate. It should also be remembered that the premise of long-run constancy[80], however convenient for test purposes, need not necessarily hold. The real exchange

79 The *St* exchange rate is the same as the *St-1* rate except for a random-error term, i.e. exchange rate changes *St-St-1* are simply a random error term. Random walk is an example of a non-stationary series.

80 When the nominal exchange rate changes by the same percentage as relative prices, the real exchange rate remains unchanged. During periods when PPP holds the real exchange rate remains constant.

rate may in fact permanently change (Levich 1998). It is, for example, plausible that real productivity shocks affect countries differently over longer periods. Moreover, in the case of Indonesia, the possibility of a permanent increase in the nominal money supply (above real GDP) causing inflation and the nominal value of exchange rate to change permanently cannot be rule out. Further, trade is not only influenced by prices but other factors, *inter alia* qualitative differences, innovations and changes in domestic demand patters etc. Dornbusch's overshooting phenomenon, i.e. the slower speed of conversion on goods compared to capital markets following disturbances may also explain the observed lack of stationarity. Since PPP depends on goods whereas IRP relies on capital market arbitrage, the latter explains short-term exchange rate changes more persuasively.

Finally, while the concept of PPP may be straightforward, it must also be noted that measurements and interpretations are subject to limitations. CPIs, for example, were only available in monthly increments and converted to weekly averages causing an unintended smoothing of the data. More notably, individual basket compositions were different. The homogeneity of the data is especially problematic when, as in this case, developed and developing countries are compared; the composition of the Indonesian CPI, for example, includes a high percentage of subsistence and stable food items, Australia a greater percentage of service-related items. Nonetheless, care was taken to avoid miss-specifying tests. That is, tests implicitly assumed that the exchange rate floats freely—BI in substance does not peg the exchange rate—and that the real exchange rate results from a linear transformation of the data that relies on underlying *I(1)*fundamentals. However, causations, as already noted elsewhere, may not always be clear (see also 5.4.2). Despite some arbitrariness, results nevertheless remained relatively robust over the period and it is doubtful whether correcting for limitations would have significantly impacted on the broader dynamics of the series.

Relevance of Findings

Levich (1998 p.117), summing up the purely commercial aspects of PPP-based tests, notes that:

> … when parities hold, a source of risk and a source of [commercial] opportunities disappears … a firm can make its selection of production locations on the basis of competitive advantage … when PPP holds, exchange rate changes do not affect the real cost of goods produced or the real revenues from goods sold.

It is apparent that the value of the rupiah divides into three clear phases: the first half of the research showed the currency to be undervalued vs. the real exchange rate, the second half showed the currency to be overvalued. The final quarter of the second half of the sample showed a consistent, depreciating trend of the nominal exchange rate in line with PPP (see Figure 5.3 and 5.4). It is suspected[81] that BI hastened this process by adopting policies to prevent the rupiah from appreciating, or, alternatively, that BI dampened the value of the currency by selling the rupiah on international exchange markets. This strategy indeed makes sense since it curtailed Indonesian imports and expanded Indonesia's export markets, which dramatically declined due to the drastic appreciation of the exchange rate in 1997.

Outcomes resulting from either an over or under-valued currency are of commercial significance to foreign entities. For instance, policies to prevent an appreciation of the rupiah must inevitably increase the costs of imports and reduce the value of overseas remittances denominated in the rupiah. But it may, of course, also improve the export position of foreign entities. Net benefits may therefore become a function of and depend upon the entity's status as a net exporter and the extent of any net overseas remittences. Economic risk depends on whether the entity's net investments are exposed to currency losses causing the operation to ultimately become unprofitable. Such events may be due to any number of reasons not necessarily associated with poor managerial practises[82], i.e. a change in monetary or fiscal policies or, of more immediate concern, the risk of exchange rate volatilities resulting in *transaction* or *translation* losses from financial positions. A depreciating value of the rupiah, for instance, will cause a loss in (net) asset values of the enterprise when translated into AUDs; a more detailed analysis of these issues falls outside the scope of this study.

[81] The suspicion is *inter alia* based on the fact that during this period Indonesia's trade surplus increased.

[82] The level of risk acceptance may be judged by the structure of ownership. Manager-controlled forms are relatively more risk averse than owner-controlled forms of ownership where an asymmetric manager reward structure exists. Hired managers do not internalise the benefits from successful risk taking but internalise the costs attributable to unsuccessful risk taking.

To what degree observations may be generalised over the longer-term remains an open question. Findings are obviously temporal and dependent on the selected sample period and are therefore subject to change. It is however likely that BI will: (a) continue with its current policy of limiting any upward movements in the rupiah, at least until a more acceptable external balance is achieved, and (b) that the value if the currency will remain sensitive to political and social disturbances in Indonesia.

Summarising, tests revealed little evidence in support of continuous PPP. However, a tendency of the exchange rate to intermittently return to PPP was observed and deviations close to averaged out. Parities may therefore be viewed from two positions: in its stricter form, deviations are not deemed acceptable whereas in its liberalised interpretation PPP only requires that the exchange rate evidences a tendency to mean reversion that allows for some persistence in memory. Both stationary and non-stationary series may hence shown to be mean reverting and caution must be exercised when using the term to describe findings.

What makes the PPP analysis informative, as already noted, is that showing periodicities by magnitudes of deviation enable certain inferences to be drawn from the data that are commercially relevant. For instance, when parity holds, a source of risk (and gain) is eliminated and exchange rate changes do not affect real operational costs.

5.2 Data Analysis - Uncovered Interest Rate Parity

The 1997 crisis and subsequent deregulation of the Indonesian exchange rate brought substantial social and economic changes to Indonesia. Nevertheless, floating rates showed considerable freedom to respond to IRP. Section 5.2, drawing on material from previous chapters, tests the premise that the expected rate of depreciation/appreciation of the exchange rate equals interest rate differentials. That is, given rational expectations and risk neutrality, tests are designed to reveal to what extent interest differentials provide an indicator of future changes in the spot rate.

UIRP theoreticals were discussed in detail in Chapter 3 and 4. However, observations, for convenience, are here briefly recapped to assist comprehension. Given UIRP, investors are prepared to enter uncovered transactions, i.e. investments are sold at a future date $t+1$ at the then prevailing spot rate rather than the quoted forward rate.

Investment decisions are not based on the forward but expected future exchange rate $E(e_{t+1})$. The resultant equation can be written as: $E(e_{t+1})/e_t = (1+i)/(1+i^*)$. If the interest rate is assumed to be the dependent variable and the domestic currency is expected to depreciate, an increase in the interest rate vs. the foreign country to prevent net capital outflows will result. Conversely a foreign country whose currency is expected to appreciate is decoupled from the influence of interest rates.

However, if the interest rate is considered to be the independent variable, issues are more complex. If, for example, foreign interest rates exceed domestic rates, the domestic currency is expected to appreciate. If this was not the case, the currency would experience an overshooting of the prevailing spot rate, i.e. the spot rate would depreciate to such an extent as to cause an equal expectation that the currency will again appreciate. Empirically, the UIRP therefore occurs where $e_t = E(e_{t+1})(1+i^*)/(1+i)$.

Test results indicate that conformity to UIRP depends on which dataset is used. For the whole of the research period, future rates were approximately equal in positive and negative deviations from theoretical estimates.[83] Strict parity could however not be observed, i.e. the null hypothesis, that error rates of the AUD/IDR exceed the range of normal transaction costs of ±1 %, could not be rejected. Given remaining asymmetries and a lingering lack of faith in BI's ability to control inflation—conditions not uncommon in developing economies—this was not an entirely unexpected outcome.

Although interest parity could not be confirmed within the given transaction cost band, in a broader sense, nevertheless, exchange rates could be shown to respond to changes in interest rates. However, different periodicities showed significant deviations from parity. While these largely averaged out over the whole of the research period and variations were obviously related to political and social unrest (see 5.2.1), other influences acting on the exchange rate could of course not be entirely ruled out. Such factors, asymmetric market information, market perceptions or market expectations for instance, are difficult to test and these, at any rate, are factors that do not usually form part of a conventional parity testing protocol (see also 4.4, Scope and Delimitations).

83 The evidence establishes a mean error rate of -1.93 % over the sample period.

5.2.1 Data Analysis

The test for UIRP: (a) computes an implied future spot rate based on interest-rate differentials, (b) establishes error rates—the difference between implied and future spot rates—and (c) determines the standard deviation from mean error rates. The data were also tested for accuracy using relevant error measures. Details, moreover, were analysed for breaks or changes in trends and homoscedasticity. The error term was previously defined as the difference between theoretical and actual future spot rates, i.e. existing pricing gaps between variables. If parity applies, the magnitude of the error term should be equal to or less than 1%.

To initially summarise findings, testing the H_o (that ℓ is > *±1 %*), as already noted, confirmed the null. The test showed a mean error rate and standard deviation (SD) from the mean error rate of respectively –1.93 %[84] and 9.32 % over the period examined (see Figure 5.8). In fact, considerable volatility manifested over the whole of the sample. However, halfway through the period, rates commenced to settle, i.e. the SD of the exchange rate during the second term was less than half that of the first half.

The performance evaluation of the test, using conventional squared and absolute error measures, is listed on Table 5.2. The test achieved a MAPE of 7.8% that indicates a good model fit. The *Theil U-statistic* also showed that the test fits well, while the MAE showed test estimates to vary within 399. However, the MSE and consequently RMSE values were quite large.

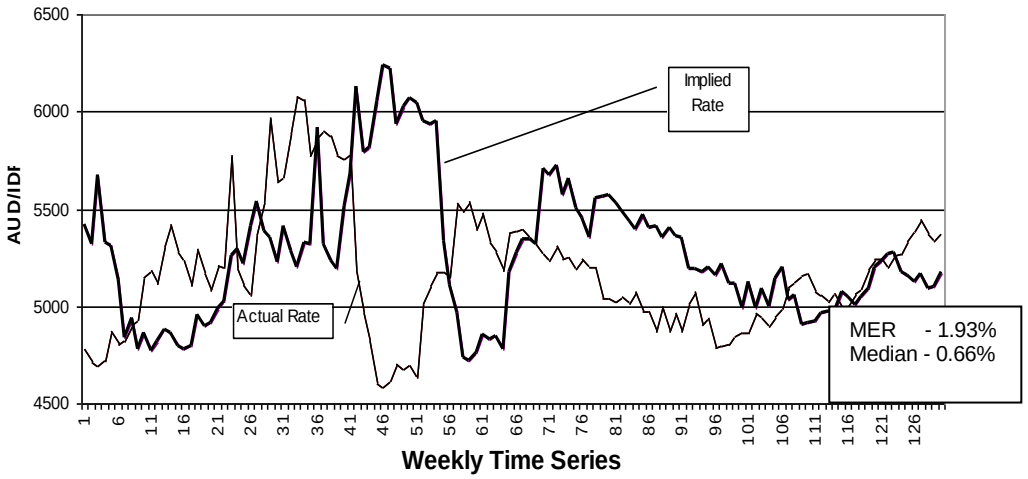
Table 5.2 - Accuracy Measures - Actual and Implied Exchange Rates

Measure	Rates
MSE	277242
RMSE	526.54
MAE	399
MAPE	7.84 %
U-statistic	0.00

84 This suggests, on average, that a 1.93 % return would have accrued to an Australian investor, ignoring transaction and tax costs. The time series is based on weekly data. Using non-overlapping data would not have significantly changed results.

Both implied and actual spot rates are shown in Figure 5.8 as time series. The lag and subsequent correlation between actual and implied exchange rates—typically evidenced in weeks 56 to 64 and subsequently in weeks 68 to 76—simply reflects the fact that spot rates are adjusted by interest differentials to derive implied rates. Correlations are therefore the outcome of the particular methodology employed and are of no particular significance.

Figure 5.8 – Uncovered Interest Rate Parity – Implied and Actual Exchange Rates, 30 Months to March 2003



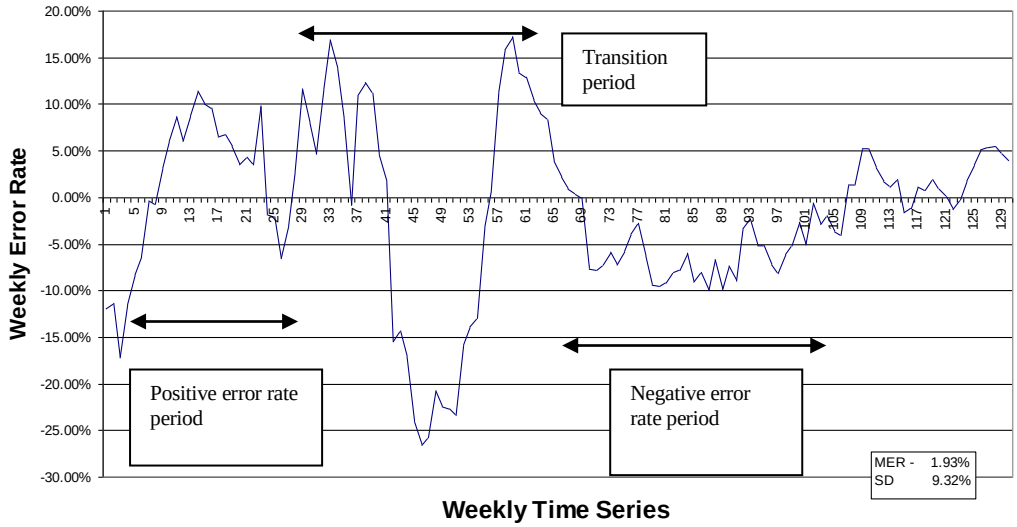
Appendix 1

Spikes in the series suggest the presence of profitable arbitrage opportunities that, when exploited, return markets to temporary equilibriums only to subsequently destabilise again. As noted, an increasing trend to convergence occurred in the last half of the sample due to the relative absence of national disturbances. Implied and actual exchange rates tracked each other closely. This suggested that forecasts based on periods of relative social and political calm, e.g. last quartile results, can be expected to yield reasonably close projections[85]; forecasting methods are briefly examined in Chapter 6.

