Policy Implications of the Effects of Concentration and Multimarket Contact in China's Airline Market

Yahua Zhang[a,*] and David K. Round[b]

[a]School of Accounting, Economics and Finance, Faculty of Business, University of Southern Queensland, Toowoomba, QLD 4350, Australia

[b]Centre for Regulation and Market Analysis, School of Commerce, University of South Australia, Adelaide, SA 5000, Australia

[*]Corresponding author.

E-mail address: shane.zhang@usq.edu.au

Phone: +61 7 46312640

Fax: +61 7 46315594

Abstract

Unlike many other mergers in developed countries, which might have been assessed and their effects estimated by antitrust authorities before being granted antitrust immunity, the airline mergers that swept China's airline industry in 2002 occurred with no antitrust challenge. These mergers provide the opportunity to study important market power issues in China's airline markets. Given that increased concentration and multimarket contact are the main legacies of an airline merger, the effects of mergers on these variables can raise the potential for the exercise of market power. However, an examination of the period 2002-2004 during which the Chinese airline mergers occurred shows that the resulting increased concentration and enhanced multimarket contact did not have important consequences for airfares in Chinese city-pair markets. The presence of Hainan Airlines appears to have played an important role in suppressing the airfares charged by China Eastern and China Southern.

Keywords: Airline Mergers, China, Concentration, Market Power, Multimarket Contact

1. Introduction

Market power has been extensively studied in many industries and countries. However, studies of the market power that is created directly by mergers, or the actual effects of mergers, are relatively few in number. This is also the case for the airline industry, especially for the wave of airline mergers that has occurred since the late 1990s, including China's 2002 airline consolidations. Unlike most mergers in developed countries, which are assessed and their effects estimated by antitrust authorities before being granted antitrust immunity, the airline mergers in China's airline industry in 2002 faced no antitrust challenges.[1] This provides researchers with a good opportunity to study the potential market power issues in this market.

Price-concentration studies and multimarket contact studies in the airline industry provide a methodology to assess market power indirectly, given that concentration and multimarket contact are the two main structural market legacies produced by an airline merger. Concentration has traditionally been a concern for public policy, while multimarket contact has been suggested by some academics to be a concern, although not much attention has been paid to this variable by antitrust authorities (Scott 1993, 2001).

The empirical studies to date of the effects of both concentration and multimarket contact have produced mixed results in the airline industry, making it hard to develop effective antitrust policy recommendations. This situation has also been complicated by the controversial interpretation of the effects of concentration. Under these circumstances, therefore, it is wise to focus on the factors that can substantially restrict the carriers that enjoy dominant status at an airport or in a given market from

[1] After being discussed for more than ten years, China's first antitrust law was passed in 2007 and became effective on 1 August 2008.

exercising market power. The presence of low-cost carriers has been proved to have this effect and deserves attention. In this study, concentration variables are found not to have made substantial contributions to airfare levels. We also dismiss the importance of multimarket contact after China's airline mergers. Therefore, we conclude that the airline industry in China could be treated with a relatively lenient antitrust policy in the presence of low cost carriers, or in the presence of aggressive rival airlines.

The next section will provide a brief background to China's airline mergers. Section three reviews the relevant literature. Section four contains the methodology and a description of the unique data set that was developed for this study. The results are analysed in section five. The final section summarises the research and concludes with some implications for Chinese competition policy.

2. Background

Before 1997, both the regional and trunk airlines in China were tightly regulated by the Civil Aviation Administration of China (CAAC) in every aspect of air services provision, including market entry, route entry, flight frequency, and pricing. The year 1997 marked the start of deregulation, privatisation, and consolidation for China's airline industry (Zhang and Round 2008). Since then China's airlines have experienced a period of unexpected shocks from both home and abroad; intense competition has occurred between domestic carriers; increased challenges have emerged from aggressive international airlines; further deregulation demands have come from foreign governments; and a worldwide trend towards airline alliances has grown. Profits for China's airlines were no longer guaranteed, and profit fluctuations were unavoidable. For example, the airfare relaxation in 1997 immediately led to

repeated price wars in the domestic markets and resulted in a heavy loss of 3.5 billion Chinese yuan for the whole industry in 1998 (*International Finance News* 2003).

Not happy to see this result, CAAC issued several notices from 1998 to 2001 to prohibit deeper discounts being offered by airlines (for example, discounts were not allowed to be deeper than 20%). However, these attempts to regain control over airfares achieved little success, largely due to the lack of effective enforcement of these notices. Strong voices opposing price re-regulation also came from consumers who had benefited from price competition, and also from the airlines, which were reluctant to be deprived of their new-found pricing freedoms.[2]

China's airline mergers were then proposed. CAAC hoped that re-grouping the state-owned airlines (although most of them had been partly privatised and publicly listed) would reduce what it regarded as unnecessary competition. The mergers were consummated on 11 October 2002, resulting in three major airline groups (Air China, China Southern, and China Eastern), with a few remaining independent airlines.

