Evaluating the price effects of two airline mergers in China

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Abstract

This paper compares the price effects of two influential airline mergers taking place in China in 2010. We offer the first comparative analysis of two different types of airline mergers in the Chinese airline market: a parallel merger and a complementary merger. With a difference-in-differences approach, we found that the two types of mergers resulted in similar pricing patterns for the airlines involved in the mergers, suggesting that complementary mergers could also confer an increase in market power. It has been found that the negative impact of high-speed rail on fares gradually weakened after the mergers.

Keywords: Airline merger; price effect; comparative analysis; high-speed rail; overlapping network; complementary network.

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1. Introduction

In 2010, two large-scale airline mergers took place in China: state-owned China Eastern completed its merger with Shanghai government-owned Shanghai Airlines (MU-FM), and Air China successfully increased its stake in Shenzhen Airlines from 25% to 51% (CA-ZH). Both China Eastern and Shanghai Airlines took Shanghai as their primary base and operated overlapping services on many routes in and out of Shanghai. Both of them suffered severe financial losses before the merger and their financial positions became exacerbated during the 2008 global financial crisis (Zhang, 2015). This merger was supported and guided by the government, with an obvious purpose of eliminating head-to-head competition between the two, which would undoubtedly strengthen China Eastern's dominant status at Shanghai's Hongqiao and Pudong Airports. Before being taken over by Air China, Shenzhen Airlines was China's largest private airline since 2005. However, China's air transport policy had long been hostile to the private carriers (Zhang and Zhang, 2016), which in part resulted in Shenzhen Airlines' poor financial performance. Seeking financial support was one of the motives for Shenzhen Airlines to receive a cash injection from Air China in 2010. By taking control of Shenzhen Airlines, Air China was able to extend its network and exert influence over the South China market, which was traditionally China Southern Airlines' territory.[1]

However, unlike the MU-FM merger whose aim was to strengthen China Eastern's dominant status in Shanghai, Air China and Shenzhen Airlines were based in separate airports and their networks were largely complementary. Therefore, the CA-ZH merger was of complementary nature while the MU-FM case was regarded as a parallel merger. It should be noted that this does not necessarily mean that a complementary network has little or no overlap. In fact, Air China and Shenzhen Airlines had 82 overlap routes in 2009 and this number was 57 in 2011. The complementary nature mainly reflects the fact that the brand of Shenzhen Airlines continued to grow and expand post-merger. In contrast, the integration between China Eastern and Shanghai airlines was much deeper after the merger. The brand of Shanghai Airlines gradually weakened and even disappeared on many key routes out of Shanghai. In fact,

[1] Both Air China and China Southern had the intention to take over Shenzhen Airlines. However, Air China had already had equity in Shenzhen Airlines and was in a better financial position than China Southern in 2010. Air China had a much smaller presence in China's domestic market than China Eastern and China Southern, particularly in South China. Improving its presence in Shenzhen and Guangzhou as well as South China was Air China's key motivation of acquiring Shenzhen Airlines, which was the main reason that we label this takeover as a complementary merger. By increasing its equity in Shenzhen Airlines to 51%, Air China could effectively control this carrier at the lowest cost.

Shanghai Airlines has largely lost independence after the merger. In this sense, we label the China Eastern and Shanghai Airlines merger as parallel.

In the antitrust analysis of airline alliances, a complementary alliance is one where the two firms link their existing networks so as to feed traffic to each other and build a new complementary network to provide improved services for connecting passengers (Oum et al., 1996; Park, 1997). In contrast, parallel alliances refer to collaboration between two firms that compete against each other on some routes of their network, that is, routes overlap. Only one airline of the alliance partners may provide services on any given route after they form an alliance. Park (1997) found that effects on airfares and consumer surplus are different for each type of alliance. For complementary alliances, Zou et al. (2011) showed the overall effects on airfare depend on the relative strengths of the airfare reducing effects due to cooperative pricing setting and the increased willingness to pay for services improvements. That is, they have both positive and negative effects on airfares. Although the appeal of mergers and of airline alliances is much the same for an airline, the same conclusion may not necessarily apply to the airline merger cases, given that alliances are frequently subject to instability (Oum et al., 2000), while a merger is usually irreversible and permanent. The two mergers with different route systems provide us with a great opportunity to examine their effects on airfares.

Although the impact of mergers on airfares has been extensively studied in previous literature, research into the merger cases in the Chinese market is sporadic, mainly due to the unavailability of data. To the best of our knowledge, the CA-ZH merger has not been rigorously studied in the literature. Zhang (2015) is the only paper that examined the price effects of the MU-FM merger based on a small number of routes. Given that the two mergers took place roughly at the same time, and that merging parties, Air China and China Eastern, and the acquired parties, Shanghai and Shenzhen Airlines, are of similar size, it would be interesting to do a comparative analysis of their respective effects on the routes directly and indirectly affected.

Although China introduced its Anti-Monopoly Law in 2008, the new antitrust enforcement agencies had limited resources and little experience in dealing with antitrust cases. All the airline mergers or code-sharing agreements have never been challenged, nor were any conditions imposed on the relevant parties. It appears that China's state-owned airlines could enjoy a certain degree of market power through either explicit and implicit collusion, or mergers and acquisitions to defend their market share and eliminate potential competition from private carriers (Zhang and Zhang, 2016). Therefore, the lack of a general deterrent effect of the antitrust law gives us an opportunity of examining the pricing effects, which would be otherwise suppressed by effective enforcement of anti-competitive laws in many developed economies. In this study, the price effects of the two mergers in China's airline market will be examined and compared with a difference-in-differences approach. While one approach to gauging the effects of a merger is to study market-level fare changes on routes where the merger partners overlap (Dobson and Piga, 2013; Fageda and Perdiguero,2014; Huschelrath and Muller, 2014, 2015; Shen, 2017; Carlton et al., 2019), this paper studies fare changes at the carrier level on routes served by at least one of the merger partners, following the same approach used in Kwoka and Shumilina (2010). The carrier-level effects are allowed to differ between the merger partner(s) and other carriers serving the route.[2]

This paper is organized as follows. Section 2 reviews relevant studies on airline mergers and their effects. Section 3 describes the data and methodology. Section 4 reports and interprets the main results. Section 5 contains the summary and concluding remarks.

2. Literature Review

A complex pattern of motives might exist for a single merger case. The managerial literature has voluminous discussions of the motives for mergers and acquisitions (Trautwein, 1990; Mukherjee et al., 2004; Zhang and Round, 2008; Geiger and Schiereck, 2014), among which the monopoly theory and efficiency theory are the most commonly investigated motives behind mergers. The monopoly theory concerns the pursuit of market power by lessening competition (Stigler,1964). A horizontal merger eliminates direct competition between the merging parties and thus has market power implication. The efficiency theory is associated with the acquisition of financial synergies, operational synergies, and managerial synergies, which was one of the motives pursued by most merging parties as noted in their annual financial reports (Chatterjee, 1986; Farrell and Shapiro, 2000).

From a theoretical perspective, in oligopolistic markets, a merger among directly competing firms is likely to result in higher prices unless there are significant efficiency gains associated with the merger (Deneckere and Davidson, 1985; Farrell and Shapiro, 1990, 1991). However, there is an exception to this theory when merging firms are not direct competitors. Levy and Reitzes (1992) found that only a merger that involves neighboring products in the characteristics' space may raise prices. That is, the more similar products merging parties produce, the higher prices post-merger. In the airline industry, the most common product differentiation is reflected through the network that airlines serve. Two airlines can be regarded

2 We are indebted to one anonymous reviewer who helped us develop this statement.

as highly differentiated if their networks do not overlap (Dobson and Piga, 2009). Mergers among highly differentiated airlines are less likely to cause higher airfares since they do not alter the market competition situation. Empirically, few studies directly examined market power and cost savings after airline mergers. Most studies conclude that efficiency gains outweigh market power effects if fares decrease after a merger (Mizutani, 2011; Dobson and Piga, 2013; Carlton et al., 2019), and vice versa if fares increase after a merger (Borenstein, 1990; Werden et al., 1991; Huschelrath and Muller, 2014, 2015; Zhang, 2015; Shen, 2017).

In the US, there were two waves of airline mergers. The first wave occurred in the 1980s following the airline deregulation (Borenstein, 1990; Werden et al., 1991; Kim and Singal, 1993; Morrison, 1996; Kwoka and Shumilkina, 2010). The second wave emerged in the new century when the landscape of the world airline industry had completely changed and airlines operated in a more deregulated and competitive environment (Brueckner et al., 2013; Luo, 2014; Huschelrath and Muller, 2014, 2015; Shen, 2017). As for the first merging wave in the 1980s, many mergers involving overlapped network were approved. In general, market power was detected following the mergers taking place during this period, especially when the merging firms had overlapping routes or if one party provided services and the other was a potential entrant. The US authorities have paid more attention to anti-competitive effects when investigating recent airline mergers. During this period, approved mergers were mainly those with complementary networks. Thus, for the mergers taking place during the second merging wave, fares generally decreased because of the dominance of efficiency gains.

In the EU market, some papers reported significant price increases after airline mergers as a result of the increase in concentration and market power (Veldhius, 2005; Brueckner and Pels, 2005; Gaggero and Piga, 2010). Other studies drew opposite conclusions. Dobson and Piga (2013) examined two low-cost airline mergers in Europe, i.e., EasyJet's acquisition with Go Fly and Ryanair's acquisition with Buzz. They found that after both mergers, fares were greatly reduced especially for those early booking tickets, largely due to the realization of immediate efficiency improvement following the mergers. Fageda and Perdiguero (2014) investigated the impact of a merger between a full-service airline and two LCCs in Spain. They found no significant changes in airfare on routes where the two LCCs competed before the merger, whilst price notably increased on routes where the full-service airline was competing with LCCs. In the Japanese market, Mizutani (2011) reported that the merger between Japan Airlines and Japan Air System significantly increased competition and reduced the price as after the merger, Japan Airlines was able to compete with the biggest Japanese airline group—All Nippon Airways more actively.

The research on Chinese airline mergers is very limited. Zhang and Round (2009) studied the airfare changes by China Eastern and China Southern after the 2002 airline consolidations and showed that the mergers did not trigger significant airfare increases. Zhang (2015) investigated the merger between China Eastern and Shanghai Airlines, both of which were encountering severe financial problems prior to the merger. Using the departure day price data, the author found that on average the prices increased by approximately 22% on the seven sample routes one year after the merger.