85 Predictive heuristics, based in the notion that the future is more likely to reflect the recent rather than distant past, can be used. Consequently, predictions may be obtained by taking a moving average of the last *t* out of the *n* signals that have appeared in the series. If *t=n*, the prediction is the average of all previous signals. If *t=1*, the value of the last number acts as the predictor of the next number. The best value for *t* depends on the nature of the series. The use of this method can actually be improved by moving the value of *t* towards the optimum. Alternatively, a weighted average of previous signals can be taken as the prediction for the next series. The size of the weights exponentially decreases backwards in time, i.e. less emphasis is given to older observations. The

Periodic variables however showed a distinct lack of correspondence to parity. Figure 5.9 analyses deviations by plotting error rates on a weekly basis. The chart, particularly in the first half of the period, indicates large positive and negative deviations from parity, i.e. over two-thirds of error rates fell between –11.25 % and +7.39 %. This period was also marked by considerable political unrest and other turbulences. For example, the immediate pre-and post-periods of Megawati Sukarnoputri's election on 26.7.2001—the June-August 2001 quarter—showed a good deal of variation. The period leading up to the election revealed the nominal value of the rupiah to be predominantly above its implied value, while the post-election period showed a gradual return to parity and strengthening of the nominal value of the rupiah. To assume the complete absence of spikes, even when IRP prevails, is of course unrealistic. For example, sudden changes in markets prior to the end of a trading week, combined with differences in time zones between Indonesia and Australia, make spikes unavoidable.

Figure 5.9 – Uncovered Interest Rate Parity, Weekly Error Rates, 30 Months to March 2003



Appendix 1

approach can be improved by selecting the most appropriate exponential coefficient for a given series to be forecasted—steeper exponentials are more appropriate for some series rather than others.

The whole of the sample period thus divides into three clear periods of volatility (see Figure 5.9)[86]: (a) a pre-election period to week 42 showing mainly depreciating values of the rupiah, (b) a post-election transition period where the exchange rate considerably overshoots its equilibrium both in terms of positive and negative values, and (c) a subsequent strengthening of the rupiah and gradual return to equilibrium values from week 101 that showed a mean error term of 0.98 %. Figure 5.8 and 5.9 reflect these volatilities, i.e. nominal exchange rates obviously register the uncertainty and subsequent improvement in the outlook of the rupiah on forex markets. By comparison, interest differentials represent a smooth series of changes that take on positive values over the whole of the sample period (see Figure 5.10).

Although strict parity could not be confirmed in terms of the mean-reverting property of the AUD/IDR exchange rate[87],it may be argued that over the whole of the sample periodic interest differentials were mostly offset by realised changes in the exchange rate. The IDR substantially depreciated in line with IRP. Key points flowing from these findings include the recognition that:

- Parity appears to work better during periods of political and social calm and over longer rather than shorter periods where substantial variations from IRP manifest. To the degree that changes are random, investors are unable to consistently exploit arbitrage opportunities.

- Although the mean error term increased in the second half of the period (see Table 5.5), standard deviations were less than half that of the rate of the previous period indicating a less volatile exchange rate (see also Figure 5.9).

- When phases of a depreciating vs. an appreciating period of the rupiah are juxtaposed, comparisons show a disproportionate increase in the mean error term during the latter phase (see Table 5.5).

86 Figure 5.9 implies an apparent positive bias in the error term, i.e. there appear to be more positive than negative error rates in evidence. This is simply a manifestation of the particular methodology applied, and the positive bias does not denote any qualitative outcomes (see Chapter 4).

87 Efficient markets are defined by Levich (1998 p.213) to mean that '… on average errors of the formulation of expectations about prices or returns are zero and [that] these errors follow no patterns that may be exploited…'.

Given the last point, it may be hypothesised that during an appreciating period of the currency, forward interest rates tend to undervalue future estimates of the exchange rate. To this extent, the interest rate elasticity, i.e. reductions in Indonesian interest rates, lag actual exchange rate changes. Interest rate volatilities are briefly analysed in the next section.

Disaggregation of Interest Rates

Table 5.3 examines trends in nominal interest rates. The table lists the absolute range and standard deviation from the mean for both Indonesian and Australian interest rates.

Table 5.3 - Nominal Interest Rate Volatility - Australian and Indonesian Three-Month Interest Rates - July 2000 to December 2002[1]

Indonesia	Absol. Range[2] %	Mean Three-Month Rate %	SD %	Period
Period Total	1.15	3.84	0.40	July 2000 to Dec. 2002
First Half	1.15	3.87	-	July 2000 to Dec. 2001
Second Half	1.08	3.81	-	Jan. 2002 to Dec. 2002
Australia				
Period Total	.61	1.28	0.18	July 2000 to Dec. 2002
First Half	.61	1.35	-	July 2000 to Dec. 2001
Second Half	.23	1.19	-	Jan. 2002 to Dec. 2002

1 Interest rates commence in July 2000 due to requisite forward exchange rate calculations.
2 Highest minus lowest rate.

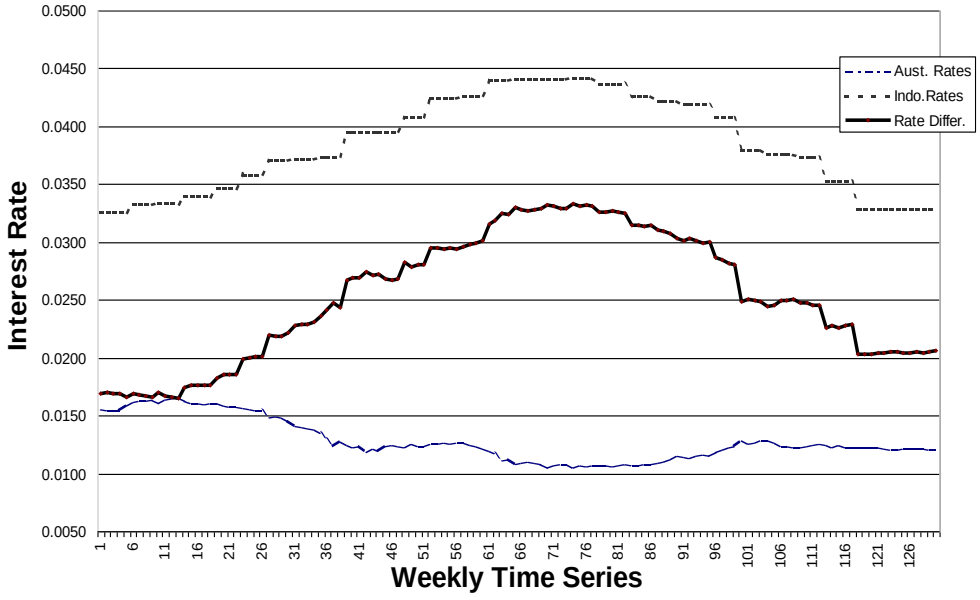
Interest differentials clearly reflect Indonesia's preoccupation with inflation and exchange rate concerns over most of the period examined. Widening gaps in nominal interest differentials, see Figure 5.10, indicated a continued country risk[88] in the first half of the period that reflected in Indonesian swap premiums.[89] It may also be

88 Sovereign credit risk (ratings) suggested that country risk had remained relatively high in Indonesia in comparison to other Asian countries.

89 According to BI, a rise in swap premiums vs. the USD had caused covered interest rates to consistently turn negative during 2001 indicating a continued perception of risk by markets (Bank Indonesia 2002). Indonesian

instructive to look at the regression of the exchange rate on corresponding interest rate differentials. The analysis shows that nominal exchange rates and nominal interest rate differentials trend in opposite directions over the sample period, i.e. increasing/declining interest rates reflected in a depreciation/appreciation of the exchange rate. For example, the slope coefficient for the first half of the period suggested that each 1 percent increase per annum in the nominal interest differential (Figure 5.10) was associated with a 1.5 percent depreciation of the currency.

Figure 5.10 – Three-Month Interest Rates and Interest Differentials, 30 Months to March 2003



Appendix 2

The research period obviously reflects stretches of political and social unrest mirrored by co-variances in the exchange rate. The first half of the period, for example, was marked by a depreciating followed by an appreciating phase of the rupiah in the second half of the period. Due to differences in respective policy priorities, noticeable asymmetries in Indonesian vs. Australian interest rates[90] are observable, i.e. Figure

swap premiums have been on a downward trend since 2002 and sovereign credit ratings improved as a result (Bank Indonesia 2002).

90 Indonesian interest rates exhibit a steady increase from an annualised rate of 13 % in July 2000 to a peak of 17.6 % in December 2001. From this date, a steady decline in rates to below 9 % occurred. In comparison, Australian three-month interest rates commenced at an annualised rate of 6.5 % and declined to their lowest point of 4.23 % in December 2001. The first half of the research period therefore shows increasing Indonesian and decreasing

5.10 shows rates to respectively peak and trough in December 2001 reflecting relative monetary policy concerns. Australian monetary policies, particularly during the second half of the research period, reflected increasing concerns over a potential private debt blow-out or emerging asset bubble; Australia's debt/GDP ratio had grown at an exponential rate close to 1 since the late 1960s. Rising interest rates to address emerging imbalances mirrored these issues, i.e. concerns over a debt bubble that had fuelled aggregate demand and increased prices. The concern was that a continued increase in private debt aggregates would result in a speculative asset boom at the expense of productivity rates that had the potential to ultimately lead to a collapse of asset prices, i.e. the ratio of interest payments to GDP was in danger of becoming unsupportable.

Disaggregation of Error Rates

Frequent and large deviations from IRP occurred over the whole of the sample period. However, deviations of this magnitude are not in line with parity[91] which requires if not continues reversion then at least smaller variations closer to transaction costs. At first glance, a significant association between exchange and interest rates is therefore not evident.

This conclusion is premature. When statistics are examined for underlying changes in trends, a more acceptable metric emerges. For example, Figure 5.8 indicates an increasing trend to parity during the last quartile of the sample. Separating the period into two equal, consecutive periods—one containing a stretch of large error rates—shows a less volatile exchange rate in period two that resulted in a standard deviation of less than half that of the rate of the previous period.

To this end, periodic differences were statistically examined for: (a) variances, using *Levenes*' F test for equality of variances of the subperiod's error terms, and (b) the mean, using the *t*-test for equality of means (Fox 1997). Tests were defined as $H_o: = \sigma_1 = \sigma_2$. Respective *F* and *t* values followed by *p* values are shown in Table 5.4.

Australian interest rates followed by an approximate reversal in these trends in the second semester January 2002 to March 2003.

91 Parity is defined as a condition where a high percentage of observations fall within transaction cost parameters.

Table 5.4 - Test of Homoscedasticity and Mean Error Rates - October 2000 to March 2003

Period	Mean Error %	F-Stat. (p-value)	t-Stat. (p-value)
Oct. 2000 to Dec. 2001	- 0.29	44.14 (0.00)	1.38 (0.17)
Jan. 2002 to March 2003	- 2.56		

The *F*-test, as expected, did not support the null (indicated by the *p*-value). Variances in pricing errors reduced considerably in the second half due to the fact that substantial fluctuations caused by prevailing political uncertainties manifested in period one. Although the error mean increased in the second half of the period, the *t*-test revealed that the error mean for the two periods as indicated by its *p*-value was statistically the same. Nevertheless, variances, as noted, reduced in the second half of the period, pricing became more consistent, arbitrage opportunities consequently diminished and foreign exchange markets became more aligned to interest parity.

Disaggregation of Spot Rates

Table 5.5 provides an analysis of mean spot and error rates for the two periods to shed further light in the asymmetric relationship between the two periods. The data show an appreciating period of the rupiah in the second half of the sample to be linked to a disproportionate increase in the error term when compared to a depreciating period of the exchange rate in the first half of the sample (see Table 5.5).

Table 5.5 - Comparison of Actual to Implied Spot Rates and Changes in Mean Error Rates - October 2000 to March 2003

Period[1]	Rupiah Actual Spot Rates (Mean)	Rupiah Implied Spot Rates (Mean)	Rupiah Error Rate (Mean)	Error Rate (Mean) %
First Half	5242	5257	15	-0.29
Second Half	5101	5232	131	-2.56

The outcome suggested that UIRP applies to a greater extent during periods of increasing rather than declining interest rates. This scenario makes sense when it is recognised that: (a) existing monetary transmission problems slow down the dispersal of interest rates to financial markets and (b) that markets tend to be generally better informed about impending central bank parameters during an inflationary phase of the economy. If empirically confirmed, these findings may have significant implications for both investors and speculators.

Summarising, during a declining period of Indonesian interest rates in the second half of the research period, the rupiah's spot rate had shown a marked tendency to divert from its implied UIRP path, i.e. the mean error rate increased significantly in comparison to rates in the first half of the research period (see Table 5.5). More specifically, the first half of the sample evidenced an increasing interest differential between Indonesian and Australian interest rates (see Figure 5.10) and a corresponding increase in the depreciation of the exchange rate. The interest rate gap widened and the AUD/IDR exchange rate depreciated substantially in line with UIRP predictions. In contrast, decreasing interest rate differentials and an average appreciation of the exchange rate marked the second half of the research period. Nevertheless, increasing error rates, i.e. the fact that actual exchange rates remained predominantly below their UIRP implied value, resulted. It will be recalled that solving forward, i.e. forming expectations of the future exchange rate may be written as:

$I_{t+1} = S_t + S_t\left(\frac{r - r^*}{1 + r^*}\right)$ or $S_t = \sum_{i=0}^{\infty} E_t(R^*_{t+i} - R_{t+i}$, where the error rate is $\ell = S_{t+1} - \left(S_t + S_t \frac{r - r^*}{1 + r^*}\right)$. This suggests that exchange rates may be quite sensitive to news, i.e. that rates react to news or expected changes in interest rates. According to Wickens (2008), apart from market transmission problems, the theoretical explanation of this phenomenon may be due to the fact that exchange rates—that is, financial markets in general—respond rather indiscriminately to new information about either current or expected future (nominal) interest differentials. For example, a rise in R_t (with R^*_t remaining the same) or an anticipated future change R_{t+n} causes $E_t s_{t+1}$ to change, i.e. it will cause $E_t s_{t+1}$ to fall. Since $R_t > R^*_t$, UIP requires that s_t and $E_t s_{t+1}$ change so that $s_t > E_t s_{t+1}$. An increase in R_t causes the exchange rate to appreciate

while rational expectations imply that the exchange rate depreciates; it should here be noted that the future expected exchange rate depreciation (period t to period t+1) does not occur from period t-1 to t.