3. Literature review

The salient features of China's airline industry in the post-merger period are greatly increased airport and route concentration, and enhanced multimarket contact among the big three airlines. Several case studies have focused on mergers in the airline industry following the 1980s merger waves in the U.S., including GAO (1988), Borenstein (1990), Werden et al. (1991), Kim and Signal (1993), and Morrison (1996). The results of their findings are mixed. Generally, in most cases the concentration created by mergers in both routes and airports is positively associated with airfares, but its impact is not always as systematic and consistent as expected, and there is

[2] The government has had little influence on pricing since 2001, when the 'revenue pooling scheme' collapsed. For the role played by CAAC and a detailed discussion of other competition issues in China's airline market, see Zhang and Round (2008).

evidence that significant anti-competitive effects may not follow. Early literature examining the effects of airport dominance such as Borenstein (1989), Morrison and Winston (1989), Berry (1990), and GAO (1990) reported a positive relationship between airport dominance and airfares. However, later studies suggested that such effects might have been overstated in the absence of controlling for many other factors that affect fares (Morrison and Winston 1995; Tretheway and Kincaid 2005).

The effect of route concentration on airfares is ambiguous. In Evans and Kessides (1993) and Lee and Luengo-Prado (2005), the impact of airport market share is positive and significant, while route market shares have no effect on airfares after controlling for the effects of scarce facilities and other sunk costs. Some other authors point to a positive relationship between airfares and route concentration when measured by market share (for example, Fischer and Kamerschen 2003). However, Fischer and Kamerschen pointed out that the sign for the route Herfindahl–Hirschman Index (HHI) on airfares is theoretically ambiguous. They found a negative and significant effect of route HHI on yields.

The lack of a clear relationship between price and concentration has led to a shift in focus to other factors that can be clearly observed and measured and that can consistently and significantly constrain the exercise of market power in spite of concentration. Tretheway and Kincaid (2005) claimed that the presence of low-cost carriers could have such an effect, which had been confirmed by numerous empirical studies including Bennett and Craun (1993), Dresner et al. (1996), Morrison (2001) and Vowles (2000, 2006).

The concept of multimarket contact, a measure of the extent to which the same firms compete in multiple markets, can be traced to Corwin Edwards (1955). Multimarket contacts give the firms familiarity with the strategies of their rivals and

facilitate their tacit coordination and mutual understanding (Bernheim and Whinston 1990; Scott 1993; Baum and Korn 1996). There have been a few studies on multimarket contact in airline markets, but they provide mixed results. Evans and Kessides (1994) reported the existence of a positive relationship between fares and multimarket contact. Singal (1996), Baum and Korn (1996), and Gimeno and Woo (1996) endorsed the mutual forbearance hypothesis as being relevant to the airline industry. However, some other studies such as Sandler (1988) conclude that higher multimarket contact leads to greater competition in markets. Morrison and Winston (1996) found that multimarket contact was positively correlated with the occurrence of price wars.

Clearly, the effect of multimarket contact is an issue for empirical determination on a case-by-case basis. We will revisit this issue for China's airline markets, where there have been essentially no antitrust laws to oversee their conduct.

4. Model specification and data

Morrison and Winston (1995) claim that beginning with Bailey and Panzar (1981), a useful analytical tool has been developed to address the effects of competition on fares: a fare equation. A large body of literature has employed fare equations to examine pricing determinants, with many different purposes in mind. For example, research has variously focused on the effects of concentration (Borenstein 1989, 1992; Kim and Singal 1993; Leahy 1994); the effects of airline hub-and-spoke networks (Brueckner et al. 1992); the effects of the presence of low-cost carriers (Strassmann 1990; Vowles 2000); and the effects of airline alliances (Park and Zhang 2000; Brueckner and Whalen 2000; Brueckner 2003).

These studies are actually conducted within the framework established by Bresnahan (1989), where a price equation is estimated without knowing actual cost

information. This information is instead inferred from cross-sectional variations in prices and product attributes. However, the potential endogeneity of some of the independent variables is inherent in this approach. Factors such as the number of passengers, market shares, and concentration ratios may be associated with the endogeneity problem. Therefore, instrumental variables and two-stage least squares are called for.[3]

In this paper a reduced form price regression model will be estimated to find the effects of concentration and multimarket contact on airfares, with the purpose of assessing the effects of the 2002 airline mergers.

4.1. Dependent Variable

One-way airfares adjusted for inflation are used in our pricing models, a practice followed by many other researchers (Borenstein 1989; Evans and Kessides 1994; Park and Zhang 2000). The fare data sets for this study come from two Chinese airlines: China Southern (CZ) and China Eastern (MU). The raw data include the number of passengers carried by each airline, and the one-way average airfares (or revenue) charged by each of them on a given route linking two domestic cities for a given month from January 2002 through December 2004. As China's airline consolidations were consummated in October 2002, the data set contains a 10-month period before the mergers and a 26-month period after the mergers. The monthly average airfare does not include airport taxes as this amount does not constitute any part of the revenue of the airlines, nor any other type of taxes. Note that average revenue per

[3] In many instances, it is difficult to identify a demand equation without sufficient data, or sometimes it is hard to distinguish demand functions from supply functions. Therefore, reduced form estimation is popular, compared with structural models (Baker and Rubinfeld 1999). Also, as noted by one referee, the reduced form specification is generally unambiguous for interpreting the market concentration variable.

passenger is calculated as the monthly average on a given route of a single carrier, and hence is not the average revenue for an individual flight.