One salient feature of this research is the rich data that allow us to do a comprehensive comparative analysis of the two mergers whose networks were of parallel and complementary nature, respectively. Our sample contains 280 most heavily traveled routes in the Chinese domestic market and covers a period from 2007 to 2016. As pointed out by Focarelli and Panetta (2003), a short post-merger period might fail to account for a merger's long-run efficiency gains because of the harmonization of the organizational practices between the two merging firms. As both mergers occurred in 2010, the dataset covers a 3-year period before the mergers and a 6-year period after the mergers, enabling us to study the anticompetitive issues from a relatively long-term perspective.

3. Data and Methodology

3.1 Construction of the dataset

Our dataset was constructed using information from the IATA Airport Intelligence Services database. The dataset contains monthly non-stop domestic airline-route information on the origin, destination, monthly economy-class airfares and monthly number of passengers by routes and carriers, spanning from January 2005 to December 2016.[3] Based on the Statistical Data on Civil Aviation of China (CAAC, 2015), we selected 280 most heavily travelled routes with each carrying at least 300,000 passengers in 2014.[4] It must be noted that although there were 2,652 domestic air routes in 2014, these top 280 accounted for about two-thirds of the total traffic volume. We exclude all foreign airline tickets, first-class tickets, and any tickets that involve connecting points on any directional trip. Due to the incompleteness of route data in early periods, observations before April 2007 were dropped from the dataset. In line with

[3] The fares are for tickets actually purchased by economy-class passengers. They are extracted from the AirportIS database, which is constructed based on the reported information from IATA's Billing and Settlement Plan (BSP).
[4] The number of passengers is the sum of the movements of both directions of the route.

previous literature, routes carrying less than 300 passengers a month were removed from the dataset. The dataset contains 42 Chinese airlines.[5]

In our analysis, we treat each route direction as a separate market, which is consistent with the view held in the airline industry. For example, the flight number and the passenger demand from Beijing to Shanghai are different from those for the Shanghai to Beijing flight. Overall, the unbalanced panel dataset contains monthly data ranging from April 2007 to December 2016, with 270,187 carrier-route-month level observations. The unbalanced panel causes no problem if the missing data are not correlated with idiosyncratic errors (Wooldridge, 2006). It is quite common for airline literature to use unbalanced panel data as airlines frequently suspend or discontinue services on many routes, particularly tourism routes. Individual airline- and route-level fixed effects will be used to control for unobservables such as airlines' network construction and flight schedule decisions. Time fixed effects will be applied to control for seasonal factors that affect route entry and exit. Therefore, it is believed the missing data problem will not cause serious bias in this study. As both mergers occurred in the first half of 2010, the dataset contains a 3-year period before the mergers and a 6-year period after the mergers.

3.2 The model

Much literature has examined the price effects of a merger, for example, fare change rates (Kim and Singal, 1993), average price ratio changes (Barton and Sherman, 1984), and fare differences (Prager and Hannan, 1998; Vita and Sacher, 2001) before and after a merger. However, these studies largely ignored the permanent differences between the treatment group and the control group, which could be resolved with the difference-in-differences (DID) method. In the airline industry, the DID approach has been frequently used in previous research (Kwoka and Shumilina, 2010; Zhang, 2012; Fageda and Perdiguero, 2014; Aguzzoni et al., 2016; Shen, 2017). Our paper also uses the DID method to investigate the fare effects of the mergers. It should be noted that the main focus of this study is not to analyze competition behavior at the route level. Rather, we focus on the analysis of fare changes at the carrier level on routes served by at least one of the merger partners. Following Kwoka and Shumilkina (2010) and Le (2016), the basic model is given as follows.

$$\ln{(yield)_{ijt}} = \beta_0 + \beta_1 treat_{\mathrm{ij}} + \beta_2 Merger_t + \beta_3 Merger_t \times treat_{\mathrm{ij}} + Z_{ijt}\tau + X_{jt}\delta + \gamma_i + \varphi_j + v_t + \mu_{ijt}. \quad (1)$$

[5] The list of airlines contained in our sample is presented in Table A1 in Appendix A1.

In equation (1), subscripts i, j, and t represent specific airline, route and time, respectively. The vector Z_{ijt} contains carrier-route level control variables such as airline's market share on a specific route and variable NewMarket. The vector $\mathrm{X_{jt}}$ contains other route-level control variables such as population, GDP, distance, Herfindahl-Hirschman index (HHI), LCC, HSR, and tourism (Hurdle et al., 1989; Kim and Singal, 1993; Zhang and Round, 2009; Kwoka and Shumilkina, 2010; Fageda and Perdiguero, 2014).

The control variables included in the model are as follows.

- MarketShare (MKS), a carrier-route level variable, measured as the logarithm of market share of airline *i* on route *j* in time *t.* To address the endogeneity issue, the one-period-lagged value of the variable is used in the regression.
- NewMarket, a carrier-route level dummy variable that equals one when the merging airlines entered a new market (not served by the merging airlines in the pre-merger period) after the merger.
- lnDistance, measured as the logarithm of route distance, is expected to have a negative sign because our dependent variable is average airfare per kilometer (yield). The route distance data can be found in the *Statistical Data on Civil Aviation of China* (2015).
- lnPOP, a market-level variable measured as the logarithm of the geometric mean of city populations at the two endpoints of each route. The data of population are collected from the *Chinese City Statistical Yearbook* (2007-2016).[6]
- lnGDP, a market-level variable measured as the logarithm of the geometric mean of city GDP at the two endpoints of each route. The data of GDP are collected from the *Chinese City Statistical Yearbook* (2007-2016).
- Tourism, a market-level dummy variable, equals one for a tourist route. A tourist route is the one whose arrival destination is one of the top 30 Chinese cities with most developed tourism ranked by Forbes.
- HHI is the market-level HHI in logarithmic form measuring market concentration. It is computed based on quarterly passenger volume carried by each airline on a route. In the airline economics literature, HHI is widely used to measure market competition as a proxy of market power (Zhang et al., 2020).
- RivalNo is the number of non-merging rival airlines on route *j* at time *t*.

[6] We tried both registered population and total resident population data in the analysis. The results are highly consistent.

- LCC is a market-level dummy that takes the value of one if low-cost carriers (9C, 8L, AQ, PN, and KN) present on route j at time t. Its sign is expected to be negative.
- HSR is a market-level dummy variable that takes the value of one if direct high-speed rail (HSR) service is available on route j at time t. Its sign is expected to be negative since HSR is regarded as a substitute for air services.[7]
- $\gamma_i, \varphi_j,$ and v_t capture unobserved fix effects of airline, route, and time, respectively. μ_{ijt} is the error term.

The key objective of DID approach is the comparison between treatment group and control group. Before explaining our treatment and control groups, we first define two terms that we will use repeatedly in this section and throughout the rest of the paper. A product is defined at the carrier-route level as a combination of carrier, origin airport, and destination airport, representing the flight path a passenger could select to travel from his/her origin to destination on a specific carrier. A market is defined as a route connecting origin airport and destination airport which is independent of airlines. The treatment group in Model (1) is defined at the carrier-route level following Kwoka and Shumilkina (2010). The control group contains non-merging airline-route products that are not affected by either the MU-FM merger or the CA-ZH merger. Four types of products are included in the treatment group, namely, Overlap products, Potential products, Rival products, and Unrelated products. Table 1 gives the definitions of each type of products.[8]

Table 1 The definitions of each type of products in the treatment group

Products	Definition

[7] HSR ticket prices did not change over time in China during the study period. For example, the fare for a second-class HSR seat (analogous to an economy-class airline seat) from Beijing to Shanghai has been RMB 553 since its opening in 2011 until now. Therefore, we use the HSR dummy instead of the HSR fare in the model.

[8] Here are some examples to illustrate the concept of carrier-route level products. There were five airlines operating on the route "PEK (Beijing)-SHA (Shanghai)" in our dataset before the mergers. They were MU (China Eastern), FM (Shanghai Airlines), CA (Air China), CZ (China Southern), and HU (Hainan). Since both MU and FM operated on this route before the MU-FM merger, the *Overlap dummy* equals 1 for products "MU-PEK-SHA" and "FM-PEK-SHA" before and after the MU-FM merger. CA, CZ, HU were competing airlines on this route before the MU-FM merger. Therefore, the *Rival dummy* equals 1 for products "CA-PEK-SHA", "CZ-PEK-SHA" and "HU-PEK-SHA" before and after the MU-FM merger. As for the *Potential dummy*, FM operated on the route "XMN(Xiamen)-WUS(Wuxi)" before the MU-FM merger while MU was not present on this route, but operated at the two endpoints— "XMN" and "WUS". In this case, MU can potentially extend its service between "XMN" and "WUS". Therefore, MU was a potential entrant to FM on the route "XMN-WUS". Thus, the *Potential dummy* equals 1 for the product "FM-XMN-WUS". As for the *Unrelated dummy*, CA operated on the route "FOC(Fuzhou)-CSX(Changsha)" before the CA-ZH merger while ZH was not present on this route, norat the two endpoints—"FOC" or "CSX". In this case, the *Unrelated dummy* equals 1 for the product "CA-FOC-CSX". Therefore, our models focus on the carrier-route combinations and each combination only involves the airline included. We did not create route level dummies such as overlap route, potential route, and unrelated route dummies.

Overlap	An overlap product involves a route serviced by both Air China and Shenzhen Airlines before they merged, or by both China Eastern and Shanghai Airlines in the MU-FM case.
Potential	A potential product involves a route serviced by one of the merging airlines, with the other operating as a potential entrant serving one or both endpoints of the route.
Rival	A rival product refers to the situation where there was at least one non-merging firm, competing with one or two merging carriers before the merger.
Unrelated	An unrelated product is a route served by one of the merging airlines, with the other carrier being neither a potential nor an actual competitor.

The key focus of the DID approach is the interaction term of the dummy "Merger" and the dummy "Treatment products". The interaction term in Model (1) for Overlap products and merger dummy could be positive because competition is supposed to be lessened after the merger on the overlap routes, resulting in increased market power and prices. A merger would eliminate the potential entry and further result in higher prices, and thereby the interaction term in Model (1) for Potential products and merger dummy is expected to be positive. The interaction term in Model (1) for Rival products and merger dummy could have a positive or negative sign. A reduction in the number of competitors following the merger can facilitate collusive behaviors among airlines, giving the rival airline the chance to raise airfares. However, it could be the case where the merging parties are too dominant after the merger and the rival airlines could not afford to charge higher prices as they may lose market shares by doing so. The interaction term of the unrelated products and merger dummy is expected to be negative or insignificant due to the likely efficiency gains.