Observing the two data series suggests when investors hold expectations that a change in the domestic interest rate is imminent in period t+n, s_t will change during t in anticipation, that is, the anticipated rate will remain until further interest rate changes occur that validate the process. If in due course no change in the prevailing interest rate occurs however, s_t can be expected to revert to its original value. This trend was evident in the last quarter of the research period (see Figure 5.8). The exchange rate appreciated early in the second period, beyond UIRP expectations, and subsequently evidenced a revision to its original value in the last quartile of the period in line with UIRP when it became evident that interest rates would not fall further.

As previously discussed, interest rates in the context of the AUD/IDR exchange rate are seen as one of the more important variables that determine the value of the Indonesian currency. Although BI engages in regular currency interventions, reserve holdings at this stage are insufficient to affect the exchange rate in any substantial way. Rather, UIP holds due to monetary and fiscal policy changes (where monetary policies are also given expression through the money supply). However, from time to time, expected exchange rate changes may cause the spot rate to overshoot its equilibrium value. On the other hand, given flexible prices, PPP implies that the real exchange rate remains constant through goods arbitrage. Nonetheless, as also previously noted, current findings make this eventuality improbable in the Indonesian context; at least in the short-run PPP did not show any inclination to mean reversion—even when the weaker assumption of *relative* PPP was applied—and PPP can therefore be rule out as having a consequential impact on the short-term exchange rate (see also 5.1.1). Research data during the two broad phases of the sample period, one being marked by increasing interest rates the other by decreasing interest rates, therefore suggest that a preliminary working hypothesis of the theoretical behaviour of the exchange rate may be formed: During periods of increasing inflation, when domestic interest rates rise predictably, the exchange rate depreciates in line with UIRP. Given that foreign interest rates remain constant, a consequential widening of interest differentials occurs. During periods of declining inflation, when markets are less well informed about

impending monetary policies (Bank Indonesia 2003), UIRP applies to a lesser extent. That is, during periods of declining inflation, falling interest rates display sticky tendencies due to market transmission problems and interest rates become less flexible. The exchange rate becomes temporarily decoupled from interest rates. The economy returns to equilibrium at higher prices and the exchange rate overshoots its equilibrium value (but returns over the longer term to UIRP - see Figure 5.8) based on expectations that inflation will further fall. This cycle, when short-run changes in the nominal exchange rate exceed their long-run (UIRP implied) value, may be defined as an overshooting phase of the currency in terms of the *Dornbusch* definition.

5.3 Data Analysis - Covered Interest Rate Parity

Section 5.2 analysed UIRP. Section 5.3 tests for CIRP. Parity is based on the premise that existing interest differentials or forward premiums/discounts reflect in differences between spot and forward exchange rates. If error rates are small and near zero, theoretical estimates can be regarded as an unbiased predictor of forward rates. Cross-rate based forward rates are first compared to theoretical estimates of future expected spot rates[92].

In the absence of direct forward quotes on Australian forex markets, cross rates based on the USD are used. Error rates and a standard deviation from the mean are then calculated. The data are subsequently analysed for breaks or changes in trends and tested for accuracy using squared and absolute error measures. A more demanding test for CIRP involves the use of comparable assets and interest rates issued by different institutions in separate national markets. This approach was adopted by this study. The test showed a near perfect correlation over the sample period. Theoretical rates determined by statistical computations served as an unbiased predictor of forward exchange rates. However, results indicated that commercial banks, in all probability, establish forward point margins collusively by using existing term structures.

5.3.1 Data Analysis

The test for CIRP compares a series of forward rates to theoretical estimates. The results showed: (a) a mean error and standard deviation from the mean error rate of

92 Estimates of future AUD/USD and USD/IDR exchange rates are based on relative Australian/U.S. and U.S./Indonesian interest differentials.

respectively 0.2 % and 0.4928 %, and (b) a correlation coefficient close to *1* (see Figure 5.11). Mean error rates for the two periods were statistically the same (p-value = 0.10). Forward rates and estimated expected exchange rates tracked each other closely and variations fell well within the range of transactions costs. Since the mean deviation between forward rates and estimates was small and close to zero, theoretical estimates of the exchange rate can be regarded an unbiased predictor of forward rates. The performance of the test, using a range of error measures, is shown in Table 5.6.

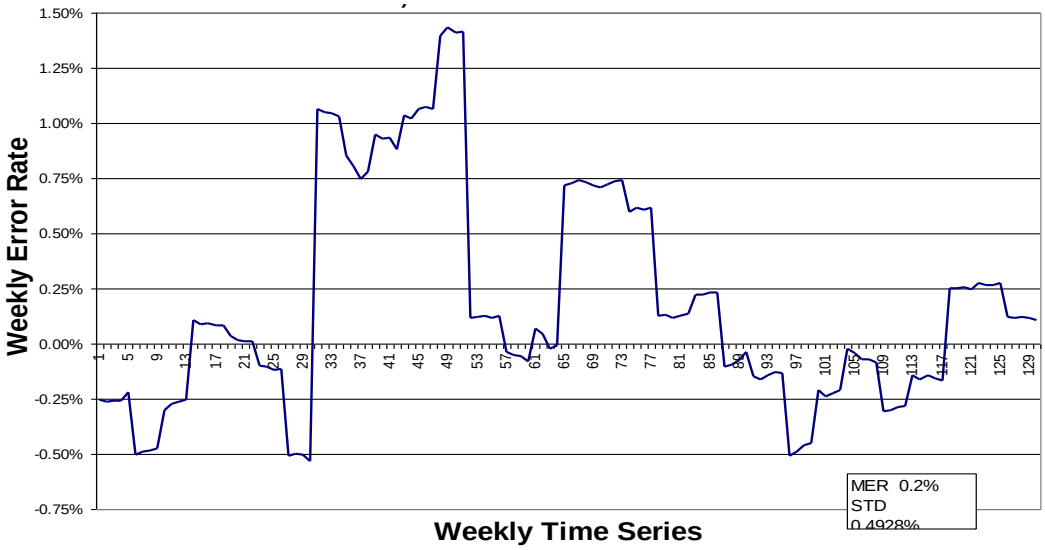
Table 5.6 - Accuracy Measures - Actual and Implied Exchange Rates

Measure	Rates
MSE	863.99
RMSE	29.39
MAE	20.83
MAPE	0.38%
U-statistic	1. 04E-06

The test achieved a MAPE of 0.38% that indicates an extremely good model fit. The smaller value of the *Theil U-statistic* indicated that the test fitted well, i.e. the rate was close to zero and the MAE showed that test estimates varied within a value of 21. The mean squared forecast error was generally much smaller when compared to the corresponding mean absolute error, indicating that computations did not systematically over-or under predict results.

Figure 5.11 shows error rates as periodic deviations from zero, i.e. gaps between estimated and actual forward rates exhibit random patterns and an error band between 0.5 %. and 1.5 %. Since forward rates show a strong correlation to theoretical estimates, a graphical presentation of the relationship is here omitted.

Figure 5.11 – Covered Interest Rate Parity, Weekly Error Rates, 30 Month to March 2003



Appendix 4

It should be noted that the apparent positive bias in the error trend in Figure 5.11 simply reflects the methodology used to determine error rates, i.e. error rates are a function of the currency selected as the domestic currency (the IDR). The description as either negative or positive merely expresses a mathematical rather than qualitative relationship.

Differences between the two periods were also statistically examined for homoscedasticity of variances and the mean. An *F* test was used to test for possible differences in variances of the two subperiods and a *t* test to test for differences in the sub-periods' mean. Respective values are shown in Table 5.7.

Table 5.7 - Test for Homoscedasticity and Mean Error Rates - October 2000 to March 2003

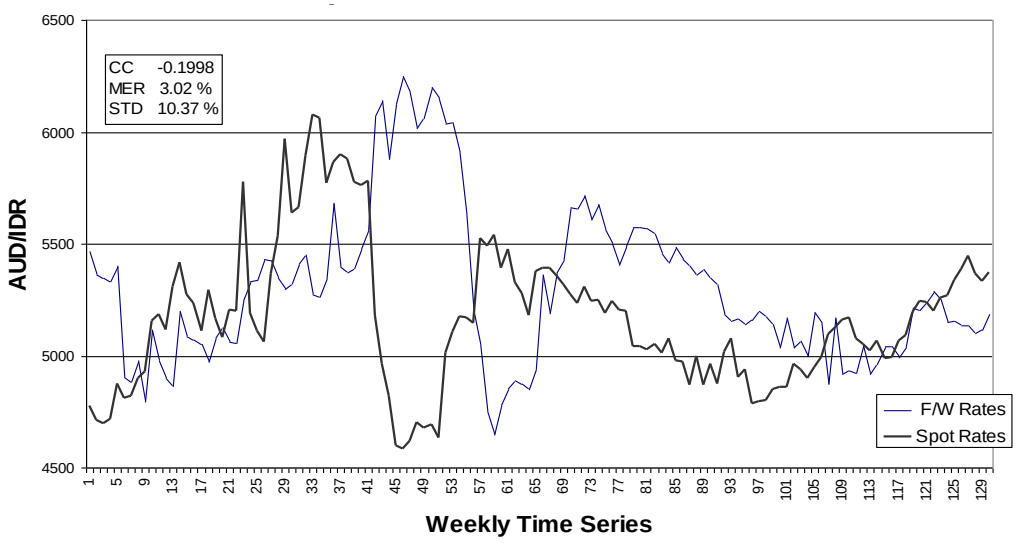
Period	Mean Error %	F-Stat. (p-value)	t-Stat. (p-value)
Oct. 2000 to Dec. 2001	0.25	29.0 (0.00)	1.67 (0.10)
Jan. 2002 to March 2003	0.11		

The *F*-test showed significant differences in variances for the two periods (*F* value = 29.0 and *p* value 0.00). However, mean error rates were statistically not different for the two periods (*t* value = 1.67 and *p* value 0.10). The near perfect correlation between forward rates and estimates is of course not surprising. In the absence of risk, the association suggests that quoted forward prices very likely reflect the term structure of interest rates, i.e. trading banks can be expected to incorporate term rates into their foreign exchange bid and ask prices. To what degree this observation can be generalised is however less clear; it is probable that different institutions use different strategies to price forward transactions. While the test confirmed parity, periodic error rates nonetheless showed variations from central values (see Figure 5.11). However, these variations were small enough not to warrant further disaggregation.

Although not part of CIRP, forward rates were also compared to realised future spot rates—see Figure 5.12. This test examined the degree of risk associated with so-called *convergence trading* and defines the term by reference to variances of forward from realised spot rates *t+1*; of the two tests, it is the more demanding. If the mean error term is small and deviations cluster around zero, the forward rate can be regarded as an unbiased predictor of future realised spot rates. Salvatore (2001 p. 491) notes that:

> … if the forward rate exceeds the future spot rate as often as it falls below it, then we would say that the market is efficient [and] … that few opportunities exist for risk-free arbitrage.

Figure 5.12 – Comparison Three-Month Forward to Realised Spot Rates, 30 Months to March 2003.



Appendix 5

The test resulted in a mean error rate of 3.02 % (Median 1.09 %; SD 10.37 %)—see Figure 5.12.[93] Although results appeared to indicate a reasonable, that is, approximate fit over the long term, the data suggest that over shorter periods forward rates can only be seen as an estimate of future realised exchange rates. The poor fit, given the premise of market efficiency and rational expectations, may indicate forward prices incorporating risk premiums[94] and exploiting these biases may result in speculative gains that reflect risk acceptance.

Disaggregation of Interest Rates

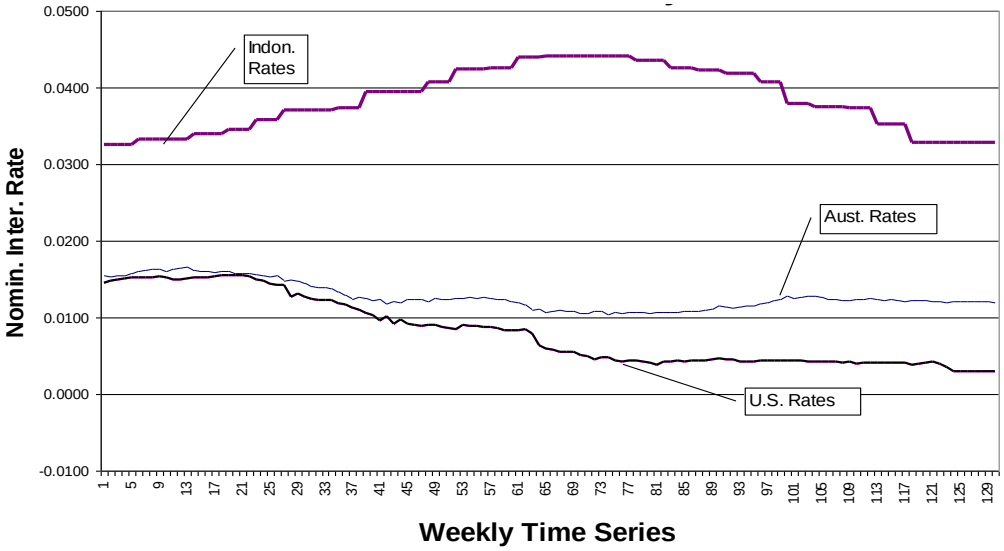
The sample period, as previously noted, was marked by sharply differing interest rates and interest rate volatilities reflecting respective national monetary priorities (see Table

93 The lag and subsequent correlation between spot and forward rates shown in Figure 5.12, (see for example weeks 28 - 41 and 42 - 55) reflects the fact that quoted forward rates are very likely based on interest differentials between official Australian and Indonesian term structures.