However, data for some routes were not complete, either because of suspension of air services on these routes, or because of incomplete data collection by the airlines. If the total service interruption time length, or the number of periods with missing data on a route, was more than 12 of the 36 periods, it was dropped from our analysis. After screening, the final data set consisted of 113 markets for China Eastern and 76 for China Southern. As Chinese domestic airlines only report one-way revenue and traffic statistics, in our analysis each direction on the same route will each be treated as a separate market.[4] This can be justified by the fact that pricing decisions were usually delegated to the local sales offices that understood local markets and could closely monitor and match rivals' prices. All the routes are non-stop routes. Also it should be noted that during 2002-2004 Chinese airlines had not designed transfer programs to attract connecting passengers, and so the revenue and traffic information in our data are for local passengers.

4.2. Independent Variables

Route HHI

Most researchers argue that the ideal measure of route market share is the share of all local origin-to-destination passengers for the observed carrier in a given market (see Borenstein 1989 and Fischer and Kamerschen 2003). However, some studies have found that using either the number of flights or the number of passengers in a market as a basis for market concentration calculation generates similar results (see

[4] Unfortunately, because the relevant carriers do not report round-trip statistics, we are unable to combine meaningful data for round-trip markets. Although only some of the markets are two halves of round trips, correlation in error terms might arise. The use of the GMM estimation technique can accommodate this problem.

Bailey et al. 1985; Borenstein 1991; Borenstein and Rose 1994; and Stavins 1996). Owing to the unavailability of all of the traffic data for the two airlines, instead of using the passengers carried on each route, route market share was calculated using the available seat numbers (we checked the *Timetable for Chinese Air Carriers*, issued by the CAAC Chinese Air Carrier Timetable Press every March and October, for the frequency of each airline and the type of aircraft used for each flight). This method was also used by Lijesen et al. (2004).[5]

Based on the calculated market shares, the HHI for each route level can be computed accordingly. The annual average HHI was used as it can better reflect the interaction between carriers than the semi-annual HHI. The endogeneity problem has long been recognised as being associated with the regression of price on concentration. Given that we use an input measure of concentration (capacity) instead of an output measure (sales or number of passengers carried), and the capacity has been predetermined before a pricing schedule is put into effect, the endogeneity problem has been mitigated.[6]

Busy Airport Dummy

A dummy variable is specified for the top 10 cities (in terms of the number of passengers handled in 2004, according to data provided in *China Civil Aviation Statistics* 2005) from which flights depart, in order to capture the buyer effect on prices. The buying power of a small number of travel agents in large cities is

[5] Our interviews with sales managers of the two airlines in China also suggested that the number of seats available on each airline should reflect their share of the market. In fact, load factor is regarded as an important performance indicator, and as such is a priority goal for each airline. Whenever there is a significant difference in load factors, a price war is most likely to occur to bridge the difference.

[6] Greene (2003, p. 382) notes that predetermined variables in a model "can be treated, at least asymptotically, as if they were exogenous in the sense that consistent estimates can be obtained when they appear as regressors."

generally strong, and this power could upset any price-fixing agreements among the airlines. This dummy variable may also reflect economic scarcity. For example, these airports are usually congested in terms of take-off and landing slots and the use of airport facilities, and therefore a fare premium may arise, but not necessarily imply market power per se (Levine 1987; Tretheway and Kincaid 2005). Price wars have been found to be less likely to occur in the markets associated with busy airports (Morrison and Winston 1996). Therefore, caution should be taken in interpreting the busy airport dummy because of the multiple effects that it might capture.

Hub-to-Hub Market Dummy Variable

Hub-to-hub markets are those where an airline has control over some of the airport facilities at both terminal airports on a particular route: where the two airports are the airline's primary or secondary hubs.[7] An airline may share a hub with other airlines. For example, after acquiring Wuhan Airlines, China Eastern has Wuhan as one of its secondary hubs, but Wuhan Airport is also a secondary hub for China Southern. An airline does not necessarily have a dominant status at its hub airport in terms of market share, but will be a strong competitor for other airlines in markets out of this airport. We define any market linking an airline's primary or secondary hubs as a hub-to-hub market. Generally, prices in hub-to-hub markets are likely to be higher, owing either to unilateral effects or to coordinated effects, but this may not always be the case given that efficiency gains may also be associated with these markets.

[7] For example, after the mergers, China Eastern Group's primary and secondary hubs included Shanghai, Jinan, Nanchang, Taiyuan, Hefei, Ningbo, Lanzhou, Nanjing, Wuhan, Xi'an, and Kunming (source: China Eastern's website, available at www.ce-air.com). The China Southern group operated the following primary and secondary hubs: Guangzhou, Urumqi, Shenyang, Harbin, Changchun, Dalian, Shenzhen, Haikou, Zhengzhou, Wuhan, Changsha, Nanning, Zhuhai, Xiamen, Shantou, and Guiyang (source: China Southern's website, available at www.cs-air.com).