In Model (1), the dependent variable $\ln(yield)_{ijt}$ is defined at the carrier-route product level. which is the logarithm of average airfare per kilometer on route j served by carrier i in time period t. To control for inflation during the study period, this variable is adjusted by consumer price index (CPI). . The calculation of ticket prices by carrier and route, rather than the average for all carriers on a route, is designed to permit analysis of the effect on the merging carrier's pricing from the elimination of the other carrier as an actual competitor or potential competitor, and on the non-merging rival carriers' pricing behavior. $Merger_t$ is a dummy that equals 0 before the merger and equals 1 after the merger. The coefficient β_3 of the DID model captures the pure price effect caused by mergers.

Since our goal is to analyze and compare different price effects caused by the two mergers, Model (1) will be run separately for the MU-FM merger and the CA-ZH merger. Tables 2 and 3 show the descriptive statistics of the variables used in the empirical analysis.

Table 2 Descriptive statistics for the MU-FM merger affected markets

	Pre-merger				**Post-merger**			
Variable	**Mean**	**St. Dev.**	**Min**	**Max**	**Mean**	**St. Dev.**	**Min**	**Max**
Price (RMB)	727.83	259.94	200.10	2,118.30	834.47	301.32	151.80	2,904.90
Yield (RMB per km)	0.61	0.25	0.10	3.64	0.68	0.24	0.18	6.28
Distance (km)	1,127.50	520.80	254	3,278	1,150.41	516.44	254	3,278
Population (10,000)	801.37	396.86	77.43	2,338.16	836.15	407.68	80.00	2,417.08
GDP (billion RMB)	1,017.87	609.52	15.14	4,166.49	1,868.15	1,121.22	21.46	7,731.33
HHI	3,104.37	1,099.33	1,115.51	1,0000	3,810.49	1,291.38	1,425.48	10,000
MarketShare	0.30	0.21	0.004	1	0.22	0.17	0.0014	1
RivalNo	2.81	1.22	0	7	4.13	1.75	0	11
Overlap	0.09	0.29	0	1	0.06	0.25	0	1
Potential	0.13	0.33	0	1	0.09	0.28	0	1
Rival	0.57	0.50	0	1	0.45	0.50	0	1
Unrelated	-	-	-	-	-	-	-	-

Table 3 Descriptive statistics for the CA-ZH merger affected markets

	Pre-merger				**Post-merger**			
Variable	**Mean**	**St. Dev.**	**Min**	**Max**	**Mean**	**St. Dev.**	**Min**	**Max**
Price (RMB)	746.09	267.86	200.10	2,028.60	853.60	307.23	151.80	2,904.90
Yield (RMB per km)	0.62	0.25	0.08	3.64	0.69	0.25	0.18	6.28
Distance (km)	1,140.86	522.91	254	3,278	1,161.84	515.24	254	3,278
Population (10,000)	847.80	447.86	77.43	2,338.16	888.82	462.66	80.00	2,417.08
GDP (billion RMB)	1009.15	600.41	15.14	4,166.49	1,883.24	1,123.07	21.46	7,731.33
HHI	3,155.98	1,183.29	1,115.51	10,000	3,847.87	1,328.80	1,425.48	10,000
MarketShare	0.30	0.21	0.004	1	0.22	0.17	0.0014	1
RivalNo	2.82	1.22	0	7	4.16	1.76	0	11
Overlap	0.04	0.21	0	1	0.03	0.17	0	1
Potential	0.16	0.37	0	1	0.12	0.32	0	1
Rival	0.63	0.48	0	1	0.50	0.50	0	1
Unrelated	0.0005	0.02	0	1	-	-	-	-

4. Results

4.1 The results of the baseline model

We estimate the DID model using both random effects (RE) and fixed effects (FE) approaches. The Hausman test shows that the FE model should be adopted. But the random effects results are retained to illustrate the signs and coefficients of time-invariant variables such as route distance, tourism destination, NewMarket, etc. The results of our key variables remain robust no matter FE or RE is used. The time fixed effects (year and month dummies) are applied in all the regression specifications to control for common time trends and unobservable shocks throughout our sample period. Two methods are applied to deal with the endogeneity issue associated with the variable "HHI". In Column (3) we replace the HHI with its one-period-lagged value. In Column (4) the classical instrument introduced by Borenstein (1989) is used.[9] The estimation results are presented in Tables 4 and 5.

Table 4 The Estimation Results for the MU-FM Merger

	Dependent variable: lnYield			
Variables	(1) RE	(2) FE	(3) FE	(4) FE+IV
L.lnMKS	0.0058***	0.0075***	0.0078***	0.0065***
	(0.0008)	(0.0008)	(0.0008)	(0.0008)
Merger	-0.0293***	-0.0320***	-0.0289***	-0.0503***
	(0.0067)	(0.0067)	(0.0067)	(0.0069)
Overlap	0.0295*	-	-	-
	(0.0155)	(.)	(.)	(.)
Rival	-0.0236***	-	-	-
	(0.0087)	(.)	(.)	(.)
Potential	-0.0216*	-	-	-
	(0.0128)	(.)	(.)	(.)
NewMarket	0.0233	-	-	-
	(0.0221)	(.)	(.)	(.)
Merger*Overlap	0.0616***	0.0675***	0.0621***	0.0906***
	(0.0059)	(0.0059)	(0.0059)	(0.0062)
Merger*Rival	0.0749***	0.0779***	0.0750***	0.0983***
	(0.0053)	(0.0054)	(0.0053)	(0.0056)
Merger*Potential	0.0505***	0.0526***	0.0509***	0.0742***
	(0.0057)	(0.0057)	(0.0057)	(0.0060)

9 The instrument for route level HHI in Borenstein (1989) is the square of the fitted value of route market share (from its first-stage regression) plus the "rescaled" sum of the squares of all other carrier's shares.

RivalNo	-0.0317***	-0.0323***	-0.0306***	-0.0335***
	(0.0005)	(0.0005)	(0.0005)	(0.0005)
lnHHI	0.0231***	0.0178***		0.0043*
	(0.0023)	(0.0023)		(0.0023)
L.lnHHI			0.0344***	
			(0.0021)	
lnDistance	-0.4640***	-	-	-
	(0.0068)	(.)	(.)	(.)
lnPOP	-0.0322***	0.1029***	0.0940***	0.1222***
	(0.0059)	(0.0126)	(0.0126)	(0.0126)
lnGDP	0.0398***	0.0437***	0.0456***	0.0527***
	(0.0040)	(0.0048)	(0.0048)	(0.0048)
HSR	-0.0085***	-0.0069***	-0.0073***	-0.0071***
	(0.0016)	(0.0016)	(0.0016)	(0.0016)
LCC	-0.0090***	-0.0101***	-0.0096***	-0.0108***
	(0.0021)	(0.0022)	(0.0022)	(0.0022)
Tourism	-0.0208***	-	-	-
	(0.0076)	(.)	(.)	(.)
Constant	2.7488***	-1.3275***	-1.4252***	-1.3922***
	(0.0558)	(0.0842)	(0.0840)	(0.0845)
N	196020	196020	196020	194885
R^2	0.336	0.330	0.331	-

1. Cluster-robust standard errors in parentheses.
2. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$
3. To save space, the coefficients of year and month dummies and other control variables are not reported.

Table 5 The Estimation Results for the CA-ZH Merger

	Dependent variable: lnYield			
Variables	(1) RE	(2) FE	(3) FE	(4) FE+IV
L.lnMKS	0.0073***	0.0088***	0.0092***	0.0080***
	(0.0008)	(0.0008)	(0.0008)	(0.0008)
Merger	-0.0233***	-0.0250***	-0.0229***	-0.0435***
	(0.0057)	(0.0057)	(0.0057)	(0.0060)
Overlap	0.0283	-	-	-
	(0.0179)	(.)	(.)	(.)
Rival	0.0059	-	-	-
	(0.0085)	(.)	(.)	(.)
Potential	0.0143	-	-	-
	(0.0115)	(.)	(.)	(.)
NewMarket	-0.0121	-	-	-
	(0.0174)	(.)	(.)	(.)
Unrelated	-0.1207	-	-	-

	(0.1340)	(.)	(.)	(.)
Merger*Overlap	0.0734***	0.0709***	0.0658***	0.0913***
	(0.0066)	(0.0066)	(0.0066)	(0.0068)
Merger*Rival	0.0595***	0.0616***	0.0589***	0.0812***
	(0.0052)	(0.0052)	(0.0052)	(0.0055)
Merger*Potential	0.0679***	0.0694***	0.0667***	0.0885***
	(0.0055)	(0.0055)	(0.0055)	(0.0058)
RivalNo	-0.0296***	-0.0300***	-0.0292***	-0.0310***
	(0.0005)	(0.0005)	(0.0005)	(0.0005)
lnHHI	0.0441***	0.0397***		0.0285***
	(0.0022)	(0.0022)		(0.0023)
lnDistance	-0.4564***	-	-	-
	(0.0065)	(.)	(.)	(.)
lnPOP	-0.0398***	0.0754***	0.0672***	0.0911***
	(0.0056)	(0.0111)	(0.0111)	(0.0111)
lnGDP	0.0426***	0.0511***	0.0531***	0.0584***
	(0.0038)	(0.0046)	(0.0046)	(0.0047)
HSR	-0.0015	-0.0002	-0.0009	-0.0011
	(0.0015)	(0.0015)	(0.0015)	(0.0015)
LCC	-0.0088***	-0.0097***	-0.0091***	-0.0104***
	(0.0022)	(0.0022)	(0.0022)	(0.0022)
Tourism	-0.0161**	-	-	-
	(0.0074)	(.)	(.)	(.)
L.lnHHI			0.0530***	
			(0.0020)	
Constant	2.5417***	-1.3753***	-1.4481***	-1.4262***
	(0.0538)	(0.0754)	(0.0750)	(0.0756)
N	211447	211447	211447	209920
R^2	0.323	0.321	0.322	-

1. Cluster-robust standard errors in parentheses.
2. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
3. To save space, the coefficients of year and month dummies and other control variables are not reported.

As shown in Tables 4 and 5, the coefficients of Merger*Overlap are significantly positive, which implies that the mergers were positively associated with the yields for Overlap products. The coefficient of Merger*Potential is statistically significant in all four specifications with smaller magnitudes compared with the coefficients of Merger*Overlap, which is consistent with previous studies such as Borenstein (1990), Kwoka and Shumilkina (2010), and Fageda and Perdiguero (2014). For years China Eastern had cut-throat competition with Shanghai Airlines and Air China in the key markets such as the Beijing-Shanghai route (Zhang, 2015;

Ho et al., 2018). The merger can mitigate competition by eliminating an effective competitor. At the route level, it would be easier for them to engage in collusion with a smaller number of airlines after the merger. In fact, Chinese carriers have a tradition of holding periodic negotiations to prevent price wars (Zhang and Round, 2011). Ho at al. (2018) found that the announcement of the merger between China Eastern and Shanghai Airlines led to the rise of the stock prices of Air China, suggesting potential market power gains for the rival airlines. As such implications will be fully understood by investors, rival firms' stock prices will be bid up in the anticipation of higher profits in the affected market (Hosken and Simpson, 2001).