94 Premiums in this context can be defined as the forward rate tn less the market's expected future spot rate. However, the determination of premiums applicable to the AUD/IDR exchange rate proved difficult due to the absence of any meaningful data relating to expected future exchange rates. At any rate, the literature notes that this method—the *ex ante* comparison of expected to forward rates to determine risk premiums—is not entirely satisfactory. It can always be alleged (and the method rejected on the grounds) that the survey of expected rates is biased. In the light of these deficiencies, Levich (p. 378) is forced to admit that '… the existence of currency risk premiums [in the context of forward rates] remains a matter of some debate'.

5.10).[95] A long-term decline in Indonesian interest and swap rates, due to a general easing of inflationary concerns and an improvement in covered USD interest parity, was subsequently interrupted by the 'Bali incident'. The event resulted in a rise in swap premiums and rates, by late October 2002, turned again negative (Bank Indonesia 2002). By comparison, Australian interest rates, due to a general reduction in inflationary anticipations, mirrored prevailing U.S. interest trends and gradually declined over much of the period examined (see Figure 5.13); the size of U.S. treasury markets actually plays a dominant role in influencing international interest rates.

Figure 5.13 – Australian, U.S. and Indonesian Three-Month Interest Rates, July 2000 to Dec 2002



Appendix 4

Although Australian interest rates showed a strong link (correlation 0.8774) to U.S. rates that indicated a continuing association between U.S. and Australian capital markets, negative Indonesian correlations (-0.4145) reflected Indonesia's ongoing inflation and exchange rate concerns. The absence of a convergent trend also points to

95 Although Australian and U.S. statistics recorded similar (official) inflation rates, short-term CB-determined mean interest rates remained approximately 200 basis points apart, i.e. U.S. rates remained below Australian rates over the sample period. Long-term market rates showed smaller yield gaps. Gaps implied that Australian markets, during this period, were not convinced that inflation rates could be controlled, and that pressures due to current account deficits would cease. It must be noted that Treasury Bills are no longer used to fund Australian government deficits and that Australian authorities no longer borrow overseas but issue treasury bonds to finance any domestic budget shortfalls. Further, the float of the AUD in 1983 now permits balance of payments to be separated from money supplies thus giving the RBA more effective control over monetary policies via overnight interest rates.

the absence of sustained U.S. capital inflows. The further disaggregation of interest rates is not warranted since theoretical estimates to test for both covered and uncovered IRP are based on the same interest rate differentials as previously examined (see Table 5.3).

In summary, while the analysis of CIRP suggests that theoretical estimates determined by statistical computations serve as a useful predictor of forward rates, this observation does not apply when forward rates are compared to realised future spot rates. Nevertheless, convergence becomes increasingly evident in the second half of the period as Indonesian politics and consequently the Indonesian economy stabilises (see Figure 5.12). Differences over the period examined were not unexpected. The second test was more demanding in that future realised spot rates are influenced by a number of factors. It must also be remembered that many forces not anticipated three months earlier, such as social or political unrest, balance of payments disequilibria, changes in monetary or fiscal policies and or exogenous impacts, affect spot rates; see Table 5.8 below. Given this context, Salvatore (2001 p. 492), summarising various research outcomes, notes that:

> … although the forward rate … in general seems to exceed the future spot rate as often as it falls below it, the degree by which the forward rate exceeds or falls short of the future spot rate (i.e. its variance) may itself be large or small … [and that] the forward rate seems to be a good but not efficient predictor of the future spot rate.

Present findings confirm Salvatore's observations, i.e. visual reference to Figure 5.12 suggests that variations of realised from forward exchange rates smoothened out when taken over the whole of the sample. Nevertheless, the test also showed that during periods of transitory turbulence, opportunistic arbitrage events occured. Spikes on charts represented profitable trading opportunities that, when exploited, returned markets to temporary equilibrium, only to destabilise again.[96]

It must further be remembered that the Indonesian economy during the whole of the sample period was typically constrained by tight monetary policies. A coordinated

96 Observed similarities to UIRP are due to a common set of interest rates being used in both tests. Similarities are therefore not surprising. The UIRP uses interest differentials to establish estimated expected future spot rates. The CIRP test uses forward market quotes in all probability based on the same term structures.

approach to the framing of regional policies would have undoubtedly eased these constraints.[97] The adoption of a regional, that is, mutually acceptable policy framework resulting in a reduction in interest rates should have therefore been considered. Meanwhile, given the existence of a non-cooperative equilibrium, Indonesia can be expected to retain tight monetary policies and use fiscal measures to address emerging social concerns. As a result, the country's growth rate must remain below the rate it would otherwise have been.

5.4 The impact of Trade on the Exchange Rate

Table 5.8 lists and summarises a number of issues, apart from IRP and PPP, that affect the value of the AUD/IDR exchange rate. The table ranks factors by adopting a three-tiered qualitative rating implied in the literature, i.e. factors are described in terms of their impact on the value of the rupiah as *direct*, *indirect*, or *difficult to quantify*. Although not part of parity testing, tests to determine the impact of economic growth on the AUD/IDR exchange rate were also conducted but proved inconclusive. Findings were therefore not reported. The remainder of this chapter—due to the relevance of this issue to research questions—is given over to an analysis of the effect of merchandise trade on the exchange rate.

97 Since the Indonesian economy is to some degree integrated with the economies of its Asian neighbours, the adoption of a common, regional approach to the setting of monetary policies and therefore exchange rates, makes sense. But, such policy co-ordinations have only been episodic in the past and produced no lasting arrangements. This issue is again addressed in Chapter 7.

Table 5.8 - Factors Impacting on the Value of the Rupiah (Ordinal Ranking)

Factor	Comments	Ranking
Interest Rates/Monetary Policies	A persistent interest differential in Indonesia's favour prevailed during the research period. Interest rates, however, declined significantly during the period. Monetary policy was aimed at absorbing excess bank liquidity while also trying to lower interest rates with specific attention being given to existing interest rate differentials. Base-money was maintained consistent with inflation targets.	Direct (Tested)
PPP and Inflation	A persistent Indonesian inflation differential, above Australian rates, prevailed during the research period.	Direct (Tested)
Base-Money and Inflation	Inflation decreased in 2002 to 10.03 % due to weak aggregate demand. The pass-through impact from exchange rate changes reduced due to an appreciating exchange rate. Base money grew by 9.1 % during 2002. Comparatively little volatility. Absorption of excess bank liquidity. M1 and M2 grew at a slower pace.	Direct (Tested)
Trade Deficit	A persistent trade deficit between Australia and Indonesia, in favour of Indonesia, prevailed during the research period. In an aggregate sense, a shift from a deficit to a surplus current account balance, due to both a reduction in imports plus export increases, resulted. A narrowing in capital account deficits due to foreign debt restructures, also occurred. Moderate to low growth prevailed during the sample period. Foreign debts remained at an elevated level of approximately USD 131b. at the end of 2002.	Direct (Tested)
Economic Growth and Domestic Outlook	Real growth was moderate at 3-4 % and still below pre-crisis levels. Moderate Increases in government investments, a rise in exports and a moderate increase in commodity demand for exports occurred. Total investment levels were weak but resulted in improved capacity utilisation.	Direct (Tested)
Fiscal Policies	Reflect financial consolidation although currently in deficit mode.	Indirect
Decline in Swap Premium and Improved Market Sentiment.	Improvement due to debt rescheduling, disbursement of International Monetary Fund loans, improved sovereign debt ratings, privatisation programs and also BI's commitment to maintain exchange-rate stability.	Indirect
Exchange Interventions and Sterilisation Programs	Implementation of regulations limiting rupiah transactions by non-residents, supervision of foreign exchange transactions, moral persuasion to prevent panic buying of USDs, limiting foreign exchange speculations, prohibiting forward sale and swap transactions by non-residents, foreign exchange sterilisation or interventions by selling dollars to reduce volatility and ease market pressure. The aggregate impact of these interventions is not quantified by BI.	DQ*
Market Sentiments and Socio-Political Perceptions	Market sentiments can weaken the exchange rate considerably. International confidence remains low. The periodic impact of these factors on the exchange rate during both 2001 and 2002 was significant.	DQ*

Source: Extracted from the Bank Indonesia 2001 (b) and Bank Indonesia 2002 annual report and author's estimates.
* DQ = difficult to quantify.

5.4.1 Theoretical Context

Australian/Indonesian trade balances were tested to determine the degree of influence of trade on the AUD/IDR exchange rate. However, it must be initially noted that trade and not the exchange rate is generally regarded as the dependent variable in this relationship. First, theoretical settings underpinning the association between trade and the exchange rate are briefly discussed. These comments are followed by an analysis of actual findings.

Historically, currency prices were typically determined by trade-based currency flows—the flow approach. To this degree, exchange rate changes could be shown to be a function of bilateral trade balances. Ultimately, post-Bretton Woods, the *stock or asset* approach assumed greater prominence (Levich 1998). It is self-evident that currencies may therefore be used as either: (a) a medium of exchange or (b) a store of future value. The literature (Mark 1995) particularly notes that:

- Stock models are of primary importance in determining exchange rates in the short run since asset portfolios can be rapidly rebalanced.

- Flow imbalances can be maintained, at least over the short-to-medium term, if not indefinitely. The experience of persistent Australian and also U.S. current account deficits serves to illustrate this point. As long as surplus countries are willing to accumulate assets and supply funds and deficit nations are able to accommodate liabilities and service their debts—and both in fact accept variations to the value of their currencies—there may be little problem. The fact that countries run large current account imbalances may not necessarily indicate maladjusted policy responses but an efficient allocation of international resources.

- Elements of both these issues are related—current account surpluses lead to asset acquisitions[98] from deficit countries in turn affecting currency prices.

98 The current account balance is equal to domestic savings minus investments—surplus savings result in capital outflows or foreign investments.

In a purely Australian context, dynamics suggest that the value of the AUD is largely dependent on the terms of trade[99], i.e. existing international pricing arrangements (Hunt & Terry 1997). Australian imports, on the other hand, are closely correlated to changes in domestic growth, i.e. volumes reflect coefficients and lags in the import-domestic-demand function. While these observations broadly address theoretical issues, they are too general to shed much light on the contemporaneous relationship between the AUD/IDR exchange rate and trade balances. For this analysis, more conventional methods must be used to determine existing associations. These are discussed under the next heading.

5.4.2 Data Analysis

Figure 5.14 establishes the degree of association between Australia's trade balance with Indonesia and the AUD/IDR exchange rate.[100] The trade balance, shown on the X-axis, was assumed to be the independent variable for the purpose of this test. To establish a regression, exchange rates were plotted against the Australian/Indonesian trade balance. That is, a bivariate linear regression was used to test a straight-line relationship of the $Y = a+\beta X$ type, where Y is the dependent and X the independent variable. The slope β represents changes in Y due to corresponding changes in X.

Reference to the fitted regression to test the *prima facie* dependency of the exchange rate on trade shows that a reduction in the Australian trade deficit is associated with a depreciating AUD.[101] This only makes sense when the exchange rate is seen as the independent variable, i.e. it can be expected that a cheaper AUD encourages Australian exports and decreases imports. However, if the exchange rate is assumed to be the dependent variable, this outcome is difficult to defend on theoretical grounds. A

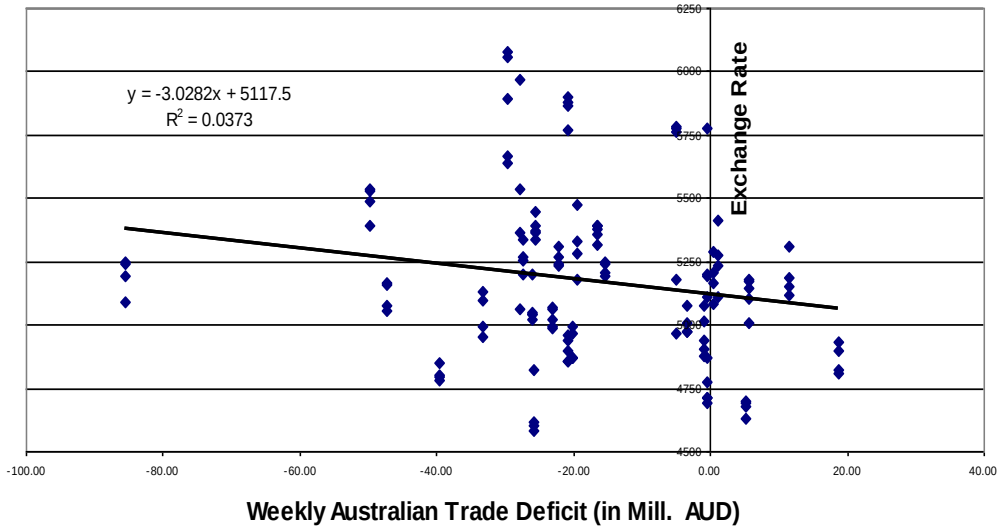
99 Recourse to the classic five-sector flow model of the economy may assist in clarifying this issue. The model suggests that trade equilibrium occurs when $S+T+M = I+G+X$ (Mitchelson & Mann l995). Algebraically altering the equation results in $S+T-I-G = -M+X$ and suggests that current account balances inter alia reflect domestic savings or, assuming an open flow model, capital flows (where *S, G, T, X* and *M* = savings, government sector, taxes, investments, and exports and imports). A current account deficit, all things being equal, should therefore raise interest rates, attract capital inflows, and cause the exchange rate to appreciate. Rogoff (1996), examining theoretical constructs—while specifically acknowledging that trade flows influence exchange rates—notes that the association frequently manifests only over longer periods. He suggests that a five to ten year time span may indeed be regarded as reasonable before parity can be expected to kick in.