Multimarket Contact

No widely accepted variable has been developed for measuring multimarket contact. Authors have developed their own formulae to take certain considerations into account. In general, methods have been based on two basic types of measurement: count measures and probabilistic measures. Singal (1996) has justified the use of the count measure in airline research. Following Heggestad and Rhoades (1978) and other contributions to the multimarket contact literature (Evans and Kessides 1994; Jans and Rosenbaum 1997; De Bonis and Ferrando 2000), a contact matrix was constructed to measure how many times an airline meets other airlines for each of the sample routes in each period of analysis. The method for the construction of this variable is a reproduction of the one used in many previous articles in the literature (see, for example, Evans and Kessides 1994 and De Bonis and Ferrando 2000).[8]

Evans and Kessides (1994) acknowledge that some routes are more important than other routes for an airline because they may generate more revenue or profits, and so they incorporate into the multimarket measure the revenue received from the route as a percentage of the airline's total revenue. Singal (1996) constructed a more

8 See Appendix 1 for a brief description. To simply illustrate the method of calculation, consider a market in which three airlines A, B, and C operate. If we assume that A meets B 50 times in other markets and meets C 40 times, while B meets C 10 times in all of the sample markets, then the contact matrix is:

Airline	A	B	C
A	–	50	40
B	50	–	10
C	40	10	–

The total number of market meetings for the three airlines is 50 + 40 + 10 = 100. The number of possible pairings of airlines in this market is 3*(3–2)/2 = 3. Therefore, the average market contact for each airline in this market would be 100/3 = 33.3.

complicated measure of market contact by considering the number of carriers, the size of the route and the magnitude of the presence of competing firms, as well as their relative market shares. In our study, the basic count measure without incorporating any weights such as market share is preferred, as concentration variables have been separately included in the reduced form equation. The domestic timetables mentioned above were used to check the number of times the airlines met each other on each route for each time period.

Distance

Distance is the major variable that affects costs. It is measured by the non-stop mileage (stage length) between departure and arrival cities. If the airfare rather than the yield is used as the dependent variable, price should be expected to rise with distance. The stage length can be found in *China Civil Aviation Statistics* (2004).

The Presence of an Aggressive Carrier

China had no low cost carriers until 2005. However, Hainan Airlines was established in January 1993 and started operations on 2 May 1993. Its emergence is believed to have had the effect of lowering airfares. With the aim of becoming a national trunk airline, Hainan has taken every opportunity since then to expand.

After taking over Chang'an Airline in Xian and Shanxi Airline in Taiyuan in 2001, Hainan was able to develop bases in northwestern cities, which were part of China Northwest's and later China Eastern's territory after the two airlines merged. At the same time, Hainan acquired the Beijing- and Tianjin-based Xinhua Airlines, helping it to gain access to Beijing Airport, and the adjacent Tianjing Airport. In the mid-1990s, Hainan deployed several aircraft at Ningbo, a neighbouring city to Shanghai, to establish a home base in the East China area.

Thus, a series of takeovers has allowed Hainan to fly to and from Hainan Island in the South, Xian and Taiyuan in the northwest, Beijing and Tianjing in the north, and Ningbo in the east, making it the fourth largest airline in China by the end of 2002, in terms of destinations serviced and traffic carried. During the implementation of its expansion strategy, price competition was an effective and frequently-used means of acquiring market share, and therefore the presence of Hainan on a route may have had a similar effect to that of a low cost carrier by creating pressure on the major carriers, and thus a dummy variable indicating the presence of Hainan Airlines is included as an indicator of price competition whenever a city-pair is served by this airline.

Tourism Market Variable

Traditionally, Guilin, Haikou, Sanya, Zhangjiajie, Huangshan, Hangzhou, and Wuyishan have been labelled as tourism cities because their economic growth is heavily dependent on the tourism industry.[9] Tourists tend to have a more elastic demand than do business travellers; consequently, low fares are expected for the markets in and out of these cities owing to the high ratio of leisure to business passengers.

Number of Passengers

The interpretation of the impact of passenger numbers is controversial. Some researchers think that this variable measures the returns to traffic density, and therefore an increase in output should lead to a decrease in prices due to the use of larger, more cost-efficient aircraft (Brueckner et al. 1992; Brueckner and Spiller 1994; Lee and Luengo-Prado 2005). Graham et al. (1983) predicted a negative sign for this variable on airfares, but their result showed an insignificant positive coefficient.

[9] Some other cities may also have important sightseeing spots, like Xi'an, but flights to these cities may also involve a high percentage of business passengers as they are also significant commercial cities. Consequently, we chose not to include them as tourist cities.

Fischer and Kamerschen (2003) also argued that a larger number of passengers would lead to increases in load factors and therefore unit costs per passenger should decrease.