Lastly, the coefficients of Merger*Rival in both tables are significantly positive. However, the Rival products in the MU-FM case may contain products that could be affected by the CA-ZH merger and this may also be the case for the Rival products in the CA-ZH merger. In other words, the Rival results can be contaminated since the carrier-route observations from the other merger exist in the rival groups. As a result, the magnitude of the Rival product coefficient could be over-estimated. For instance, on the Beijing (PEK)-Shanghai (SHA) route, the Rival product "CZ-PEK-SHA" of the MU-FM merger is also the Rival product of the CA-ZH merger. In this case, it is not certain which merger caused the price change for the Rival product "CZ-PEK-SHA". To obtain the pure price effect of the Rival products, we conduct a robustness test by removing the CA-ZH products from MU-FM's Rival products and removing the MU-FM products from CA-ZH's Rival products. The results are shown in Tables 6 and 7.

Table 6 The Estimation Results for the MU-FM Merger with the New Rival Group

	Dependent variable: lnYield			
Variables	(1) RE	(2) FE	(3) FE	(4) FE+IV
L.lnMKS	0.0037***	0.0056***	0.0058***	0.0045***
	(0.0009)	(0.0009)	(0.0009)	(0.0009)
Merger	-0.0202***	-0.0231***	-0.0203***	-0.0417***
	(0.0071)	(0.0071)	(0.0071)	(0.0073)
Overlap	0.0290*	-	-	-
	(0.0156)	(.)	(.)	(.)
Rival	-0.0315***	-	-	-
	(0.0093)	(.)	(.)	(.)
Potential	-0.0213*	-	-	-
	(0.0129)	(.)	(.)	(.)
NewMarket	0.0226	-	-	-
	(0.0223)	(.)	(.)	(.)
Merger*Overlap	0.0605***	0.0663***	0.0616***	0.0902***

	(0.0060)	(0.0060)	(0.0060)	(0.0063)
Merger*Rival	0.0697***	0.0729***	0.0706***	0.0937***
	(0.0054)	(0.0055)	(0.0054)	(0.0057)
Merger*Potential	0.0503***	0.0524***	0.0509***	0.0742***
	(0.0058)	(0.0058)	(0.0058)	(0.0061)
RivalNo	-0.0311***	-0.0318***	-0.0305***	-0.0332***
	(0.0006)	(0.0006)	(0.0005)	(0.0006)
lnHHI	0.0257***	0.0208***		0.0059**
	(0.0025)	(0.0025)		(0.0026)
lnDistance	-0.4651***	-	-	-
	(0.0073)	(.)	(.)	(.)
lnPOP	-0.0374***	0.0978***	0.0904***	0.1215***
	(0.0064)	(0.0144)	(0.0144)	(0.0144)
lnGDP	0.0421***	0.0463***	0.0481***	0.0565***
	(0.0044)	(0.0052)	(0.0052)	(0.0052)
HSR	-0.0111***	-0.0095***	-0.0099***	-0.0097***
	(0.0017)	(0.0017)	(0.0017)	(0.0017)
LCC	-0.0063***	-0.0063***	-0.0055**	-0.0073***
	(0.0023)	(0.0024)	(0.0024)	(0.0024)
Tourism	-0.0209**	-	-	-
	(0.0081)	(.)	(.)	(.)
L.lnHHI			0.0353***	
			(0.0023)	
Constant	2.7513***	-1.3363***	-1.4241***	-1.4233***
	(0.0601)	(0.0954)	(0.0951)	(0.0958)
N	168999	168999	168999	167865
R^2	0.330	0.339	0.340	-

1. Cluster-robust standard errors in parentheses.
2. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
3. To save space, the coefficients of year and month dummies and other control variables are not reported.

Table 7 The Estimation Results for the CA-ZH Merger with the New Rival Group

	Dependent variable: lnYield			
Variables	(1) RE	(2) FE	(3) FE	(4) FE+IV
L.lnMKS	0.0115***	0.0133***	0.0143***	0.0127***
	(0.0009)	(0.0009)	(0.0009)	(0.0009)
Merger	-0.0228***	-0.0245***	-0.0221***	-0.0424***
	(0.0059)	(0.0059)	(0.0059)	(0.0061)
Overlap	0.0264	-	-	-
	(0.0182)	(.)	(.)	(.)
Rival	0.0014	-	-	-

	(0.0090)	(.)	(.)	(.)
Potential	0.0106	-	-	-
	(0.0117)	(.)	(.)	(.)
NewMarket	-0.0138	-	-	-
	(0.0178)	(.)	(.)	(.)
Unrelated	-0.1261	-	-	-
	(0.1368)	(.)	(.)	(.)
Merger*Overlap	0.0715***	0.0688***	0.0628***	0.0891***
	(0.0067)	(0.0067)	(0.0067)	(0.0069)
Merger*Rival	0.0595***	0.0618***	0.0588***	0.0805***
	(0.0053)	(0.0053)	(0.0053)	(0.0056)
Merger*Potential	0.0668***	0.0689***	0.0657***	0.0879***
	(0.0055)	(0.0056)	(0.0056)	(0.0058)
RivalNo	-0.0293***	-0.0298***	-0.0288***	-0.0306***
	(0.0006)	(0.0006)	(0.0005)	(0.0006)
lnHHI	0.0475***	0.0422***		0.0328***
	(0.0024)	(0.0025)		(0.0025)
lnDistance	-0.4529***	-	-	-
	(0.0070)	(.)	(.)	(.)
lnPOP	-0.0379***	0.0975***	0.0868***	0.1034***
	(0.0060)	(0.0120)	(0.0120)	(0.0120)
lnGDP	0.0433***	0.0587***	0.0604***	0.0649***
	(0.0041)	(0.0051)	(0.0051)	(0.0051)
HSR	0.0015	0.0031*	0.0025	0.0022
	(0.0017)	(0.0017)	(0.0017)	(0.0017)
LCC	-0.0127***	-0.0132***	-0.0127***	-0.0141***
	(0.0025)	(0.0026)	(0.0026)	(0.0027)
Tourism	-0.0184**	-	-	-
	(0.0080)	(.)	(.)	(.)
L.lnHHI			0.0579***	
			(0.0023)	
Constant	2.4902***	-1.5748***	-1.6493***	-1.5703***
	(0.0583)	(0.0812)	(0.0808)	(0.0814)
N	180014	180014	180014	178654
R^2	0.323	0.318	0.320	-

1. Cluster-robust standard errors in parentheses.
2. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
3. To save space, the coefficients of year and month dummies and other control variables are not reported.

Consistent with our expectation, the coefficient magnitudes of the Rival product become slightly smaller in Tables 6 and 7. The price change of the Rival products in the MU-FM merger was larger than that in the CA-ZH merger. These results have anti-competitive implications.

When merging firms are able to raise prices through collusion or dominant firm status after the merger, rival firms will also benefit from the merger. It appears that the rival airlines have gained a certain degree of market power after the mergers through easier price collusion resulting from higher concentration. Due to the overlapping nature of the MU-FM merger, it seems that the merging parties' rival airlines also enjoyed higher market power than CA-ZH's rivals.

We now look at the results for the control variables. First, the coefficients of NewMarket in both Tables 6 and 7 are statistically insignificant. This means that when the merged airlines entered new markets after the mergers, they did not seem to be able to charge higher prices for the new services. Second, the coefficients of the distance variable are negative and statistically significant in all the regressions for both mergers, suggesting that the yield decreases as distance increases due to the well-known distance effect. Third, the coefficients of the tourism dummy are statistically negative in the RE models for both mergers. This finding is not unexpected since a large proportion of the tourists tend to be price sensitive. Fourth, the variable of population is significantly positive in the FE models. The impact of population on fares could be twofold. On one hand, it picks up the demand effect. That is, higher population implies higher air travel demand, resulting in higher airfares in the relevant markets. On the other hand, it can pick up the supply effect. Larger market size can result in economies of density and drives down costs and hence fares in the airline industry. The results of the population variable show that the demand effect dominates. Fifth, the coefficients associated with the LCC dummy are negative and statistically significant in all cases, implying that the presence of LCCs on a route can lead to a reduction in fares. The result is consistent with previous LCC literature (Fageda and Perdiguero, 2014; Luo, 2014; Huschelrath and Muller, 2014; Zhang et al., 2014, 2017; Fu et al., 2015). Sixth, the coefficient of GDP is positive which is reasonable that airfare increases as the national income grows. Lastly, in both mergers, the coefficients of route HHI are consistently positive and significant, which suggests that increased market concentration due to the mergers are associated with higher product prices. The HHI has been commonly used as a proxy for competition (Lijesen, 2004; Choo et al., 2018; Manuela et al., 2019). The results of route HHI show that the increased market concentration as a result of the merger can be one of the sources of market power in China's airline market. The market share variable's coefficient is positive and significant, implying that a rise in market share as a result of the merger can lead to increased unilateral market power and higher prices at the carrier-route, or product level.

4.2 The impact of HSR

One noteworthy result is the coefficients of HSR in both merger cases. The sign of HSR in the MU-FM merger is negative with small magnitudes and the sign of HSR in the CA-ZH merger is positive or insignificant. Since HSR is considered as a strong substitute for airlines, competition should be enhanced on air routes with parallel HSR services and thus airfares should be significantly reduced. To further investigate the impact of HSR, we add an interaction term of HSR and the number of quarters after HSR entered each of the airline markets into Model (1). This allows us to understand how HSR impacted airfares over time. The results are shown in Tables 8 and 9.