100 It is assumed that Indonesia's trade balance reflects a reverse configuration.

101 It is noted that for most of the sample period a trade surplus in favour of Indonesia prevailed (see Figure 5.14). Negative trade balances in Figure 5.14 denote an Australian trade deficit.

cheaper AUD is unlikely to result from increased exports to Indonesia unless other factors affect the exchange rate.

Figure 5.14 – Regression Analysis – Weekly Trade Balance vs. AUD/IDR Exchange Rate – 30 Months to March 2003



Appendix 9

It must also be noted that the existing association (R^2 = 4%), showing the trade balance as the dependent variable, is extremely weak, i.e. no discernable relationship between variable seems to exist. Visual reference to the slope of the regression implies a plausible $\alpha = 0; \beta = 0$ approximation, i.e. the estimate shows a (goodness) fit coefficient of r = -0.19301 (R^2 = 0.03725) and standard error[102] of 20.08. Obviously, the smaller the error and higher the R^2 coefficient in relation to its upper limit or *1*, the closer the relationship and stronger the association. The subjective strength of the relationship indicates little correlation, that is, the exchange rate is not influenced by the trade balance nor are trade variations to any degree explained by changes in the exchange rate. [103]

102 The rate is inversely related to the adjusted R^2 (0.037), i.e. the fraction of the variance explained by variables.

103 Adopting a less demanding regime that uses average monthly instead of weekly spot rates results in a slightly improved coefficient. Nevertheless, the explanatory power of the statistical relationship, although indicating some mathematical association, remains weak and indicates little statistical association.

Results are not entirely unexpected. Since both Indonesian exports and imports are largely priced in USDs, the ultimate value of the IDR is closely linked to the value of the USD, i.e. an increase in the demand for Indonesian exports is likely to result from a stronger USD. Goldberg and Tille (2009) find although the use of currencies other than the domestic currency in invoicing international trade transactions is basically determined by resident structural factors in exporting industries, i.e. market share, prevailing demand elasticities or shipment size determine currency choice, that selection nevertheless assumes a critical role in the international transmission of economic shocks. Where shipment size is a consideration, the authors also find that the empirical link between transaction size and the nominated invoicing currency is determined by bargaining between transaction partners.

Second, given the predominance of capital transactions, empirical studies have generally shown a weak association between current account balances and the exchange rate. Rogoff (1996) notes, while specifically acknowledging that trade flows influence exchange rates, that the association frequently manifests over much longer periods. Recent failures of increased U.S. trade deficits to affect the value of the USD provide an example.

Chapter 5 examined the dissertation's quantitative findings. A summary of these findings is however not provided at this point. Instead Chapter 6, apart from a general synopsis of the literature review, provides a comprehensive summary of research findings and offers some comments concerning exchange rate modelling.

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CHAPTER 6 – SUMMARY

Following a brief introduction to the research context, Chapter 6 provides a synopsis of and occasionally augments points from the dissertation's literature review (see 6.2). The chapter also summarises major research findings (see 6.3), notes policy implications and limitations (see 6.4) and augments the study by a short introduction to a proposed approach to model-forecasting (see 6.5).

6.1 Research Context

An international monetary system that recognised few if any geographic boundaries had placed the fundamental economic *raison d'etre* of nation-states—the ability to control their money supply and influence the value of their currencies—at risk. Consequently, nations can do one or the other, but not both. The 1997 Asian crisis had shown all too clearly that the adoption of a purely endogenous response to an emerging crisis scenario might not prove effective in the face of large external shocks.

Crises in international financial systems are of course nothing new. In the case of the 1997 Asian crisis, the context of this study, many of the problems that occurred could be traced to the multiple causes of pegged exchange rates and the impact of exogenous shocks. Moreover, endogenous, especially microeconomic weaknesses and poorly developed intermediation processes, had combined to introduce some relatively new problems. The research, given this context, determines the extent to which markets, post-floating the Indonesian currency in 1997, had adjusted to various international parities.

6.2 Literature Review

Section 6.2 first summarises major points from the literature review that address PPP, IRP and aspects of monetary policy application. In a few instances, further elaborations are added.

6.2.1 Purchasing Power Parity

PPP is linked to monetary theory by the fact that an expansion of the money base, unless supported by real GDP growth, can be expected to be followed by inflation.

That is, both demand and supply variables (demand-pull; cost-push inflation) are affected by expansionary monetary policies.

The PPP theorem, that exchange rates reflect price parity, has been the subject of substantial empirical review. The validation of the PPP premise requires constancy of the real exchange rate. When the nominal exchange rate reflects inflationary differences, the real exchange rate is said to equal *1*. However, short-term or continuous parity rarely finds empirical support, i.e. one of the more serious defects of PPP is due to permanent changes in the real exchange rate.[104] The incidence of a supply or demand shock, for example, will affect domestic prices. If an unplanned increase in output, e.g. a supply shock occurs, market clearance demands a decrease in relative prices. As a consequence, the value of the nominal exchange rate appreciates. If, on the other hand, a demand shock results, domestic prices increase and the value of the exchange rate depreciates. Changes in the real exchange rate occur when relative price level changes are not analogously reflected in nominal exchange rates.

Nevertheless, the evidence appears to support the application of relative PPP during periods of hyperinflation or, alternatively, over longer periods of low inflation or for heavily traded goods (Officer 1976). Research consequently appears to reject the assumptions of short-run, but seems less conclusive about the prognostic qualities of long-run PPP (Isard 1988).

To summarise, the PPP theorem works best (the LOP holds more consistently) for constantly traded commodities, less well for all traded goods, not well at all for all goods (including non-traded goods), and better over longer rather than shorter periods (Reilly & Norton 1995). The literature notes that while PPP is unsuitable as a short-term predictive, IRP models may be regarded as more short-term responsive. Both these findings are confirmed by this research.

6.2.2 Interest Rate Parity

In contrast to PPP, the IRP theorem focuses on capital flows to account for exchange-rate relativities. In the absence of risk and or monetary interventions, that is, given

104 In contrast to the nominal exchange rate, which describes the exchange relativity of two currencies, the real exchange rate describes the exchange relativity of two goods or bundles of goods akin to the terms of trade.

efficient currency markets, IRP postulates that exchange rate changes can be expected to be offset by differences between interest rates. Interest differentials *ex ante* determine changes in exchange rates. Potential investor gains, due to interest rate differentials, are offset by a depreciation of the currency. But the validity of the IRP theorem is by no-means empirically supported (Pugel & Lindert 2000).

Given the absence of a reliable association between exchange and interest rate differentials, the literature notes that variations may *inter alia* reflect changes in exogenous environments. These can generate co-variances in both exchange and interest rate differentials (Isard 1988). An exogenous fiscal expansion for example can cause both currency value and interest rate changes. However, a comprehensive model, inclusive exogenous factors and risk premiums affecting long-run exchange rates, does not appear to exist. Salvatore (2001 p. 554) notes that '… a fully acceptable theory of exchange rate determination that incorporates both finance and trade flows has not yet been developed.'

In summary, the impact of both interest and inflation rates, despite the fact that the literature shows exchange rates to be subject to a range of both rational and frequently irrational factors[105], provides a reasonable approximation of exchange rate relativities. Despite shortcomings, IRP-based models are still accepted as a good indicator for exchange rate changes. PPP, on the other hand, although effective in the short term in the case of hyperinflation, must be deemed a longer-term predictive.

6.2.3 Monetary Policies and Policy Transmission Channels

Due to past inelastic market responses, sustained and elevated inflation rates throughout much of the 1970s and 1980s—while gradually declining—had required a succession of interest rate increases. As a result, both direct as well as indirect monetary controls were used to restrain economic growth. The general outcome, due to an inherent lack of interest rate elasticity by credit users, produced some well-documented asymmetries. In particular, persistent and excessive inflation rates—despite successive interest rate increases—resulted in less than optimal welfare

105 Trade balance and capital transfers, foreign exchange reserves, economic and employment growth, foreign and domestic investment and productivity rates, government reactions and interventions, socio-political and political and economic factors, global outlook and concerns etc. all impact in the value of a currency

outcomes. Indonesia proved to be no exception to this trend and BI's position, pre-1997, was made more difficult by constant political interferences and directives.

Authorities, consequently, became increasingly concerned with the prevailing dynamics between inflation and the conduct of monetary policies (Pugel & Lindert 2000). To this end, with the notable exception of the U.S. Federal Reserve[106], most major CBs were given legislated responsibility to maintain inflation rates within a specific bandwidth. In achieving these objectives, the literature notes that CBs must be provided with requisite operational independence while CEOs, at the same time, should be given assured terms of office. Equally, CBs must be shown to operate in a transparent and accountable manner. In the case of Indonesia, BI came under the effective control of the IMF post-1997 and remained so until to 2003. BI was subsequently provided with significantly increased powers to control inflation and discharge its operational and fiduciary responsibilities under the new Central Bank Act 1999. Transparency issues, however, remained of ongoing concern.

CB operational models can therefore be divided into two broad policy streams: at one end, governments retain most policy decisions—both goal and instrument sovereignty—on the other, CBs emulate private sector models and are given more or less unlimited discretion to achieve agreed policy objectives. A compromise in line with most democratic forms of government appears to provide CBs with instrument independence while governments retain goal sovereignty. This model was *prima facie* adopted in Indonesia and resulted in a general, post-1997, reduction in inflation. However, the danger of excessive CB independence must also be acknowledged (Macfarlane 2002). CEOs of CBs, for instance, can become captured by the prevailing opinion of powerful interest groups within a given nomenclature and eventually biased in their policy prescriptions.

Nevertheless, most monetary policy transmissions continue to be effective in achieving desired policy goals and capital markets remain dependent on BI to maintain systemic stability and adequate liquidity. Despite symbiotic relationship, CBs are occasionally forced to compete with the market's response to circumvent monetary policies. But in

106 The Federal Reserve nevertheless has been successful in achieving and maintaining low average inflation rates due to its relative independence.

general, markets present CBs with an effective tool to influence economic outcomes through the application of policy initiatives. Nevertheless, a distinction between developed and developing countries must be made. Indonesia's poorly developed financial systems and capital market structures had frequently hampered the effective transmission of monetary policies in the past. A number of broader inferences may therefore be drawn from the Indonesian experience:

- the sensitivity of markets to interest rate changes, especially during periods of excessive growth, has declined and is not always predictable.

- Poor financial structures and institutional changes continue to impact on the effectiveness of transmission channels and to this degree on the effectiveness of monetary policy transmissions.

- But also: neither financial consolidation nor shrinking reserves appear to have been major factors affecting monetary policy outcomes.

Finally, the literature notes that the effectiveness of CBs is to some degree dependent on the transparent and accountable management of their monetary function (Faust et al. 2001). For instance, the notion of transparency suggests the release of (most) open market committee deliberations—including the release of dissenting opinions—and the publication of inflation and other monetary goals.[107] The European Central Bank provides a good example of such practices. BI, by comparison, has to-date failed to implement all of the Basel recommendations and policy releases are at best opaque.

To enhance the credibility of CBs, the literature further notes that so-called *low-credibility* banks such as BI should exercise less flexibility in response to economic shocks to avoid added erosions to their reputation, i.e. such banks should conduct less

107 Despite inconsistencies, the operation of CBs in a transparent and credible manner frequently involves CBs in a dilemma. Under a two-agent model—CBs and the private sector—conflicting perceptions can arise. The private sector's behaviour may best be observed by reference to the empirical reaction to the Phillips curve. Responses may also be observed by reference to the degree of operational transparency exercised by CBs, i.e. how readily the private sector deduces CB goals and intentions. For example, if in response to a demand shock, open-market committees admit to concerns over employment and output gaps in controlling inflation (by seeking an optimal spread of the effect between output and inflation goals), the bank's admission may be seen as being incompatible with its inflationary mandate. Should these concerns become public knowledge through the release of (such) information, the outcome may be that a given CB's commitment to disinflationary goals is seen as less than credible.

expansionary policies than *high-credibility* banks (Faust et al. 2001). This is equally true for high-credibility CBs that are in danger of destroying their credibility by observing less than strict inflation protocols. Nevertheless, the adoption of extreme positions—since CBs are charged with the implementation of monetary policies that maximise rather than shrink welfare benefits—are rarely optimal in terms of resultant welfare outcomes.

6.3 Summary of Research Findings

Research justifications *inter alia* point to the absence of relevant data that address the post-floating performance of the rupiah. Research questions flowed from this gap in the research, i.e. the dissertation addresses conformity of the AUD/IDR exchange rate to a number of exchange rate parities. What follows is an initial outline of Indonesia's exchange rate policies that provides the context to the subsequent summary of the quantitative findings of this dissertation.

Indonesian Post-Crisis Exchange Rate Policies

Despite the absence of transparency or the at best only opaque reference to exchange rate policies by CBs in most developing countries, it is generally not difficult to verify that *de jure* exchange-rate regimes are followed where simple pegs are used (MacDonald 2000). Given floating regimes, since rates do not require commitment to some nominal anchor, this outcome can equally be achieved by reference to variations in foreign exchange reserves. However, verification that authorities adhere to exchange rate regimes becomes more complex when other transactions influence the level of international reserves and transparency is limited (Cukierman 2001).

Policy outlines contained in BI's Annual Reports imply the adoption of an *ex post* defensive posture following the drastic devaluation of the rupiah in 1997 (Bank Indonesia 2002).[108] The practice, despite the substantial depreciation of the currency in 1997, is not entirely supported by the evidence. Indonesia's international reserves—rather than declining—are in fact increasing. Such outcomes are unlikely to be associated with exchange rate interventions to support the value of a flagging currency. However, the collection of data to conclusively establish the degree of CB intervention

108 The rupiah, despite significant interest differentials, appreciated in 2002 vs. the USD by 10.25 %.

proved impossible. BI neither quantifies periodic interventions nor provides reasons or details the composition of periodic movements in its international reserves.[109]

Nevertheless and by BI's own admission, the currency—post-crisis—remains undervalued against the USD (Bank Indonesia 2002). Maintaining lower exchange rates, especially given Indonesia's current economic climate, makes of course sense. An undervalued exchange rate not only assists balance of payments related problems and attracts foreign investments (through more competitive exports and import replacing activities), but lower rates, in a broader context, also support the domestic recovery of the economy (Holtham 1988). International tendencies to maintain an undervalued currency, particularly by developing countries, generally support this point. However, in maintaining a cheaper rupiah, BI will obviously have to weigh-up trends in foreign debt aggregations and domestic inflation rates. Both variables must inevitably deteriorate, ultimately inviting IMF reprimand should a prolonged undervaluation of the currency occur.