In contrast, based on a profit-maximising cost equation, Dresner and Tretheway (1992) argued that higher output levels should lead to a higher marginal cost curve if the carriers were operating at the range where the marginal cost curve trended upwards. Windle and Dresner (1995) argued that the number of passengers is both a demand-side and a cost-side variable. On the demand side, an increase in the number of passengers implies a rightward shift of the demand curve and should result in higher prices, ceteris paribus. On the cost side, higher passenger density brings about cost economies and lower prices. Taking these possibilities together, the net effect of passengers on price cannot be pre-determined.

This variable is also associated with the endogeneity problem owing to the fact that fluctuations in the dependent variable can be expected to affect the passenger numbers variable. Following the literature we could use population and disposable income as instruments for handling this problem (see Dresner and Tretheway 1992 and Fischer and Kamerschen 2003). However, many of the previous studies deal only with cross-section data. For our panel data study, in addition to the time-constant variables, it is important to find at least one instrument that is time varying for the passenger numbers variable.[10] The number of carriers operating in a market could serve as an instrumental variable. As with the concentration variable, they are predetermined and so are not directly linked to a particular airline's price, and they can thus be assumed not to be correlated with the error term.

[10] Busse (2002) uses departures, or the number of planes that leave the ground, as the instrument for the number of passengers variable, in that departures reflect the airlines' capacity and their forecasts of demand. However, some researchers contend that frequency is endogenous.

The sources and measurement of the suggested instrumental variables for the number of passengers are as follows: The population of China's cities comes from *China City Statistics Yearbook* (2004). Following Brueckner and Spiller (1994) and Brueckner and Whalen (2000), the geometric mean (in thousands) of the population for both route endpoint cities is used to measure the market's "population potential", which is assumed to influence demand. Instead of using disposable income as an instrument, GDP per capita is preferred. Given the high percentage of business passengers on many of China's domestic routes, GDP per capita is more appropriate to reflect the business activities of a city. The GDP per capita data also come from the *China City Statistics Yearbook* (2004). Following the traditional approaches in the literature, the geometric mean of GDP per capita of route endpoints is used to reflect the demand for air travel. The time-varying instrument - number of carriers - is obtained from the airline timetables.

Year, Quarter and SARS Period Dummy Variables

To capture the fare trend from year to year, a year dummy variable for each of 2003 and 2004 is included in the regression model. Quarterly dummy variables are also included, with the first quarter being the benchmark season. Prices in the SARS period (May and June 2003) were extremely high because all businesses and individuals cancelled unnecessary travel. The airlines realised that demand was almost perfectly inelastic during this period, and charged high prices accordingly. To control for this unusual period, a SARS dummy variable is included.

The definition of all the variables, their abbreviations, and the data sources are summarised in Appendix 2.

5. Estimation and Discussion

The descriptive statistics for China Eastern and for China Southern are given in Tables 1 and 2 respectively. The regression results are reported in Table 3.

It is common for a deviation from homoskedastic errors to occur in the context of panel data as a result of the error variances specific to the cross-sectional unit. This has been confirmed by conducting two tests suggested by Greene (2003) and Wooldridge (2002).[11] In the presence of heteroskedasticity, serial correlation, and endogeneity, the Generalised Method of Moments (GMM) has been widely used and recommended by econometricians (see Wooldridge 2002 and Baum et al. 2003). The GMM method that was introduced by Hansen (1982) makes use of the orthogonality conditions, or instruments, in an optimal way in cases where there are more instruments than endogenous variables, to allow for efficient estimation in the presence of heteroskedasticity of unknown form. We report the estimation results using the GMM approach separately for China Eastern and for China Southern, respectively, as a Chow test suggests that the coefficients in the two regressions using the two airlines' data are significantly different.

The use of instrumental variables comes with a cost—the loss of efficiency in the IV estimator compared to its OLS counterpart. It is necessary to test whether the endogeneity problem exists and whether these instruments are needed. The Durbin–Wu–Hausman test for endogeneity can be performed in Stata by producing the C statistic, from which we can judge whether instrumental variable techniques are needed. This test is chosen for its validity when robust standard errors are used. The C test statistics are reported in the last row of Table 3. They are all significant at the 1% level, indicating that instrumental variable techniques should be used.

[11] The user-written command in Stata "xttest3" and "xtserial" can perform these tasks.

5.1. Concentration Variables

Most of the route HHI indexes in 2002 exceeded 4500 in the post-merger period, which falls into the highly concentrated market category, according to the US Merger Guidelines. Most of the increases in the route HHI due to the mergers involving China Southern were well beyond 100 points, which would raise "significant competitive concerns" under the Guidelines. However, although the route HHI variable has a positive and significant sign for both China Eastern and China Southern at the 1% and 10% levels respectively, an increase in airport HHI by 100 points will result in about one Chinese yuan in airfares for both airlines, if all other variables are held constant. This result seems to be consistent with the findings of Evans and Kessides (1993): Route-level dominance does not confer much market power, if any, on the airlines.

The busy airport dummy and the hub-to-hub market dummy do not necessarily represent concentrated markets. They might reflect multiple effects. For example, the busy airport dummy denoting the top 10 busiest cities from which the flights depart, might reflect the effects of both the buying power of big travel agents and economic scarcity. As many airlines operate from these airports, making price collusion more difficult, a significant positive impact on airfares might be more likely to imply the economic scarcity effect rather than the market power effect. The busy airport coefficient is significantly positive for China Eastern only, showing that the economic scarcity effect dominated the buying power effect and provided these busy airports with an airfare premium. As most of the busiest airports have approached their full capacity, hindering an increase in flight frequencies and new entry, it is not surprising to see this price premium.