Table 8 The Estimation Results of the MU-FM Merger with HSR Lag Effects

	Dependent variable: lnYield			
Variables	(1) RE	(2) FE	(3) FE	(4) FE+IV
L.lnMKS	0.0037***	0.0056***	0.0057***	0.0044***
	(0.0009)	(0.0009)	(0.0009)	(0.0009)
Merger	-0.0181***	-0.0215***	-0.0188***	-0.0401***
	(0.0070)	(0.0071)	(0.0071)	(0.0073)
Overlap	0.0268*	-	-	-
	(0.0156)	(.)	(.)	(.)
Rival	-0.0328***	-	-	-
	(0.0093)	(.)	(.)	(.)
Potential	-0.0224*	-	-	-
	(0.0128)	(.)	(.)	(.)
NewMarket	0.0227	-	-	-
	(0.0223)	(.)	(.)	(.)
Merger*Overlap	0.0590***	0.0657***	0.0610***	0.0897***
	(0.0060)	(0.0060)	(0.0060)	(0.0063)
Merger*Rival	0.0694***	0.0731***	0.0708***	0.0940***
	(0.0054)	(0.0054)	(0.0054)	(0.0057)
Merger*Potential	0.0488***	0.0513***	0.0498***	0.0732***
	(0.0057)	(0.0058)	(0.0058)	(0.0060)
RivalNo	-0.0306***	-0.0313***	-0.0300***	-0.0327***
	(0.0006)	(0.0006)	(0.0005)	(0.0006)
lnHHI	0.0243***	0.0192***		0.0042*
	(0.0025)	(0.0025)		(0.0026)
lnDistance	-0.4659***	-	-	-
	(0.0073)	(.)	(.)	(.)
lnPOP	-0.0377***	0.1159***	0.1085***	0.1400***
	(0.0064)	(0.0144)	(0.0144)	(0.0144)
lnGDP	0.0441***	0.0518***	0.0535***	0.0622***
	(0.0044)	(0.0052)	(0.0052)	(0.0052)

HSR	-0.0485***	-0.0474***	-0.0474***	-0.0482***
	(0.0023)	(0.0023)	(0.0023)	(0.0023)
HSR*Quarter	0.0069***	0.0071***	0.0070***	0.0072***
	(0.0003)	(0.0003)	(0.0003)	(0.0003)
LCC	-0.0059***	-0.0061***	-0.0053**	-0.0071***
	(0.0023)	(0.0024)	(0.0024)	(0.0024)
Tourism	-0.0244***	-	-	-
	(0.0081)	(.)	(.)	(.)
L.lnHHI			0.0335***	
			(0.0023)	
Constant	2.7624***	-1.4716***	-1.5568***	-1.5621***
	(0.0600)	(0.0954)	(0.0951)	(0.0957)
N	168999	168999	168999	167865
R^2	0.345	0.342	0.342	-

1. Cluster-robust standard errors in parentheses.
2. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
3. To save space, the coefficients of year and month dummies and other control variables are not reported.

Table 9 The Estimation Results of the CA-ZH Merger with HSR Lag Effects

	Dependent variable: lnYield			
Variables	(1) RE	(2) FE	(3) FE	(4) IV
L.lnMKS	0.0117***	0.0135***	0.0144***	0.0128***
	(0.0009)	(0.0009)	(0.0009)	(0.0009)
Merger	-0.0204***	-0.0224***	-0.0201***	-0.0404***
	(0.0059)	(0.0059)	(0.0059)	(0.0061)
Overlap	0.0237	-	-	-
	(0.0182)	(.)	(.)	(.)
Rival	0.0003	-	-	-
	(0.0090)	(.)	(.)	(.)
Potential	0.0097	-	-	-
	(0.0117)	(.)	(.)	(.)
NewMarket	-0.0163	-	-	-
	(0.0178)	(.)	(.)	(.)
Unrelated	-0.1279	-	-	-
	(0.1366)	(.)	(.)	(.)
Merger*Overlap	0.0704***	0.0672***	0.0614***	0.0877***
	(0.0067)	(0.0067)	(0.0067)	(0.0069)
Merger*Rival	0.0590***	0.0616***	0.0587***	0.0804***
	(0.0052)	(0.0053)	(0.0053)	(0.0055)
Merger*Potential	0.0644***	0.0667***	0.0636***	0.0859***
	(0.0055)	(0.0056)	(0.0055)	(0.0058)
RivalNo	-0.0284***	-0.0289***	-0.0279***	-0.0296***

	(0.0006)	(0.0006)	(0.0005)	(0.0006)
lnHHI	0.0473***	0.0417***		0.0321***
	(0.0024)	(0.0025)		(0.0025)
lnDistance	-0.4538***	-	-	-
	(0.0070)	(.)	(.)	(.)
lnPOP	-0.0383***	0.1169***	0.1063***	0.1231***
	(0.0060)	(0.0120)	(0.0120)	(0.0120)
lnGDP	0.0466***	0.0674***	0.0690***	0.0739***
	(0.0041)	(0.0051)	(0.0050)	(0.0051)
HSR	-0.0400***	-0.0396***	-0.0397***	-0.0410***
	(0.0022)	(0.0022)	(0.0022)	(0.0022)
HSR*Quarter	0.0078***	0.0081***	0.0080***	0.0082***
	(0.0003)	(0.0003)	(0.0003)	(0.0003)
LCC	-0.0115***	-0.0119***	-0.0114***	-0.0128***
	(0.0025)	(0.0026)	(0.0026)	(0.0026)
Tourism	-0.0231***	-	-	-
	(0.0079)	(.)	(.)	(.)
L.lnHHI			0.0568***	
			(0.0023)	
Constant	2.4855***	-1.7475***	-1.8169***	-1.7448***
	(0.0582)	(0.0812)	(0.0808)	(0.0814)
N	180014	180014	180014	178654
R^2	0.320	0.322	0.323	-

1. Cluster-robust standard errors in parentheses.
2. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
3. To save space, the coefficients of year and month dummies and other control variables are not reported.

All the variables except for HSR are consistent with Tables 6 and 7. It can be seen that the HSR entry resulted in a significant reduction in fares. However, the interaction term HSR*Quarter is significantly positive although the magnitude is relatively small, meaning that as time elapsed, the negative impact of HSR on airfare would gradually weaken. When HSR first entered the markets parallel to airline services, it posed a strong competitive pressure on air travel demand, pushing leftward the demand curve. However, over time, airlines could respond to the entry of HSR by developing new strategies such as reducing frequency and capacity, and charging higher prices to price-insensitive passengers as HSR may not be a good substitute to these passengers. For example, the capacity on the Beijing-Ningbo route decreased by 38% two years after the entry of HSR. These adjustments could shift the supply curve to the left and help limit the further decline of the equilibrium price.

In addition, Zhang (2011) noted that with the opening of HSR between Beijing and Shanghai, major airlines on this route closely monitored the bookings and adjusted the airfares accordingly to maintain a certain level of load factor. This means that immediately after the opening of HSR services, airlines were unlikely to charge higher prices. However, while HSR poses a threat to air transport along some routes, it can also be used to provide feeding services to long-haul air services in hub airports, particularly in hub airports with HSR stations (Albalate et al., 2015). China Eastern introduced the air-rail service in 2012, which allowed passengers living in nearby cities such as Hangzhou, Suzhou, and Wuxi to use HSR to and from Shanghai Hongqiao airport. The air-rail service was extended to China Eastern's other hub airports such as Wuhan in 2014. Air China has followed suit and introduced the air-rail service at the airports of Shanghai and Chengdu in the last few years. Since 2013, Spring Airlines has been reimbursing Beijing passengers flying to/from Shijiazhuang airport (the airline's hub) for their round-trip HSR tickets between Beijing and Shijiazhuang (Xia et al., 2018). In 2017, the Director of CAAC announced that some flights from the second- and third-tier cities to Beijing would be shifted to Tianjin and Shijiazhuang in the future and these airports will be linked to Beijing via HSR. In May 2018, China Railway Corporation and CAAC signed a strategic cooperation agreement on advancing air-rail intermodal transport. With deeper integration between air and rail services, the threat of HSR to airlines diminishes.[10]

4.3 Disentangling two mergers' effects

Since the two mergers took place in the same year, it might be difficult to disentangle the pure impacts of each merger. Therefore, in the previous analysis, we interpreted the results with caution to avoid over-stating the causal effects. In this section, we further tried other measures as a robustness test to disentangle the effects of the two mergers, following the method used in Vaze et al. (2017). Specifically, we separate each type of products by creating two dummies. For example, the dummy variable "Overlap" is divided into "Overlap_own" and "Overlap_common". "Overlap_own" refers to the Overlap products provided by the airline(s) from one of the two merging groups, and "Overlap_common" refers to the Overlap products jointly provided by airlines from both merging groups. The dummies of "Potential" and "Rival" products are treated in the same way. We use the Beijing (PEK)-Shanghai (SHA) route as an example to explain this treatment. "PEK-SHA" was served by CA, MU, and FM before the merger. Therefore, the products "CZ-PEK-SHA" and "HU-PEK-SHA" were regarded as both

[10] The improvement in air service quality in response to the HSR entry could be a significant factor that led to price increase. Fu et al. (2018) reported that HSR competition in China indeed reduces flight delays. Specifically, on the short-haul routes within a 2-hour HSR ride, the average delay time of airlines decreases by 6.71%. On the medium-to-long-haul routes with 2 to 5-hour HSR ride, airline delay time on average decreases by 3.32%. Unfortunately, due to the data unavailability constraints, we are unable to include a service quality variable in our model, which is a limitation of this study.

CA-ZH and MU-FM mergers' rivals in our previous analysis. In the new robustness test, these products which are both CA-ZH and MU-FM mergers' rivals are labeled as "Rival_common". Also note that the control groups contain non-merging carriers on the routes not affected by either the CA-ZH merger or the MU-FM merger. We rerun the DID model with the interaction terms of the mergers and the new product dummies. By reconstructing our treatment groups by dividing the products into two categories: one only relevant to one merger; and one related with both mergers, we are able to disentangle the impacts of the two mergers. The results are shown in Tables 10 and 11.