Specifically, since signs of speculative transactions (re) emerge, policies to slow down the appreciation of the rupiah may have been implemented due to remaining fears of a speculative currency attack. Such a scenario makes sense; it not only assists in maintaining a positive trade balance but, at the same time, builds up a 'war chest' of foreign reserves to ward-off future speculative currency attacks. It must, of course, also be recognised that political uncertainties caused by presidential elections and weaker export markets on the supply side, and persistent strong demand on reserves to service foreign debts and finance imports, had caused the currency to come under periodic pressure (Bank Indonesia 2001b). Nevertheless, an examination of BI's foreign asset reserves over the whole of the research period showed that foreign exchange reserves, rather than declining, had in fact increased.

It is therefore open to question whether BI, as the bank claims, had in fact pursued policies to stop a depreciation of the rupiah. If these suspicions are unfounded and the bank actually adopted a defensive posture, BI might be expected to sell its foreign assets in order to keep the rupiah from depreciating. This, the evidence indicates, was

109 It is noted that the IMF requires the maintenance of a certain level of international reserves equal to a percentage of foreign debts.

not the case. An appreciating IDR, unless trends translate into protectionist policies, would of course be in Australia's interest. A stronger rupiah would provide an opportunity to redress existing trade imbalances without Australia being necessarily branded mercantilistic.

At any rate, Indonesian authorities appear to target exchange rates to a greater extent than for instance the Reserve Bank of Australia (RBA) to prevent rates from engaging in self-sustaining fluctuations. That is, the maintenance of the value of the Indonesian exchange rate assumes precedence over most other policy objectives. Given relative shallow currency markets and currency turnovers and the direct relationship between exchange rates and risk premiums[110]—this is a difficult balancing act.

It must also be noted that certain limits on forward and swap transactions[111]—unless conducted for underlying economic reasons—apply to counter excessive exchange rate volatilities of the IDR. Policy clashes nevertheless occur when, for example, high frequency interventions to stabilise the exchange rate conflict with other objectives such as structural adjustment programs.[112] The probability that Indonesia is pursuing policies to limit or at least delay the pace of an appreciating rupiah should also be taken into consideration by commercial entities when setting financial objectives. International precedence indeed lends credence to this hypothesis; Chile, for example, followed a similar path in the early 1980s—as did Mexico in 1995—and both benefited from the adoption of such such strategies (Hernandez & Montiel 2001). China continuous to adopt this approach and only reluctantly accepted a recent rate increase in the par value of its currency.

The dilemma in Indonesia's case has always been that the control of inflation and defensive exchange-rate actions required the application of tight monetary policies; controlling money stocks also avoided the damaging pro-cyclical policies of the past

110 Risk premiums may *inter alia* be defined as the difference between Indonesia's Yankee Bonds and U.S. 10 year Treasury notes, which amounted to an approximate mean difference of 6 % during 2001.

111 Total foreign exchange volumes for spot, forward and swap transactions amounted in 2002 to USD 270b. Swap transaction accounted for more than 50 % of this total (Bank Indonesia 2002).

112 Cyclical adjustments are reversible policy responses in reaction to temporary shocks in demand or supply conditions. Indonesia, however, is undergoing a structural adjustment program associate with the substantial collapse of its economy in 1997 that involves fundamental and transformative processes associated with structural changes in labour and capital markets. A substantial restructure of the financial sector as well as shifts in trade flows and Indonesia's competitive positioning had brought further changes.

from being adopted again (Fry 2000). On the other hand, less than liquid banks and the private sector required credit infusions, i.e. additional funds at lower interest rates, to sustain economic growth. Much of Indonesia's public sector requires both, tight monetary policies and additional funds, to maintain repayment schedules and credit ratings.[113] Non-performing loans as of December 2002 had actually reduced to 7.5 % of outstandings, not a credible result compared to international default rates. It had necessitated writing off approximately 400 trillion rupiah, over two-thirds of outstandings, since 1997. The agency responsible for the recovery program has now been disbanded due to its own inefficiencies; to this degree, Indonesia's foreign debts could not be further reduced.[114]

Statistical Findings

The PPP test confirmed the non-stationarity null of the real exchange rate. The evidence, although rejecting the assumption of UIRP, also rejected the related notion that exchange rate premiums are quantitatively unimportant, that is, rates trended to parity over the longer term.[115]. Tests showed forward rates to be closely correlated to theoretical estimates but evidenced deviations from future spot rates.

To strengthen research findings, although not part of parity tests, the study also examined a number of secondary factors that influenced the exchange rate. The study found that neither GDP growth rate (differentials) nor trade balances affected the AUD/IDR exchange rate. In the case of the latter, it was more likely that the exchange rate influenced trade balances. However, the association was extremely weak to enable more definitive views to be formed.

Points below briefly summarise individual findings:

113 Public sector borrowings were used to increase the liquidity of compromised banks and other entities.

114 Some of the improvements, it must also be noted, were due to the conversion of (doubtful) debts to equity, a practice permitted under the new Central Bank Act 1999. Moreover, improvements in the capital adequacy ratio of most banks resulted from the accumulation of state-issued bonds with low risk ratings. These assets now form approximately half of the total asset base of most banks while loans make up only one-third of this total. BI is currently proceeding with the implementation of the Basel Core Principles for Effective Banking Supervision as reflected in the Master Plan for the Enhancement of the Effectiveness of Banking Supervision (Bank of International Settlements 2002).

115 Indonesia's international reserves increased by 12.7 % during 2002 to USD 31.6b, suggesting only limited intervention by BI; nevertheless foreign debts, equally divided between the public and private sector, remained high at USD 131b. The resulting ratio (the reserves to debt ratio) remains unsatisfactory.

1. Indonesia's inflation rate could not be linked to increases in the money supply, i.e. increases in base money were consistent with GDP growth and increases in the money supply could not be linked to inflation. The subsequent test for PPP, although showing the real exchange rate as straying and subsequently returning intermittently to PPP, could not convincingly reject the null hypothesis that the real exchange rate was non-stationary. Rather, the real exchange rate followed a random walk and deviations from its long-run equilibrium were cumulative with only temporary inclinations to mean reversion.

2. The degree of conformity of the exchange rate to UIRP depends on which dataset, i.e. sub-period, is selected for examination. For the whole of the research period, future rates were approximately equal in showing positive and negative deviations from theoretical estimates.[116] Nevertheless, strict parity could not be confirmed and the null hypothesis (that error rates of the AUD/IDR exceed the range of transaction costs of ±1 %) could not be rejected. However, an increasing trend to parity manifested when periods of volatile data[117] were excluded from the sample. It can therefore be concluded that the IRP theorem serves as a useful proxy for predicting mean values of the AUD/IDR exchange rate over longer periods when extreme fluctuations smoothen out.[118]

3. When juxtaposing phases of a depreciating vs. an appreciating period of the rupiah, an appreciating phase of the currency was disproportionately linked to an increase in the mean error term. This suggested a temporary decoupling of exchange rates from interest rates, i.e. during a declining phase of inflation, a reduction in the three-month Indonesian interest rate

116 The evidence establishes a mean error rate of -1.93 % over the sample period.

117 BI's own research indicates a daily volatility rate of the rupiah vs. the USD of 1.4 %, with the Bank intervening to lessen volatility and ease market pressures. By comparison, the volatility of the AUD/IDR exchange rate, over the sample period, obviously reflects the smaller size of the exchange market for AUD/IDR denominated transactions.

118 The outcome, although indicating significant findings in terms of both the short and longer-term behaviour of the Indonesian exchange rate, can however not be regarded as conclusive. The fact that frequent extremes around central values occur, condemns results as being less than satisfactory for short-term forecasts. Where requirements necessitate longer-term fundamental estimates to for example assist strategic capital forecasts or profit projections, findings may however provide approximations.

lagged exchange-rate movements. The delay seems plausible given existing monetary transmission and BI communication problems.

4. The test for CIRP, the comparison of forward to theoretical estimates of future expected spot rates, showed a near perfect correlation over the sample period. Theoretical rates determined by statistical computations served as an unbiased predictor of forward exchange rates. Results may have been indicative of the fact that commercial banks, in all probability, established forward point margins by using existing term structures. Cross-rate based forward rates were also compared to realised future spot rates. However, this more demanding test showed some degree of divergence from parity indicated by the mean error term. The forward AUD/IDR exchange rate can hence be regarded as an approximate but not necessarily accurate indicator of future realised spot rates.
5. Trade was ruled out as having an impact on the exchange rate. The data in fact indicated the opposite, i.e. results appeared to suggest that the exchange rate actually influenced trade balances. However, statistical associations were not significant enough to draw definitive conclusions.
6. Finally, national growth differentials could not be linked to changes in the AUD/IDR exchange rate. Details were hence not included in this dissertation. The growth hypothesis is clearly contingent on the existence of a dominant and growth-linked trade relationship. Neither condition applies to the Australia/Indonesia trade association.

Summarising, interest rate differentials, when periods of political and social unrest are excluded, provide a reasonable estimate of future Indonesian exchange rate changes. Of the two core components, PPP and IRP, the former proved to be the more controversial of the two theories examined.

The relative version of PPP tested mandates that exchange rate changes are proportional to changes in inflation differentials between the domestic and foreign economy. This premise could not be confirmed.

Specifically, PPP was first tested by using two time series to examine both the real and nominal behaviour of these rates over time, i.e. to show the length and magnitude of deviations from PPP equilibriums. The real exchange rate was defined as the nominal exchange rate adjusted for changes in domestic and foreign prices. To avoid bias, the AUD/IDR exchange rate was also tested for stationarity using standard unit root tests, i.e. the null, the non-stationarity hypothesis vs. the alternative of stationarity was tested. As noted, both tests proved ambivalent although the less demanding version of PPP established the real exchange rate to be approximately mean-reverting over time.

Tests results were thus largely unpersuasive; although parity, in the narrow sense, could not be confirmed, over longer periods drifts to parity became however evident. Nevertheless, conclusions that models adequately reflected the risk of future exchange rate changes, e.g. that statistical models and computations serve as a useful platform to forecast exchange rates, could not be formed.[119] Historical precedence abounds; large segments of movements in the USD, for example, could not be linked to conventional pricing theories based on macroeconomic fundamentals. In fact, rates frequently and for long periods moved in counterintuitive directions.

Nonetheless, in the long run, periodic spikes in the AUD/IDR exchange rate smoothened out due to the increased distribution of error rates. Predictives based on longer-term averages therefore assumed greater validity. Since an inverse relationship between *Type I and Type II* errors is assumed, errors could however not be reduced without increasing the sample size.

It should be remembered that the equilibrium price of any currency, despite short-term dynamics, will eventually come to mirror the intrinsic value of the economy consistent with macroeconomic fundamentals. This is true. However, since exchange rates also respond to a range of extraneous influences including news and anticipated events—rational or otherwise—as well as social and political developments and external pressures, prognostics models cannot hope to incorporate all these nuances and parameters into anyone deterministic model. Given, in particular, the randomness of

119 Much of the short-term variability of the exchange rate could not be linked to any of the parities tested. Variances are frequently due to social or political disturbances, perceptions, expectations or speculative pressures that are difficult to measure.

events, short-term systems are prone to failure and of little use in forecasting exchange rates. The IDR serves as a prime example. Other approaches or even naïve-based models may well prove the better alterative.

The question therefore remains how predictive models should be? Clearly, models incorporating some of the factors examined in this dissertation should at least out-predict naïve-based approximations that simply follow a random walk.[120] This proposition, although it is not the main purpose of this research, is further examined under 6.5 below.

6.4 Policy Implications

Policy implications derived from research outcomes were progressively addressed throughout the text. Nevertheless, implications are briefly summarised below and provided under two headings: policy implications relevant to commercial agents and policy implications of public interest.

Commercial Policy Implications

When IRP applies, covered cost of funds are the same across currencies and returns are identical for all currencies, that is, covering exchange risks using forward contracts attracts identical costs to covering risk using offsetting borrowing and lending arrangements. When the forward rate equals the expected future sport rate, the cash flow from hedging or leaving currency exposures open are identical. The Fisher parity, the prediction that the International Fisher Effect and PPP are consistent when currencies with high interest rates also exhibit high inflation rates, points to a link between markets and national premiums that relate to perceptions of economic and or political risk associated with a given currency. It may hence be argued that this differential is an appropriate measure of capital mobility across financial markets.

Given the prospect of continued interest (risk) and inflationary differences between Australia and Indonesia, an appreciating IDR vs. the AUD is considered unlikely. It is more likely that a gradual, long-term, depreciation of the currency vs. the AUD will occur. The possibility of a sudden and substantial decline of the IDR, given BI's

120 That the expected rate for the next period should be the same as that of the previous period.

current level of international reserves and the fact that Indonesia (now) has a floating currency, must however be rated as low and can be ruled out (Bank Indonesia 2003). These observations should be tempered by the recognition that periods of excessive imports, particularly in oil related commodities denominated in USDs, may well weaken the currency in the future—a move that could again trigger panic selling of the rupiah and threaten financial disruptions. Under these circumstances, BI interventions in forex markets would prove to be of only temporary assistance.