Hub-to-hub markets, reflecting the control of airport resources by a carrier at both terminal airports of a particular route, on average exhibited negative effects on

airfares. From our econometric results, with other factors being controlled for, it appears that hub-to-hub markets themselves did not necessarily lead to higher prices on average than do non-hub-to-hub markets. They appear not to present a problem for competition. This is in contrast to Vowles (2006), who found that markets in the US with two endpoints being dominated by the same airline exhibited consistently higher fares. The failure by Vowles to control for factors such as busy airports may, however, explain this difference.

The presence of Hainan Airlines had the clear effect of suppressing the airfares charged by China Eastern, and especially by China Southern. The airfares on average are estimated to be lower by 33 yuan for China Eastern and 141 yuan for China Southern. The greater influence on China Southern's pricing might come from the fact that Hainan Airline's initial base, Hainan province, is also a base for China Southern's Hainan branch, and Hainan province is close to China Southern's primary hubbing airport, Guangzhou. Although Hainan is not a low cost carrier, it does appear to have constrained prices in the markets in which it operated.

A natural question should now be asked: why does concentration (as measured by the route HHI) appear not to have mattered in China's airline markets? Although the big airlines have tried to enforce their dominant status in their primary hubs (Beijing for Air China, Shanghai for China Eastern and Guangzhou for China Southern), and the mergers indeed gave them opportunities to strengthen their dominant status, these positions have been constantly under threat.

Since 2002, the management rights of almost all of China's airports have been transferred to provincial governments, except for the Beijing Capital and Tibetan airports. Most of these airports were heavily in debt and were subsidised by the central government. After the transfer, the financing burden fell on the provincial

governments. Apart from Beijing, Shanghai, and Guangzhou, more than 90% of airports had suffered losses for many years because their only revenue came from charging the airlines for their use of the airports. The landing fees as well as other service fees are regulated by CAAC, and these usually cover only the variable costs of provision. Unlike the big three airports, which can also make revenue from concessionary services such as retail shops, advertising, and office rental, because they handle tens of millions of passengers each year, most of the provincial airports have long been underused, thereby requiring subsidies in order to survive. For most of them, it has been, and will be, very hard to avoid losses in the foreseeable future.

In addition, almost all of China's airports are largely independent of the airlines. The current *Regulation on Domestic Investment in the Civil Aviation Industry*[12] does not allow an airline to have more than a 25% stake in an airport. For every airport in China, attracting more airlines to operate to and from it implies an increase in revenue if its capacity can be fully utilised. Therefore, the airports welcome new airlines or encourage existing airlines to increase their frequencies. With the support of the Beijing Airport authority, China Southern has exclusively owned and operated Terminal One at Beijing Airport since September 2004. The intention for the cooperation between Beijing Airport and China Southern might have begun much earlier than 2004. This clearly sent a signal to Air China, the airline based at this airport, that the new firm sought to take market share away from it.

At the same time, Hainan Airlines and Shenzhen Airlines started to covet China Southern's base airport at Guangzhou. Shenzhen Airlines, a local airline based in Shenzhen, 150 kilometres from Guangzhou, had long planned to operate more flights from Guangzhou and eventually gained access rights in early 2005 with the

[12]See CAAC regulation series number CCAR-209.

establishment of the subsidiary Shenzhen Airlines Guangzhou Branch (He 2005). He also reported that Hainan Airlines would invest US$200 million in the construction of its Guangzhou base. The same report also mentioned that Shanghai Airlines, China Eastern, and Air China were negotiating with the Guangzhou Airport authorities for the construction of facilities to accommodate more flights to and from Guangzhou.

Clearly, the open attitude of the major airports impedes the development of monopoly power by the airlines based in these airports. The strategy of encroachment on a rival's primary base airport seems to have deterred all the airlines from charging higher airfares on most routes to and from their primary hubs, and thus consumers have enjoyed low airfares, even after the 2002 mergers.

5.2. Effects of Multimarket Contact on Airfares

Multimarket contact had a negative and significant effect on airfares for China Southern, but the effect on China Eastern's was not statistically significant.[13] This result appears to be at odds with the traditional forbearance hypothesis.

The absence of antitrust laws in China means that collusive behaviour by airlines to date has faced no threat of prosecution, as long as airfares are not more than the published full fares. Airfare collusion in China is not a secret and has been widely reported (Zhang and Round 2008). However, the results in this study suggest that there has been no systematic and successful price fixing across markets. This is consistent with casual observation. In essence, because of the strong competition in China's airline markets, explicit price-fixing agreements generally could not be expected to last long, let alone any implicit collusion implied by mutual forbearance.

[13] However, when we included an interaction term hupresence*mnc in the reduced-form regression model with China Eastern's data sample, the interaction term is negative and significant at 10%, suggesting stronger competition when Hainan Airlines is present.