Table 10 The Robustness Test Results of the MU-FM Merger

	Dependent variable: lnYield	
Variables	(1) RE	(2) FE
L.lnMKS	0.0067***	0.0084***
	(0.0008)	(0.0008)
NewMarket	0.0302	-
	(0.0219)	(.)
RivalNo	-0.0290***	-0.0293***
	(0.0005)	(0.0005)
Merger	-0.0244***	-0.0271***
	(0.0062)	(0.0063)
Overlap_own	0.0339	-
	(0.0416)	(.)
Overlap_common	0.0370	-
	(0.0561)	(.)
Rival_own	-0.0137	-
	(0.0398)	(.)
Rival_common	-0.0113	-
	(0.0397)	(.)
Potential_own	-0.0315	-
	(0.0451)	(.)
Potential_common	-0.0012	-
	(0.0409)	(.)
Overlap_own*Merger	0.0409***	0.0469***
	(0.0054)	(0.0055)
Overlap_common*Merger	0.1840***	0.1886***
	(0.0095)	(0.0095)
Rival_own*Merger	0.0636***	0.0668***
	(0.0049)	(0.0050)
Rival_common*Merger	0.0796***	0.0823***
	(0.0048)	(0.0049)

Potential_own*Merger	0.0245***	0.0277***
	(0.0067)	(0.0067)
Potential_common*Merger	0.0552***	0.0571***
	(0.0053)	(0.0053)
L.lnHHI	0.0352***	0.0322***
	(0.0021)	(0.0021)
lnDistance	-0.4642***	-
	(0.0066)	(.)
lnPOP	0.0235***	0.0948***
	(0.0063)	(0.0150)
lnGDP	0.0228***	0.0469***
	(0.0037)	(0.0048)
HSR	-0.0535***	-0.0522***
	(0.0020)	(0.0020)
HSR*Quarter	0.0080***	0.0082***
	(0.0002)	(0.0002)
LCC	-0.0104***	-0.0096***
	(0.0021)	(0.0021)
Tourism	-0.0323***	-
	(0.0074)	(.)
Constant	2.3929***	-1.4382***
	(0.0697)	(0.1003)
R^2	0.569	0.336

1. Cluster-robust standard errors in parentheses.
2. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
3. To save space, the coefficients of year and month dummies and other control variables are not reported.

Table 11 The Robustness Test Results of the CA-ZH Merger

	Dependent variable: lnYield	
Variables	(1) RE	(2) FE
L.lnMKS	0.0072***	0.0089***
	(0.0008)	(0.0008)
NewMarket	-0.0146	-
	(0.0175)	(.)
RivalNo	-0.0276***	-0.0279***
	(0.0005)	(0.0005)
Unrelated	-0.1102	-
	(0.1379)	(.)
Merger	-0.0231***	-0.0248***
	(0.0052)	(0.0052)
Overlap_own	0.0059	-

	(0.0380)	(.)
Overlap_common	0.0091	-
	(0.0539)	(.)
Rival_own	-0.0031	-
	(0.0342)	(.)
Rival_common	-0.0345	-
	(0.0341)	(.)
Potential_own	0.0186	-
	(0.0365)	(.)
Potential_common	-0.0310	-
	(0.0355)	(.)
Overlap_own*Merger	0.0604***	0.0613***
	(0.0065)	(0.0065)
Overlap_common*Merger	0.1201***	0.1248***
	(0.0108)	(0.0108)
Rival_own*Merger	0.0478***	0.0495***
	(0.0048)	(0.0048)
Rival_common*Merger	0.0717***	0.0738***
	(0.0047)	(0.0048)
Potential_own*Merger	0.0411***	0.0428***
	(0.0055)	(0.0055)
Potential_common*Merger	0.0842***	0.0860***
	(0.0052)	(0.0053)
L.lnHHI	0.0543***	0.0523***
	(0.0020)	(0.0020)
lnDistance	-0.4602***	-
	(0.0064)	(.)
lnPOP	0.0070	0.0603***
	(0.0057)	(0.0131)
lnGDP	0.0300***	0.0628***
	(0.0035)	(0.0046)
HSR	-0.0418***	-0.0406***
	(0.0020)	(0.0020)
HSR*Quarter	0.0072***	0.0074***
	(0.0002)	(0.0002)
LCC	-0.0086***	-0.0066***
	(0.0022)	(0.0022)
Tourism	-0.0319***	-
	(0.0073)	(.)
Constant	2.2954***	-1.4729***
	(0.0645)	(0.0895)
R^2	0.570	0.326

1. Cluster-robust standard errors in parentheses.
2. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
3. To save space, the coefficients of year and month dummies and other control variables are not reported.

The results in Tables 10 and 11 are generally consistent with other tables. It is worth noting that the coefficients of the interaction terms only relevant to one merger are smaller than those associated with two mergers. This makes sense as for the products associated with both mergers, two primary competitors rather than one were eliminated in the post-merger period, which would cause more severe anti-competitive effect and higher carrier-route airfares. For the products associated with only one merger, the results show that the MU-FM merger alone could cause a rise in prices by 4.7%, 6.7% and 2.8% for the Overlap, Rival and Potential products, respectively. In contrast, the CA-ZH merger alone could result in an increase in fares by 6.1%, 5.0% and 4.3%, respectively for each of the three products. As there was a large number of Potential products on the non-overlap routes in the CA-ZH merger, eliminating the potential competitors on these routes is found to have caused a greater rise in prices than in the case of MU and FM. This result again confirms our previous finding that the CA-ZH merger had anti-competitive effects despite its complementary nature. All other control variables remain robust and consistent with those in previous tables.

4.4 Lag effect of mergers

Another issue that needs to be considered is that the magnitudes of the price effect caused by mergers might change over time. There are some papers comparing the short-term and long-term effects of mergers in the US airline market (Morrison, 1996; Huschelrath and Muller, 2014). It would be interesting to investigate airline pricing patterns following the mergers in the Chinese airline market. We further analyze the lag effects of the two mergers by incorporating interaction terms of post-merger year dummies and product type dummies in our model. Airline-route fixed effects and time fixed effects are controlled for in the regressions. The trends are presented in Figures 1 and 2.

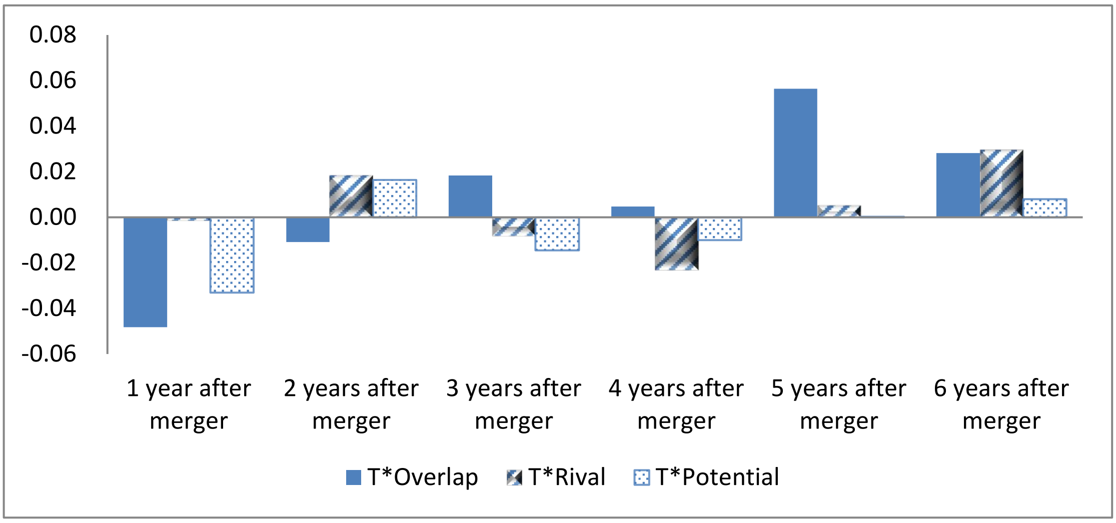

Figure 1 Coefficients of T*Overlap, T*Rival, and T*Potential in the MU-FM merger

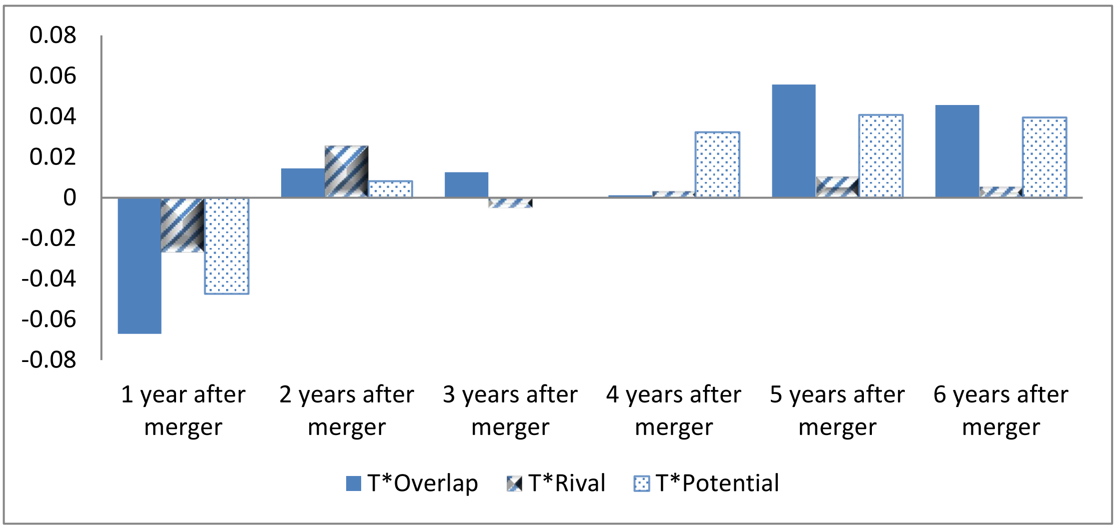

Figure 2 Coefficients of T*Overlap, T*Rival, and T*Potential in the CA-ZH merger

Figures 1 and 2 show that in the first two years after the mergers, airfares of most of the merger-affected products decreased, suggesting the merged parties and their rival carriers did not exercise any significant market power immediately after mergers. However, the prices of various carrier-route products in both mergers began to rise three years after the mergers. The longer the time that has elapsed since the mergers, the larger the magnitudes of the price increases, particularly for the Overlap products in the MU-FM merger. The CA-ZH merger roughly followed the same pattern, despite its complementary nature. In the antitrust analysis of airline consolidation, it is widely acknowledged that a complementary merger enables partners to attract more passengers by improving their connecting services and decreasing fares for connecting services. New demands can be created or taken from the existing connecting passengers of rival airlines. In contrast, parallel mergers are likely to decrease total output and increase fares and have significant anticompetitive implications (Oum et al., 2000; Yan et al., 2016). However, our results suggest the two different types of mergers in China generated similar results. That is, both mergers resulted in a reduction in fares initially and then a rise in prices two years later. Our results are in line with Zou et al. (2011), who empirically found that airline alliances allow airlines to charge higher prices on complementary routes.