The long-term value of the IDR will inevitably be determined by BI's policy objectives of maintaining a viable external balance that, at the same time, is consistent with both Indonesia's foreign debt balance and inflation target while also preventing an undue appreciation of the trade-weighted index of the exchange rate. It is a difficult and inconsistent proposition given current economic conditions. The risk of a potential future inflation flare-up can hence not be ignored and is seen in terms of the political cost of controlling inflation. If, for example, the cost of reducing inflation to say 2 % to 3 %—now regarded by most as an ideal long-term equilibrium—is seen as too high in terms of the political/social costs resulting from increased unemployment and output losses etc., a return to former demand driven policies cannot be entirely ruled out. Should this occur, a negative impact on the exchange rate and return to double-digit inflation rates seems likely.

In the case of PPP, the value of the rupiah frequently digressed from its equilibrium value over the research period, i.e. the nominal exchange rate evidenced periods of both under and overvaluations vs. PPP equilibriums. Nonetheless, the final quarter of the second half of the sample showed a depreciating trend of the nominal exchange rate in line with PPP (see Figure 5.3 and 5.4). It is suspected, and reference to the trend line supports the view, that BI hastened this process by adopting policies to prevent the rupiah from appreciating. This strategy indeed makes sense; it undoubtedly improved Indonesia's commercial competitiveness during a period of increased international competition. Policy implications derived from PPP tests, since parity deviations as a rule signal changes in the international competitiveness of firms, therefore enable conclusions for commercial applications to be drawn from the data, i.e. PPP divergences indicate whether a currency is in fact over or undervalued relative to a simple benchmark. It follows, when parity holds, that both a source of commercial risk

and opportunity disappears and exchange rate changes do not affect the real operational costs or revenues of foreign operations.

If suspicions prove to be correct and BI is in fact adopting strategies to prevent the currency from appreciating, outcomes for foreign commercial entities are significant. A lower PPP value of the currency, for example, must inevitably increase import costs but also improve the competitive position of exporters. Net benefits or otherwise will therefore depend on whether the entity is a net exporter. To this degree, economic risk must be seen as impacting on investment returns. However, potential losses do not necessarily reflect poor managerial practises. A loss of profits, for instance, may be due to a change in domestic monetary or fiscal policies or, of more immediate concern to foreign entities, the risk of exchange rate volatilities resulting in *transaction* and or *translation* losses; factors over which the foreign entity has little control. A depreciating value of the rupiah when converted to AUDs, may for instance cause a loss in the value of net asset holdings of an Australian firm operating in Indonesia. What makes PPP analyses therefore relevant to commercial entities is that analysing periodicities in terms of their magnitude of deviations enables commercial risk inferences to be drawn from the data.

Guidelines to address normally uncovered *transaction and translation* risks associated with time-variant changes in the exchange rate, i.e. policy guidelines that address foreign currency exposures to changes in the exchange rate by firms operating in Indonesia, should therefore address specific risk management strategies. In providing these guidelines, it is of course assumed that relevant forward markets and financial instruments are available in an Indonesian context to effect various hedging strategies. Caution is however indicated; this may not be the case in all instances.

According to Radebaugh, Gray & Black (2006), guidelines at the enterprise level must involve specific policy formulations that address: (1) the definition of exchange risk in terms of (a) *translation* and (b) *transaction* risk, (2) the implementation of risk monitoring systems that address data relevant to both exchange rate changes and risk exposures and (3) the adoption of risk minimisation strategies including the formulation of appropriate hedging strategies. When defining risk (see (1) above), potential risk exposures must differentiate between translation and transaction

exposures. Each not only requires different hedging strategies, but the time-variant nature of the exposure to, for example, translation risk is fundamentally different to covering transaction risk. Moreover, the implementation of risk monitoring systems, since both exposure and exchange rate changes—as already noted—are time-variant, should address these factors in terms of: (a) specific points in time as well as (b) specified future forecast periods. That is, exchange rate movements and exposures must be monitored on a continuous basis, involving the determination of consensus-based rolling forecasts of expected exchange rate changes. Hence, the first step in the process of minimising exchange risk consists of: (a) deciding what level of exposure should be hedged and (b) what level of risk may be deemed acceptable in line with corporate risk (aversion) preferences and assigned confidence levels of future exchange rate predictions.

The detailed description of various hedging options at the enterprise level here falls outside the scope of this study. However, in the case of *transaction* risk where, for example, goods are imported on credit denominated in a foreign currency and the importing entity becomes exposed to a potential foreign exchange gain or loss due to exchange rate changes between the actual transaction and future settlement date of the liability, the hedging process is relatively simple. Whilst the process may involve a potential loss of speculative gain, the aim of the hedging process remains to provide certainty of future rate commitments (Wallace 1998). Forward exchange rate contracts or options are typical hedging instruments used to hedge risk; the latter actually eliminates the downside risk of any negative exchange rate variations while permitting possible upside gains when a particular option is exercised.

In the case of hedging *translation* risk, the accounting exposure of a foreign entity arises from the translation and consolidation of financial statements at balance date to the home office currency. The hedging process becomes however more involved. For example, a potential loss due to a depreciation of the exchange rate at balance day date will depend on whether the subsidiary in question can be classified as having an exposed net asset or net liability position. In the case of the former, where assets translated at the current rate exceed liabilities at current rates (the position of most solvent entities), an entity with an exposed asset position in a weak currency area (such as Indonesia) can expect to accrue unrealised currency losses on consolidation. Thus,

and although a typical transaction exposure arises when a contracted receivable (asset) or payable (liability) denominated in a foreign currency becomes due and payable at some future date, this is not the case in a potential translation risk. The exposure, although recognised in financial statements, remains dormant and unrealised at balance date unless of course the firm in question is liquidated. However, relevant international accounting standards (see IAS Statement 133 for example) allow for the hedging of such exposures and these must be disclosed, as per the Accounting Standard, as a separate item under Shareholder Funds rather than being shown in the income statement. Again, the more detailed treatment of this material falls largely outside the scope of this study. Nevertheless, policy guidelines are provided to financial practitioners as an essential, initial, summary of policy frames and available hedging options.

Summing up, the commercial utility of parity tests in terms of their rate-deterministic qualities suggests some support for the IRP hypothesis during periods of relative economic and political stability. Meaningful results, for instance, occurred when variables were defined in first order differences and politically unstable periods were excluded from the data. PPP tests, on the other hand, although not relevant in the short-term, derive their utility and commercial relevance from the fact that PPP deviations usually signal changes in the commercial risk or viability of foreign firms operating in Indonesia. To the degree that results can be generalised, findings may therefore be taken as a broad but by no-means explicit expression of the efficient market hypothesis.

Public Policy Implication

An examination of the periodic volatility of the rupiah leaves little doubt that the currency is highly sensitive to political and or social unrest amplified by shallow foreign exchange markets. Indonesia's political transformation and geopolitical aspirations continue to pose a latent threat to the future economic stability of Indonesia and, therefore, the stability of the exchange rate. These pressures, particularly Indonesia's ongoing democratisation processes vs. interests represented by religious fundamentalism and regional aspirations, can be expected to periodically weaken the external value of the currency. Guin and Maxwell (1996 p. 311), although accepting

the basic dependency of the exchange rate on economic and social fundamentals, are moved to conclude that the coalescence of rates ultimately depends on public policies, that is, '… governmental policies and … nations allowing their currencies and interest rates to fluctuate [freely]'.

Public policy implications arising from these observations were progressively discussed throughout this text. Nevertheless, a few key points are here recapped. The value of currencies, the exchange rate—in as much as valuations are of interest to exporters and importers—becomes indeed a matter of public policy concern, i.e. trade balances typically reflect the price and volatility of a given exchange rate. Given this context, two fundamental questions were examined by this study: (a) whether the AUD/IDR exchange rate reflected economic fundamentals in the form of parities and (b) whether the variability of the exchange rate can be considered excessive. The answer to both these questions substantially linked the exchange rate to asset rather than trade flow models.

But, changes in the exchange rate not only respond to changes in economic parameters. Rather, changes in the Indonesian context, as noted, could also be linked to social and political events—either real or anticipated. Such periodic swings in the nominal value of the AUD/IDR exchange rate, while not necessarily indicative of any emerging asset bubbles, could frequently be traced to shallow exchange markets combined with relative low turnovers that typically amplified incipient volatilities.[121] The solution to shallow markets is further addressed under 6.6 below.

The answer to the second question, whether volatilities could be considered excessive, can be inferred from the fact that Indonesian authorities clearly viewed past episodes of variations with some concern and instigated controls to prevent overt speculative attacks. But volatilities, in the Indonesian context, also reflected underlying disturbances of an inherently political nature, i.e. temporary misaligned or excessively volatile exchange rates that were caused by political/social disturbances. If such variations are small, and misalignments only last a few months, it may of course be

[121] Nevertheless, over the whole of the sample period, outcomes implied that the AUD/IDR exchange rate—apart from temporary misalignments—was substantially determined by interest differentials and to a lesser extent, if at all, by trade balances.

difficult to distinguish variations from nominal trends in the exchange rate. Since permanent deviations, however, may signal changes in international competitiveness, PPP provides an additional tool for policy makers. That is, PPP divergences indicate whether a currency is in fact over or undervalued relative to a simple benchmark and actions taken to address emerging imbalances.

In a broader context, reference throughout the text was made to Indonesia's exposure to USD denominated assets and liabilities in the form of international reserves and foreign debts. Public policy implications from these exposures arise on a number of levels.

The relative stability of the USD makes it of course an ideal reserve currency for countries such as Indonesia that experience periodic volatilities in their economic, political or social conditions. The advantages for Indonesia, since the USD represents a better store of value and an enhanced medium of exchange, are therefore considerable. But less overt disadvantages of holding USD denominated reserves, official foreign exchange reserves such as currency deposits and foreign bonds maintained by BI, also arise. These result from the greater sensitivity of trade or asset values and inflation rates to changes in the value of the USD, i.e. to a potential risk exposure of exchange rate movements between the USD and the rupiah. The latter, the potential loss of USD values, in particular, has not only been of concern to Indonesian authorities but also, for example, to China (Baird 2001).

This said, there are yet broader, less obvious, longer-term concerns linked to USD holdings. Indonesia's current reserve balances consist of approximately 75% of USD denominated assets. The bulk of these investments consist of medium to short term liquid obligations with maturities of less than two years. Notes with less than 1 year maturity are also included in this mix but funds exclude any existing swap lines or stand-by arrangements BI maintains with other CBs including any IMF issued SDR's (Bank Indonesia 2003).

In due course, the size and structure of the international economy will make it inevitable that changes in the relative importance of the USD as an international reserve currency will occur, e.g. changes may cause the international transmission of

shocks that will affect welfare outcomes across economies. The changing role of the British pound-sterling as a former dominant reserve currency provides historical precedence. The role of the USD, particularly with the advent of the euro in 1999 and continued US current account deficits, has certainly come under increased scrutiny by the Bank of China. The G 20 nations have also considered the matter despite the fact that the U.S. now issues inflation-indexed government securities. A reconfiguration of Indonesia's reserve funds due to the relative liquidity of these funds is of course possible but may nevertheless turn out to be costly if required under less than ideal conditions. Changes in maturities and prices over time are closely correlated and are a major determinant, along with differences in prevailing interest rates, of the price of financial instruments. Policy makers can be expected to increasingly monitor the future development of the USD (Goldberg 2010).

Ultimately, Indonesian policy directions are jointly determined by Indonesia's Ministry of Finance and BI (Subiyantoro, Dr. H, Ministry of Finance, 2002, pers.comm.17.12). Policy directions reflect two dominant, albeit opposing, policy objectives: the maintenance of the exchange rate consistent with a low inflationary environment but also the valuation of the rupiah to achieve balanced trade or trade surpluses to prevent a further escalation of foreign debts.

Limitations

The study investigates the post-1997 application of international financial parities, that is, the study examined the post-floating conformity of the AUD/IDR exchange rate to certain international parities. Methodologies used provided an alternative to single version models in that the approach achieves the desired outcome of showing periodic magnitudes of variations from parity of more immediate interest to commercial agents. This information is arguably of greater interest to financial practitioners than data based on single, regression-based, coefficients.

The exchange rate, given this context, was seen as a crude dichotomisation of portfolio-balanced and goods market models. A finer equilibration would have of course been possible, but would have required extensive subjectivity leading outside the strict confines of parity tests. To this degree then, the study did not seek to arrive at

an empirical, long-term, position of the exchange rate. Rather, analyses, at the earliest opportunity, sought to identify potential problems and opportunities relating to the post-1997 application of certain financial parities in the Indonesia context. In other words, since prior research data were not available, it was seen as important to identify at an early opportunity the types of issues and problems facing foreign entities operating in Indonesia in managing their exchange rate exposures under a floating exchange rate regime.

While findings did not confirm *a priori* expectations, research outcomes nevertheless provided a model that enabled the utilisation of international financial parities as a tool for managerial decisions making. Subject to limitations, findings, although frequently ambivalent, are therefore of some utility; for example, results support the notion that IRP prognostics prove the better alternative to random walk models when targeting an approximation of the future AUD/IDR spot rate.

Nevertheless, results should be viewed cautiously. The dependent variable for example, the nominal exchange rate, was subject to considerable noise during the research period, i.e. various exogenous, often dichotomous, influences other than interest rates impacted on the exchange rate. Market perceptions—a predominant market psychology that reacts to other than economic events—impacted to a considerable degree on the value of the rupiah over the whole of the research period. Although these variations from IRP largely averaged out over time, financial practitioners should be aware that the currency is extremely sensitive to such temporal influences, rational or otherwise, that limit the application of IRP.

Second, since quantitative findings frequently resulted in ambiguous outcomes subject to various expositions, it was necessary to adopt a largely interpretive approach to the research data. It was, for instance, not possible to obtain meaningful information from monetary authorities that would have enabled contrastive or alternative models to be evaluated. This turned out to be particularly problematic in the case of inflation forecasts. For example, while BI uses a wider range of data to obtain an indication of a fundamental build-up of inflation, the use of factor-based data for instance was slim. That is, little evidence of the use of models that tested underlying inflation rates at

periodicities relevant to market participants for both CPI and personal consumption rates existed. This gap, models to establish trends in inflationary horizons, is puzzling and data may have been deliberately omitted for political reasons. Moreover and although breaks in volatility determined the cut off between selected sub periods and differences were then examined statistically, i.e. a F test was used to test for differences in variances of the error term and a t test to test for differences in means, finding proved less than conclusive (see 5.3).