Also as pricing power has been largely delegated to local sales managers (especially in the three biggest cities, Beijing, Shanghai, and Guangzhou), who are usually in charge of a number of routes out of their city, and it is their responsibility to maximise the revenue on these routes. The narrow focus on a small number of routes implies that mutual forbearance or implicit collusion in a broader geographic market is not possible.

5.3. Effects of Other Variables

We now briefly discuss some of the other variables in our reduced form regression model. After controlling for other factors, the year dummies reveal a strong and highly significant declining trend in airfares for both airlines. Of course, the year dummy effects will have incorporated some merger effects that could not be captured by other variables such as concentration and multimarket contact, but it seems that for the mergers involving China Eastern and China Southern, any market power gained from them has not been seriously abused by these airlines during the period 2002-2004.

The significant SARS dummy produced a positive shock to airfare pricing, as expected. The signs of the coefficient for the demand variable, the number of passengers, are not consistent for the two airlines. The effect of demand on China Southern's airfares is negatively significant at the 1% level while the effect on China Eastern's pricing is positive, although the coefficients are small in value. This ambiguity is not surprising. The literature discussed earlier suggested that the net effect of this variable on price is largely an empirical issue. The coefficients found in this study support this view.

The influence of demand on prices can also be reflected by the sign of the quarterly dummy variables. For both airlines, the fourth quarter saw significantly lower fares

than the first quarter. Unlike Western countries, where Christmas travel may push up airfares, November and December in China are usually off-peak periods despite the long holiday in early October.

The airfares in the typical tourism markets were substantially lower. This shows that where leisure passengers constitute a significant part of total passengers, airfares are much lower as a result of the airlines' recognition of the elastic demand of this group of consumers. Furthermore, many of these tourists are organised by large travel agents who have substantial bargaining power in acquiring bulk seats at cheaper fares, leading to the negative impact of the tourism route variable.

6. Conclusions

By estimating a reduced form regression for two leading Chinese airlines, we found that route concentration, while having a significant and positive impact, did not contribute in an economically meaningful way to airfares in China following the mergers in 2002. The small positive impact of route concentration on airfares indicates that increased concentration on a route might not be as detrimental to consumers as has commonly expected. In addition, in hub-to-hub markets, where carriers could command airport resources, evidence of a negative premium was found.

Two main reasons can explain the unimportance of concentration: the threat from strong rival airlines, which constantly encroach on a rival's hubbing airports, and the emergence of Hainan Airlines, which adopted an aggressive expansionary strategy with little apparent desire to engage in price fixing with the other carriers. As a result, the detrimental effect of the airline mergers was minimised.

The finding of a negative effect of multimarket contact on airfares for China Southern and an insignificant effect for China Eastern does not support the mutual forbearance hypothesis. Pricing locally instead of system-wide by the airlines'

headquarters perhaps precluded the use of tacit collusion strategies. It appears to be the practice globally that carriers tend to concentrate on a certain market or group of markets and determine prices according to conditions in these markets, rather than considering uniform or tacitly co-operative pricing across all markets. In this sense, there seems to be no need to give great weight to multimarket contact as a factor in assessing proposed airline mergers or airline alliances, at least in China. Together with the findings of the lesser importance of concentration in determining airfares, a relatively lenient antitrust policy might be justified when considering the Chinese airline industry, especially in the presence of low cost carriers, or in the continued presence of expansion-focused carriers like Hainan Airlines.

Appendix 1 The Construction of the Multimarket Contact Variable

The method for the construction of this variable is almost the same as in the previous literature discussed in the text.

Assume that there are J routes and I airlines in the sample markets. Let the subscript i=1,…, I represent an airline, and j=1,…, J represent a route. Let V_{ij} be equal to 1 if airline i operates on route j, and 0 otherwise. Then we have an $I \times I$ symmetric matrix

$$A=\begin{bmatrix} a_{11}...a_{1I} \\ \\ a_{I1}...a_{II} \end{bmatrix},$$

where $a_{kl} = \sum_{j=1}^{J} V_{kj} V_{lj} \quad k, l = 1, 2, \ldots, I$.

Off-diagonal elements a_{kl} measure the number of markets in which airline k and l meet, and diagonal elements measure the number of markets that each airline services. If there are f_j airlines offering services on route j, then $f_j(f_j\text{-}1)/2$ enumerates the total number of possible pairings of firms on route j.

From the matrix, the average airline multimarket contact for route j can be constructed:

$$\text{Multimarket contact}_j = \frac{1}{[f_j(f_j-1)/2]} \sum_{k=1}^{I} \sum_{l=k+1}^{I} a_{kl} V_{kj} V_{lj}$$

If the period subscript is added, the multimarket contact_{jt} is the average contact between the airlines on route j in month t.