As a complement to the above reported results, we will now examine how the merging airlines exercised market power in the years following the mergers and check whether the trend is consistent with those reported in Figures 1 and 2. Market power can be measured by the Lerner index (Lerner, 1934; Choo et al., 2018; Manuela et al., 2019). HHI has been used to proxy market power (Zhang et al., 2020). However, Borenstein et al. (1999) and Li et al. (2019) pointed out that concentration measures correlate to market power only under certain market conditions and the more direct way to assess market power is to use the Lerner index. We therefore calculate the Lerner index of Air China and China Eastern on a yearly basis for the period 2007-2016.[11]

The Lerner index is defined as:

$$L_{ijt} = (P_{ijt} - MC_{ijt})/P_{ijt}, \tag{2}$$

where L_{ijt} is the Lerner index of carrier i on route j in time period t, P_{ijt} is the per-passenger price of airline i on route j in period t, and MC_{ijt} is the corresponding marginal cost. The larger values of L_{ijt} indicate stronger market power of firm i on route j in period t.

To calculate the route-specific marginal cost, we follow the methodology proposed by Brander and Zhang (1990, 1993), and subsequently used in Zhang et al. (2013, 2014).

$$MC_{ijt} = CPK_{it}(D_j/AFL_{it})^{-\theta} D_j, \tag{3}$$

where D_j is the distance of route j, AFL_{it} is the average distance flown by carrier i in period t, CPK_{it} is the cost per passenger-kilometer of carrier i in period t, and θ is an unknown parameter in the cost function that ranges from 0 to 1. Zhang et al. (2014) estimated the value of θ using the data from China's airline industry and suggest that θ is around 0.4, a value that is very close to that reported in Oum et al. (1993) and Murakami (2011). Following the method used in Zhang et al. (2014), the value of θ calculated using our sample is 0.49.[12] The annual

[11] Owing to the unavailability of the financial data and operating cost data for Shanghai Airlines and Shenzhen Airlines, Lerner indices are only calculated for Air China and China Eastern, the two acquiring carriers.
[12] Please refer to the appendix for the details of the estimation methodology.

financial reports of Air China and China Eastern are used to gather relevant data to calculate CPK_{it} and AFL_{it}. The average values of Lerner indices for Air China and China Eastern are shown in Figure 3. The average values of Lerner indices for Overlap and Potential products of China Eastern and Air China are shown in Figures 4 and 5.

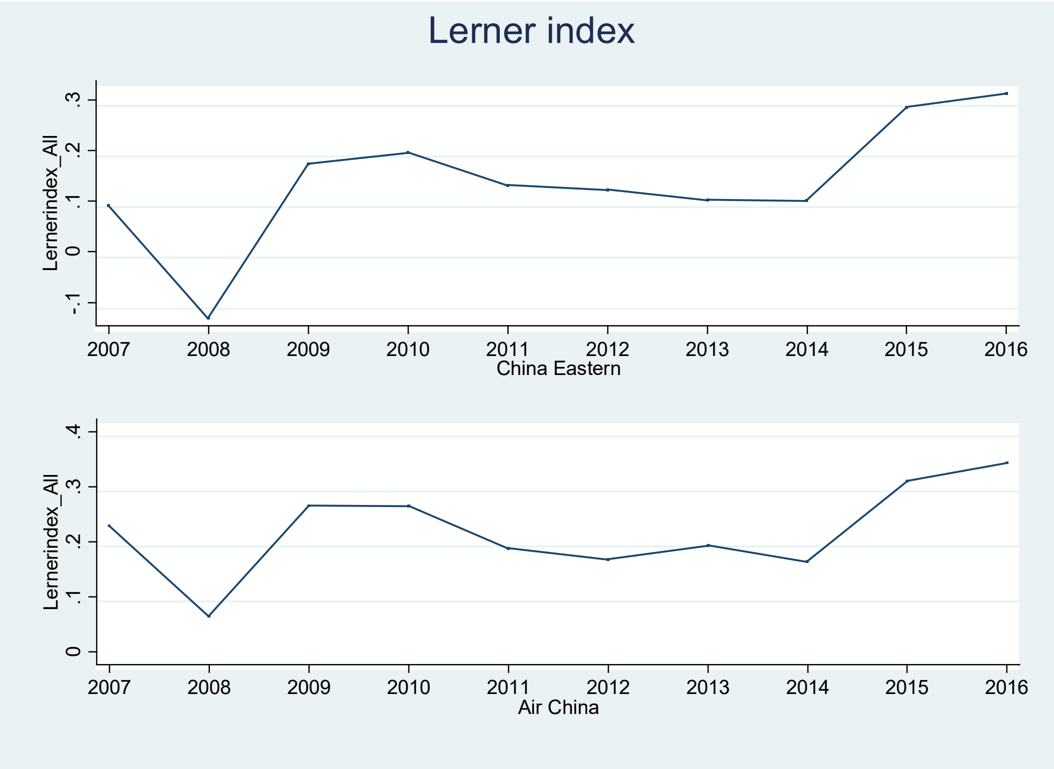

Figure 3 Lerner indices of China Eastern and Air China

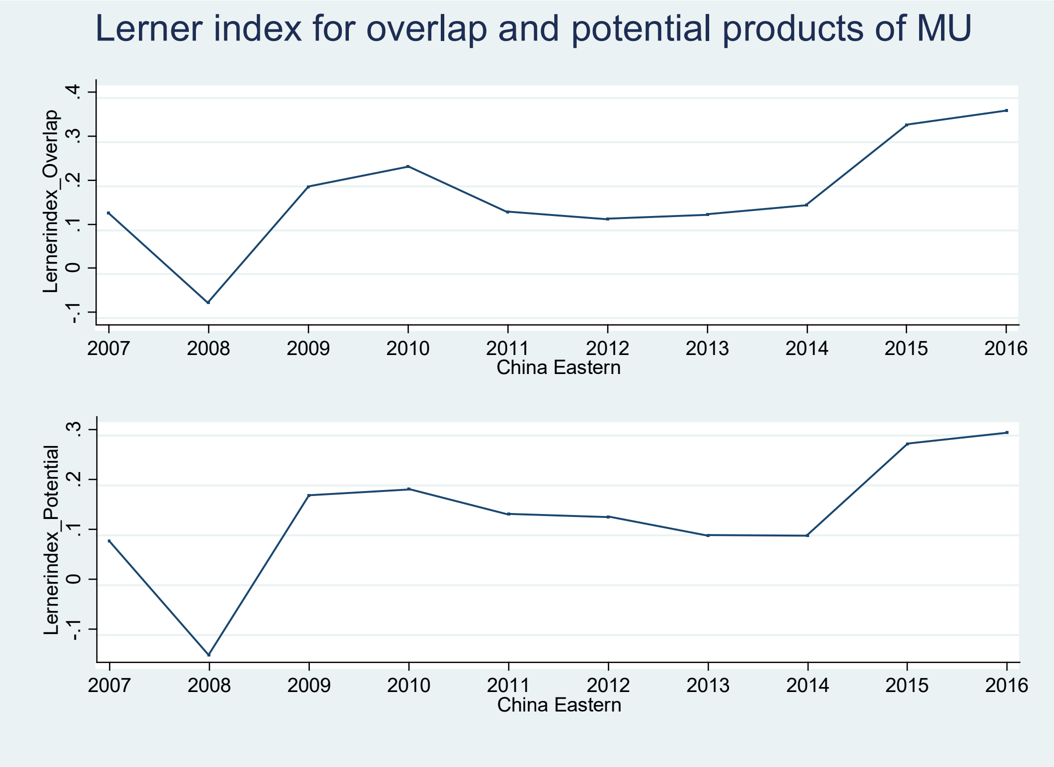

Figure 4 Lerner indices for Overlap and Potential products of MU

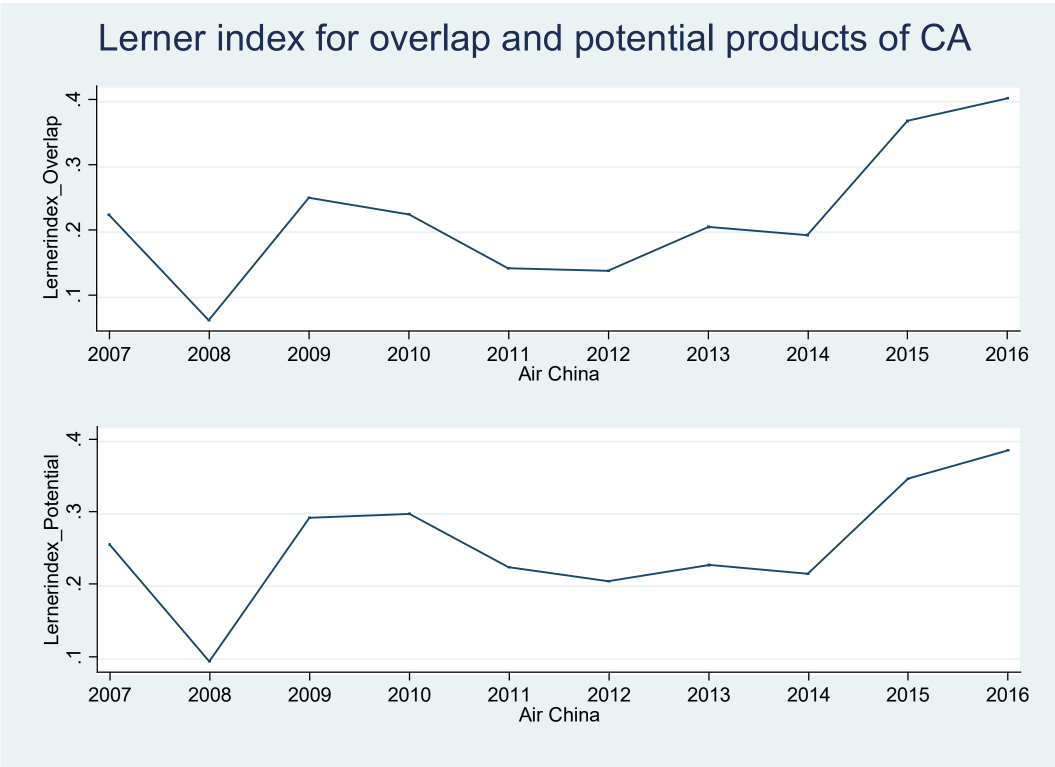

Figure 5 Lerner indices for Overlap and Potential products of CA

It can be seen in Figure 3 that the Lerner indices of both China Eastern and Air China exhibit a rising trend after a fall since the mergers occurred. The Lerner index values were larger in the long term, indicating that substantial market power might not have arisen shortly after the merger. Rather, market power only started to build up a few years after the merger. As can be seen from Figures 4 and 5, the Lerner indices of the Overlap products and Potential products also decreased first and then increased. The increase of Overlap products is slightly larger than that of Potential products, which is consistent with the regression results. The patterns of the Lerner indices are also consistent with the findings presented in Figures 1 and 2, which further confirm that market power gradually emerged in the long term rather than immediately after the mergers.