At other times, variables, such as interest or inflation rates, captured broader influences than those generally attributed to respective parity models and models became temporally decoupled from parity postulates. Interest rates, for example, not only reflected prevailing monetary policies but also changes in financial markets and market structures as well as exogenous capital market conditions. Although testing parities showed the interest rate to be predominately the independent variable, role reversals can occur when for instance monetary policies react to exchange rate changes and the interest rate becomes the dependent variable. Inflation rates, also, can assume the role of a dependent variable when exchange rates are seen as the cause of inflationary increases.

Research addressing the post-floating behaviour of the rupiah is at an early stage. The study to this end sought to provide an initial 'snapshot' of the extent to which rates conformed to parity applications of interest to commercial agents. Within limits, findings can therefore be taken as an approximation of the post-floating conformity of the rupiah to certain international financial parities.

6.5 Forecasting Models

Most criticisms of model-based forecasts appear to be based on a *a priori* belief that models do not adequately replicate dynamic economic systems. Typically, a working hypothesis—based on the premise that models show exchange rates as trending toward their long-run equilibrium—could not be formed. Failures ranged from the documentation of poor (out of sample) forecasts to the rejection of individual model components, e.g. the assumptions of IRP or PPP. Since models tended to perform little better than relative random walks, it prompted Meese and Rogoff (1983 p.3) to concluded that ' … a random walk model would have predicted major-country

exchange rates … as well as any of our candidate models'. Given these factors, poor forecasts were inevitable.[122]

Methodologies

Two basic methodologies are usually identified in the literature to forecast exchange rates, i.e. models based on macroeconomic fundamentals—monetary models for example—or naïve forecasts based on a single time series (Shim 1996).[123] However, the simple application of the monetary, or for that matter any other approach, generally fails. The monetary approach had been unable to satisfactorily explain short-run changes in the exchange rate of major industrial countries (Pugel & Lindert 2000). Nevertheless, as noted, models should at least show when the actual exchange rate differs from its long-run equilibrium that rates will trend towards their equilibrium. Meese and Rogoff (1983) subsequently explored this notion more fully.

A modified version of their monetary model uses two equations. The long-run value of the exchange rate r^*_s is determined by the relative money supply and real income, i.e. $r^*_s = (M^s/M^s_f) \times (Y_f/Y)$; the value of the foreign currency therefore becomes a function of and rises when the home country money supply (M^s) increases or the foreign money supply reduces (M^s_f). The value of the foreign currency also rises when an increase in foreign real income (Y_f) or reduction in the home country real income (Y) occurs. The second equation $r^p_s = r_s(r^*_s / r_s)^b$ shows the predicted exchange rate r^p_s as being dependent on both the current exchange rate r_s and a comparison of the long run equilibrium value of the exchange rate r^*_s to the current rate r_s. The b coefficient signifies adjustments—how much of the deviation between the long run equilibrium (r^*_s) and the actual exchange rate (r_s) eliminates over the period of the prediction. The ultimate test of the predictive power of any model of course derives from a comparison of the proposed model to naïve forecasts. Pugel and Lindert (2000) present empirical

122 In the case of fundamental or econometric models it must be noted that the exchange rate only reacts to news that is unanticipated. If, for example, the market expects poor balance of payments figures, the expectation will have been factored into the price of a given currency. In this sense, exchange rates can be regarded as forward-oriented auction prices rather than rates that are indicative of current currency prices. Nevertheless, if it is assumed that expectations are rationally formed, these should coincide with model predictions.

123 A time series is a sequence of data points at constant intervals. A time series based analysis breaks the data into components and projects components into the future. The four components typically recognised are: trend, seasonal, cyclical or random variations in the data.

evidence that over periods > 3 years, error rates, using the above model, are substantially smaller then those from the application of naïve models.

A workable model of the AUD/IDR exchange rate may also be derived from a modified/adapted version of the so-called *arbitrage pricing theory* (APT).[124] The AP model overcomes some of the shortcomings inherent in a simple capital asset pricing model since it takes into account a number of risk factors[125]. That is, the AP model is based on the premise that prevailing macroeconomic and noise factors can be sufficiently quantified (Rao 1995).[126] To derive an estimate of future spot rates, the risk-free interest rate—identified in the model by α (see footnote 125)—becomes the current spot rate, the risk free return r_f is omitted, and r_e is replaced by expected variations in factors. In this sense, similar to other models based on economic fundamentals, the model captures the behaviour of various macroeconomic variables. Nevertheless, it must be recognised that it may be difficult to adequately identify variables and their influence over time on the exchange rate.

6.6 Future Research and Conclusions

Liquid and efficient currency markets not only aid in the provision of adequate currency supplies that avoid damaging short-term exchange rate volatilities, but also reduce market segmentation and transaction costs. Currency markets for the rupiah have to-date remained exceptionally shallow and to this degree volatile. In the absence of comprehensive forward facilities and adequate liquidity, increased volatilities could frequently be traced to excessive demand surges on relative shallow spot markets. These fluctuations, in turn, triggered periodic bouts of panic selling that caused

124 The APT describes an asset pricing method that shows the expected return of any asset as the linear result of various factors that influence outcomes. This approach is preferable to basing estimates on a simple capital asset pricing model (CAPM), which, although useful in the context of an effective exchange rate, neglects specific influences affecting individual exchange rates.

125 Expected returns are based on the expression: $\alpha + \beta_1 (r_e\text{-}r_f) + \beta_2 (r_e\text{-}r_f) + \beta_3 (r_e\text{-}r_f) \ldots +$ noise. Here, α is the risk-free interest rate, β the factor beta (or sensitivity of each factor), r_e the expected factor return, r_f the risk free interest rate and $r_e\text{-}r_f$ represents the expected risk premium for each factor.

126 The value of the expected return of the APT model clearly depends on: (a) the comprehensive identification of macroeconomic factors affecting the exchange rate, (b) the allotment of appropriate risk premiums to each factor (*re-rf*), and (c) an approximation of the beta coefficient for each factor (the sensitivity of the exchange rate to a particular factor). The expression, semantically, boils down to a summation of beta adjusted factor premiums (the expected factor return minus the risk free return) plus the risk free interest rate return. The estimate of risk premiums for each factor follows the conventional rule that for each potential negative exposure of the exchange rate, e.g. a negative sensitivity to interest rate differentials, a higher return is demanded; in case of the non (or positive) exposure of the exchange rate to a factor such as current account surpluses, a lower return is accepted.

excessive spikes and pointed to thinly-spread transactions (Bank Indonesia 2002); liquid markets are said to be efficient when buy-sell (bid-offer) spreads are relatively small. In this case, large currency transactions can be accommodated and executed with relative ease and without causing excessive price swings.

Efficient markets are therefore in the interest of both market makers and market users. In order to provide a liquid and consequently more stable forex market, the introduction of an *intra-regional* or alternatively *multi-lateral*, exchange-rate system along the line of the former European Monetary System should be considered.[127] The ASEAN trading bloc, although by no means fully integrated, already possesses some broad convergences required to eventually enable a common monetary policy platform to be adopted. But the region seems to lack the political will and vision to pursue implementation (Bank of International Settlements 2002).[128]

Future Research

Future research, apart from addressing the feasibility of an intra-regional exchange rate system proposed above, could address the two principal hypotheses listed in this dissertation:

1. that Indonesian authorities pursue policies to slow down rather than strengthen the external value of the rupiah, i.e. future research could determine to what degree Indonesian authorities actually adhere to the *de jure* classification of the rupiah as a floating exchange rate, and

127 Consisting perhaps of fixed but adjustable exchange rates with member currencies being allowed to jointly float against a weighted basket. The establishment of some form of intra Asian currency fund to provide—where appropriate—short to medium balance of payments assistance could support such a system.

128 Salvatore (2001) notes that a typical agenda for the introduction of a common exchange-rate system, ultimately leading to the introduction of a common currency, includes: implementing structural reforms, adopting clear convergence criteria, determining a common monetary policy (including the pooling of foreign currency reserves), developing institutions such as a common CB to support the effectiveness of monetary union and the irrevocable fixing of bilateral conversion rates. To-date, none of these issues have been addressed. Due to the political realities in Asia, the exercise of national self-discipline and policy cooperation—including joint currency interventions—may of course not be easily achievable. It must also be admitted that economic gaps still remain between individual ASEAN members that would make such a move difficult. A lead currency that could serve as an anchor, other than possibly the Japanese yen or Australian dollar has also not emerged to date. Both these currencies, for political reasons, must however be regarded as unlikely to act in this capacity.

2. that interest differentials during an appreciating phase of the currency undervalue the estimated exchange rate to a greater degree than during a depreciating period.

Point (2) of the above notation is particularly intriguing. Given a declining interest rate environment, the ability to measure future inflationary expectations[129] held by economic agents, i.e. to assess the up or downside risk to economic outcomes resulting from rational or irrationally held expectations, is fundamental to solving the overshooting exchange rate riddle. If the cost of expectations under conditions of uncertainty affects agents' choices and economic outcomes, BI's ability to assess inflationary expectations and agents' learning rules how expectations are formed is not only essential to maintain BI's credibility and effectiveness in formulating and communicating monetary policy directions, but it is also of interest to economic agents in general. To-date, Indonesian data provides little evidence of the availability of such information.

Other issues left unanswered by this study may also merit further investigation:

1. since present tests reveale little correlation, future research could examine to what degree (if any) trade balances in the longer-term influence the AUD/IDR exchange rate, or, alternatively, to what degree the exchange rate influences trade balances.
2. Although increases in base money could not be linked to Indonesian inflation rates, it was not clear to what degree a permanent increase in monetary aggregates might not actually result in a rise in long-term inflation. Research, perhaps over a > 5 year period, might establish a link.
3. Furthermore, the rate of convergence to PPP over a longer time span of perhaps + 10 years should be examined and attention shift from the analysis of purely statistical issues to an examination of the departure of economic factors from relative PPP.

[129] Indonesian wage rate negotiation may possibly serve as a proxy for expected inflation rates.

Conclusions

Relative fixed exchange rate systems of the 1960s were considered to be the answer to volatile exchange rates. Exchange parities were fixed although adjustable, and macroeconomic indicators were subsequently used to adjust domestic policy settings to match these rates. The technical analysis and basis for these adjustments was primarily an IMF responsibility, e.g. the IMF developed rates that were subsequently adopted by the Smithsonian Realignment Scheme. Methodologies, the Multilateral Exchange Rate model for example, of course needed to be internationally consistent in changing underlying current account balances and the exchange rate that could bring about these changes. This also became an IMF mandate.

However, international monetary systems were to eventually experience a period of major structural change. Increased inflation and interest rates, oil price shocks, significant shifts in relative factor pricing, rapid innovations and deregulations of capital markets and an emerging shift in comparative advantage to Asia, all subsequently combined to bring the Bretton Woods regime to an end. Research now commenced to shift from balance of payments related issues to inflation and interest rates changes and emerging international capital flows.

The era of fixed parities, at any rate, had come to an end and currency values became a key consideration of most aspects of international financial management. The nominal exchange rate could now be shown to predominately relate to five variables: the current level of national price indexes; the expected future real exchange rate; the rate of real interest differentials consistent with time dimensions; the premium of bearing exchange risk and any country premiums between covered yields on similar claims against different countries. Present research objectives primarily sought to address these issues, that is, the study sought to determine whether and to what extent international financial parities applied to the newly floated AUD/IDR exchange rate. This said, research findings did of course not entirely settled the debate. Most parity tests in the Australian/Indonesian context in fact showed a lack of strict agreement, which however improved over time and in the long run; to this degree, parity outcomes provided reasonable estimates.

The basic insight gained from these observations suggests that economic actors wishing to obtain short-term forecasts—say on a weekly or even monthly basis—would do better to look beyond models based on purely macroeconomic fundamentals.[130] Despite limitations, it is expected that findings will provide formal consistency in the tractability of the exchange rate, e.g. findings, where approximations are sufficient, will assist commercial agents in establishing improved cash flow projections converted to either the Australian or Indonesian currency.

A caveat must finally be lodged. Although parities in a less restricted forum could be upheld, no claim that statistical computations and models reflect the risk of future exchange rate changes adequately can be made. The period under review had in fact shown prolonged stretches of political and social instability that impacted both negative and positively on the value of the rupiah. Such random events, as noted previously, cannot be ruled out in the future

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130 Most transaction-based models, such as order-based forecasts, can be shown to be correlatively associated to subsequent changes in exchange rates. Spot market observations suggest that currency traders use filters based on technical parameters inconsistent with the efficient market hypothesis.

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APPENDICES 1 - 11

Appendix 11
Pilot Survey: Market Expectations of Future Spot Rates

The following institutions were contacted during the second week in November 2004 to obtain estimates of future spot rates: Australia and New Zealand Banking Group, Commonwealth Bank, Westpac Banking Corporation, Macquarie Bank, National Australia Bank, St. George Bank, Suncorp Metway, Thomas Cook, AMP, Deutsche Bank, Bank of Queensland, Bank of America and the Bank of China. Institutions were requested to state their 'estimate of monthly changes in the AUD/IDR exchange rate for 12 months to December 2005'.

Of the 13 institutions contacted, five actually responded to the request for forward expectations; two advised that expected rates were based on *ad hoc* calculations of interest rate differentials and ruled out on account of this response. The absolute range and limited reply invalidated any statistical inferences that could be drawn from the pilot. It is suspected that responses were biased and driven by perceptions of opportunistic margins rather than any attempt to provide genuine estimates of future rate expectations. It was, at any rate, not possible to obtain a clear expositional statement of assumptions used in estimates. Differences in the absolute range of responses, however, were not entirely unexpected given the volatility of the AUD/IDR exchange rate.