Appendix 2 Definition of key variables and data sources

Variable Abbreviation	Definition	Data Source
Dependent variables		
cpiprice	Average one-way airfare for airline MU/CZ in a market	China Eastern (MU) and China Southern (CZ)
Independent variables		
routehhi	Route Herfindahl–Hirschman Index for a market	Calculated by authors based on *Timetable for Chinese Air Carriers (2002–2004)*
routeshare	Market share of airline MU/CZ in a given market	Calculated by authors based on *Timetable for Chinese Air Carriers (2002–2004)*
mnc	Average multimarket contact in a given market	Calculated by authors based on *Timetable for Chinese Air Carriers (2002–2004)*
hupresence	A dummy indicating the presence of Hainan Airlines in a market	*Timetable for Chinese Air Carriers (2002–2004)*
distance	One-way distance between the two endpoints of a market	*China Civil Aviation Statistics* (2004)
tourismroute	Tourism route dummy	
busyapt	Busiest 10 airports in China	*China Civil Aviation Statistics* (2005)
hubtohub	Markets linking an airline's primary and secondary hubs	Airlines' websites: www.cs-air.com and www.ce-air.com
paxno	Number of passengers carried by airline MU/CZ in a market	China Eastern and China Southern
sarsdummy	SARS period dummy, taking the value of 1 for the periods of May–June 2003, 0 for all other periods	

y2003	A year dummy representing year 2003	
y2004	A year dummy representing year 2004	
Q2	A quarter dummy representing quarter two	
Q3	A quarter dummy representing quarter three	
Q4	A quarter dummy representing quarter four	
Instrumental variables		
gemeanpopulation	Geometric mean (in thousands) of the population for both route endpoint cities	*China City Statistics Yearbook* (2004)
gemeangdp	Geometric mean of GDP per capita of both route endpoint cities	*China City Statistics Yearbook* (2004)
carrierno	Number of carriers operating in a market	*Timetable for Chinese Air Carriers (2002–2004)*

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Table 1 Descriptive statistics for China Eastern

Variable	N	Mean	Std. Dev.	Min	Max
cpiprice	3550	682.441	225.070	111.016	1976.359
routehhi	4068	4659.478	1985.495	2209.705	10000
busyapt	4068	0.566	0.496	0	1
hubtohub	4068	0.124	0.330	0	1
mnc	4068	36.517	24.779	0	115
hupresence	4068	0.171	0.377	0	1
distance	4068	1180.593	577.040	160	3649
tourismroute	4068	0.212	0.409	0	1
sarsdummy	4068	0.0556	0.229	0	1
y2003	4068	0.333	0.471	0	1
y2004	4068	0.333	0.471	0	1
Q2	4068	0.250	0.433	0	1
Q3	4068	0.250	0.433	0	1
Q4	4068	0.250	0.433	0	1
paxno	3661	6020.447	7371.054	26	71645
gemeanpopulation	4068	5431.266	2566.661	807.402	13410.750
gemeangdp	4068	34104.24	8917.485	16416.43	53461.83
carrierno	4068	3.061	1.205	1	7

Table 2 Descriptive statistics for China Southern

Variable	N	Mean	Std. Dev.	Min	Max
cpiprice	2573	690.614	262.350	212.159	1963.184
routehhi	2736	5688.862	2504.139	2531.979	10000
busyapt	2736	0.618	0.486	0	1
hubtohub	2736	0.211	0.408	0	1
mnc	2736	41.154	31.549	0	115
hupresence	2736	0.206	0.405	0	1
distance	2736	1214.237	650.549	452	3836
tourismroute	2736	0.263	0.440	0	1
sarsdummy	2736	0.056	0.229	0	1
y2003	2736	0.333	0.471	0	1
y2004	2736	0.333	0.471	0	1
Q2	2736	0.250	0.433	0	1
Q3	2736	0.250	0.433	0	1
Q4	2736	0.250	0.433	0	1
paxno	2576	7408.702	7657.076	145	48744
gemeanpopulation	2736	5258.334	2409.549	2022.870	11032.83
gemeangdp	2736	34802.750	8451.169	16416.430	51436.950
carrierno	2736	2.569	1.203	1	7

Table 3 Estimation results with GMM approach

	China Eastern		China Southern	
Variable	Coefficient	Robust Std. Error	Coefficient	Robust Std. Error
routehhi	0.009***	0.001	0.005*	0.002
busyapt	19.077***	6.399	-2.536	9.220
hubtohub	–23.992***	8.989	-14.377*	8.423
mnc	0.057	0.136	–0.384***	0.141
hupresence	–33.484***	8.009	–141.055***	11.144
distance	0.355***	0.008	0.336***	0.010
tourismroute	–130.5872***	8.207	–86.017***	8.226
sarsdummy	99.409***	13.642	138.011***	22.498
y2003	–58.533***	7.982	–27.008***	9.592
y2004	–67.796***	8.207	–50.685***	9.342
Q2	-3.29412	6.814	12.726	8.487
Q3	–22.487***	7.087	–7.150	9.122
Q4	–46.984***	6.842	–27.768***	8.487
paxno	0.006**	0.001	–0.008***	0.001
_cons	274.317***	16.418	294.417***	26.005
Centred R^2	0.758		0.784	
Uncentred R^2	0.976		0.973	
Observations	3546		2573	
C statistic	32.623		42.220	

Note: ***Significant at 1%. **Significant at 5%. *Significant at 10%.