It appears that the long-run post-merger pricing behavior in the Chinese market is quite different from what has been observed in the US market. Huschelrath and Muller (2015) found that in the long term, the price increased by about 3% on the routes affected by the Delta-Northwest merger compared with 11% in the short term. They concluded that post-merger entry by competitors might have led to a downward trend in the ticket price in the long run.

Unlike the Delta-Northwest merger, Air China and China Eastern did not experience significant price rises shortly after the mergers. Zhang and Zhang (2017) found that there was no significant improvement in operating efficiency for the period 2010-2014 for Air China and China Eastern. Therefore, it is difficult to attribute the initial post-merger price reduction to any efficiency gains. The most likely reason is the entry of HSR: in the early years after the mergers, the whole air transport industry was very vigilant to the entry of HSR and refrained from charging higher prices, while in the subsequent years, airlines were able to adjust their capacity and competitive strategies to accommodate the existence of HSR and thus raised their prices. Therefore, it is not surprising to see that the prices of the airlines involved in the mergers increased substantially in the later periods after the mergers.

Another possible reason for the greater market power in the long-term is associated with the presence of entry regulation and barriers, especially for those densely travelled markets. Ma et al. (2020) reported strong evidence that Chinese airlines engage in implicit collusion in densely travelled and high revenue markets. These markets are usually associated with the presence of HSR. In the last decade, the emergence of HSR has given China's airline industry and the aviation authorities an excuse to restrict the new entry to the densely travelled routes connecting with Beijing, Guangzhou, and Shanghai. It may take years for private airlines and LCCs to gain access to these markets. For example, the Shanghai-based LCC, Spring Airlines, had to wait for six years before getting approval to fly the Shanghai-Beijing route in 2011 and it was more difficult to gain an ideal time slot (Zhang and Lu, 2013; Wu et al., 2020). Actually, the total market share of LCCs in the Chinese aviation market was approximately 11% in 2018, which is significantly lower than the world's average. As Fu et al. (2011) stated, in the presence of entry regulation and barriers, it is likely that market power and high prices could sustain.

It is worth noting that for both China Eastern and Air China, the Lerner index peaked during the 2009-2010 period.[13] One critical factor that affects the Lerner index is marginal cost. As Manuela et al. (2019) pointed out, the Lerner index will also increase even when prices are stable or slightly decreasing due to intense competition, if costs decrease faster relative to the decrease in airfares. From 2009 to 2010, fuel prices dramatically dropped, which might have led to a great decrease in airlines' operation costs and marginal costs. On the other hand, China received less impact in the global financial crisis and the massive stimulus package started to take effect from the second half of 2009 and stabilized the travel demand. The drop in marginal cost coupled with the stable airfares might have resulted in a higher Lerner index in 2009-2010.

5. Concluding remarks

In this paper, we have examined the price effects of two Chinese airline mergers: the MU-FM merger with a more parallel network and the CA-ZH merger with a more complementary network. In general, we found that the products affected by the mergers show significant increases in airfares relative to the control group. A further examination of the prices in the short run and long run suggests that the price effects triggered by airline mergers could change over time. For both mergers, the price rises were larger in magnitudes in the long term relative to the short term. Their patterns have been verified by the calculated Lerner indices, suggesting that substantial market power might not have arisen shortly after the merger until a few years later.

Our findings have important policy implications for the anti-trust regulators. Traditional wisdom suggests that anticompetitive effects mainly exist on overlap routes or in hub-to-hub markets following mergers or alliances. However, in this paper, we found that although the CA-ZH merger involved fewer overlapping products and more non-overlapping products than the MU-FM merger, airfares of the products affected by the CA-ZH merger also significantly increased post-merger, suggesting that the elimination of potential competitors can also confer market power to the merging airlines. Although we should be careful in ascribing the long-run

[13] We thank one anonymous reviewer for raising this issue and giving the insights.

increase in market power to the 2010 mergers alone, anti-trust authorities should understand that in assessing the potential anticompetitive effects of a proposed merger, the long-term effects should be taken into consideration as well as the market access conditions, no matter the merger is of complementary or parallel nature.

With the rapid development of HSR network in China, airline-HSR cooperation has been topical and various theoretical models have been developed such as Xia et al. (2018). However, more empirical studies are needed to confirm the weakened negative impact of HSR on airfares revealed in this study by using more recent data. Another valuable extension is to consider connecting routes, which have been ignored in this research. This implies that the benefit to connecting passengers brought about by the mergers is not accounted for, which is a shortcoming of this research.

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Appendix A1: List of airlines included in the samples

Table A1. List of airlines included in the study

IATA Code	Airline Name	Airline Type	Year of
HU	Hainan Airlines	Joint venture FSA	1993
3U	Sichuan Airlines	Joint venture FSA	1986
CZ	China Southern Airlines	State-owned FSA	1995
FM	Shanghai Airlines	Joint venture FSA	1985
CA	Air China	State-owned FSA	1988
MF	Xiamen Airlines	Joint venture FSA	1984
HO	Yunyao Airlines	Private FSA	2005
MU	China Eastern Airlines	State-owned FSA	1988
EU	Chengdu Airlines	Joint venture FSA	2010
ZH	Shenzhen Airlines	Joint venture FSA	1992
SC	Shandong Airlines	Joint venture FSA	1999
8C	East Star Airlines	Private FSA	2009
8L	Lucky Air	Private LCC	2004
BK	Okay Air	Private FSA	2005
G5	China Express Airlines	Private FSA	2006
PN	West Air	Private LCC	2006
GS	Tianjin Airlines	Joint venture FSA	2009
CN	Grand China Air	Private FSA	2007
NS	Hebei Airlines	Joint venture FSA	2010
VD	Kun Peng Airlines	Private FSA	2007
JD	Capital Airlines	Joint venture FSA	2010
KY	Kunming Airlines	Joint venture FSA	2009
OQ	Chongqing Airlines	Joint venture FSA	2007
9C	Spring Airlines	Private LCC	2003
JR	Joyair	Joint venture FSA	2009
TV	Tibet Airlines	State-owned FSA	2011
KN	China United Airlines	Joint venture LCC	2012
GJ	Loong Air	Private FSA	2011
DZ	Donghai Airlines	Private FSA	2002
DR	Ruili Airlines	Private FSA	2012
QW	Qingdao Airlines	Joint venture FSA	2013
YI	Ying’an Airlines	Private FSA	2010
UQ	Urumqi Airlines	Joint venture FSA	2013
FU	Fuzhou Airlines	Joint venture FSA	2014
GX	Beibu Gulf Airlines	Joint Venture FSA	2015
AQ	9 Air	Private LCC	2014
GY	Colorful Guizhou Airlines	Joint venture FSA	2014
Y8	Suparna Airlines	Private FSA	2002
RY	Jiangxi Airlines	Joint venture FSA	2014
9H	Air Chang’an	Joint venture FSA	2000
A6	Air Travel	Private LCC	2016
GT	Air Guilin	Joint venture FSA	2015

Appendix A2: Calculating the value of θ

Following Brander and Zhang (1990, 1993), and Oum et al. (1993), the conduct parameter is defined as:

$$\frac{dQ}{dq_i} = \frac{p - MC_i}{p} \cdot \frac{\eta}{S_i}, \quad (4)$$

where $\eta = -\ (dQ/dp)(p/Q)$ is the (positive) price elasticity of demand, $S_i = q_i/Q$ is the market share of firm i, and MC_i is the marginal cost of firm i. Combining equation (3) and (4), we obtain:

$$p_{ijt} = \frac{\{cpk_{it}(D_j/AFL_{it})^{-\theta}D_j\}\eta}{\eta - (dQ/dq_i)S_{ijt}}. \quad (5)$$

Equation (5) can be transferred into

$$\ln\eta + \ln cpk_{it} + \ln D_j - \ln p_{ijt} = \theta(\ln D_j - \ln AFL_{it}) + \ln(\eta - (dQ/dq_i)S_{ijt}). \quad (6)$$

Let $y_{jjt} = \ln\eta + \ln cpk_{it} + \ln D_j - \ln p_{ijt}$, $x_{ijt} = \theta(\ln D_j - \ln AFL_{it})$, and $c_{ijt} = \ln(\eta - (dQ/dq_i)S_{ijt})$. Denote $c = mean(c_{ijt})$, and let $\varepsilon_{ijt} = c_{ijt} - c$. Equation (6) can be rewritten as

$$y_{jjt} = \theta x_{ijt} + c + \varepsilon_{ijt}. \quad (7)$$

If we know the estimated value of η, we can calculate the value of θ. Next, we explain how to estimate the elasticity of demand.

$$\ln(Q)_{jt} = \alpha_0 + \eta\ln(P)_{jt} + Z_{jt}\alpha_1 + \varphi_j + v_t + \mu_{ijt}, \quad (8)$$

where $\ln(Q)_{jt}$ is the logarithm form of route-level passenger volume at time t and $\ln(P)_{jt}$ is the logarithmic form of route-level airfare at time t. Z_{jt} is a matrix of control variables, which include route-level population, route-level GDP (a proxy for income), the presence of LCC and HSR on the route and route distance. φ_j and v_t are route and time fixed effects to control for the unobservable route characteristics and time shocks. Model (8) is estimated using two-stage linear regression to tackle the endogeneity issue of $\ln(P)_{jt}$. The 25$^{\text{th}}$ percentile and the 75th percentile of fitted fares in a market are used as instruments. The results are shown in Table A2.

Table A2 Price elasticity estimation

Variables	(1) 2SLS	(2) 2SLS
lnPrice	-0.9675***	-0.9873***
	(0.0241)	(0.0243)
lnPOP	-0.0208	0.0567
	(0.0294)	(0.0436)
lnGDP	0.2839***	0.2709***
	(0.0096)	(0.0098)
HSR	-0.2287***	-0.2298***
	(0.0065)	(0.0065)
LCC	0.0215***	0.0187***
	(0.0066)	(0.0066)
lnDistance	0.3868***	-
	(0.0512)	(.)
Constant	9.1541***	11.5276***
	(0.3688)	(0.2867)
Time fixed effects	Yes	Yes
Route fixed effects	No	Yes
N	65013	65013
R^2	0.18	0.47

1. Cluster-robust standard errors in parentheses.
2. $^{*} p < 0.1$, $^{**} p < 0.05$, $^{***} p < 0.01$
3. To save space, the coefficients of time dummies are not reported.

Table A2 shows that the price elasticity is approximately 0.99. By inserting this value into Model (7), we can obtain the value of θ, which equals 0.49.