Research in Transportation Economics xxx (xxxx) xxx

Contents lists available at ScienceDirect

Research in Transportation Economics

journal homepage: http://www.elsevier.com/locate/retrec

Decomposing sources of gain from airline mergers: A model and case study from China

Chun-Yu Ho [a], Patrick McCarthy [b,c,*], Yanhao Wang [d]

[a] Department of Economics, University at Albany SUNY, USA
[b] School of Economics, Georgia Institute of Technology, USA
[c] Center for Economics, Finance and Management Studies, Hunan University, Changsha, China
[d] Kelley School of Business, Indiana University Bloomington, USA

ARTICLE INFO

JEL classification:
G14
L22
L41
L43
L93
L98

Keywords:
Merger
Shareholder wealth
Market power
Efficiency
Decomposition

ABSTRACT

This paper proposes a decomposition of sources of gain of airline mergers. Economic analysis of horizontal mergers often attributes the gains of the merger to market power and productive efficiency effects. We adopt a Williamson framework to propose a decomposition analysis quantifying the relative importance of these two effects for airline mergers. First, we use an event study to compute the market power and productive efficiency wealth effects in airline mergers. Second, we use the airline's operating statistics to compute the proportion of profit gain due to market power and productive efficiency. We then apply those proportions to decompose the sources of wealth effects from the event study. In a case study, we apply this methodology to analyze the horizontal merger between China Eastern and Shanghai Airlines in 2009. Our results find that improved productive efficiency contributed about four-fifths to the merged airline's increased wealth, while increased market power contributed about one-fifth.

1. Introduction

Since the seminal work of Williamson (1968), economic analysis emphasizes market power and productive efficiency as the primary drivers of mergers. Under the market power hypothesis, a higher price and lower output level reduce consumer surplus. Part of the reduction is a transfer from consumers to the merging firms in the form of higher firms' profits and part is a loss of consumer surplus from a higher post-merger price that reduces the quantity of the goods demanded. In the case of the productive efficiency hypotheses, a lower average cost leads to a greater profit for a given output level. Understanding sources of a merger's effects is critical for evaluating mergers and for developing effective and appropriate regulatory policies. An efficiency-enhancing merger that reduces production costs but increases market power could have a net beneficial effect for consumers if the efficiency-induced cost savings offset the allocative inefficiency. Further, such efficiency enhancing mergers would be subject to less antitrust scrutiny.

This paper adopts Williamson's framework to analyze the horizontal merger between China Eastern and Shanghai Airlines in 2009. This case study is of interest for three reasons. First, there is an on-going discussion of airline mergers in the literature. Zhang et al., 2014 discuss market power in the Chinese airlines industry which from Ma et al., 2020 likely increases in a post-merger environment. Yet Yan et al. (2019) reports a productivity gain from mergers in the Chinese airline industry. Given this mixed evidence, developing an analytic framework to evaluate the overall impact of mergers is important for informing policy makers and public policy. Second, airline mergers in China are part of a broader policy of industry deregulation. As the second largest aviation market in terms of available seats, understanding the effects of airline mergers in China is of policy interest for its domestic and

* Corresponding author. School of Economics, Georgia Institute of Technology, USA.
E-mail address: mccarthy@gatech.edu (P. McCarthy).

https://doi.org/10.1016/j.retrec.2020.100996
Received 3 June 2020; Received in revised form 4 October 2020; Accepted 27 October 2020

international markets.[1] Although there was a wave of airline mergers in 2000s, the China Eastern and Shanghai Airline merger provides an excellent case study for our empirical analysis because the appropriate data are available, i.e. stock prices and operating statistics and because several studies, including Zhang (2015), Ma et al. (2020) and Ho et al. (2020), have studied this merger.[2] These studies will provide a check on whether our empirical results are reasonable and consistent.

Since Eckbo (1983), there have been empirical studies applying an event study methodology to examine the competitive effects of mergers. In particular, these studies aim to test the relative strength of the market power and productive efficiency hypotheses. In this class of models, the null hypothesis is that there is no abnormal return on competitors of the merging firms in response to the merger announcement, which suggests an indeterminacy of relative strength of those two hypotheses. The alternative hypothesis is that a positive (negative) reaction on competitors' stock is evidence that the market power (productive efficiency) effect dominates.

Although both market power and productive efficiency are likely to play a role in driving the shareholders' valuation gain of a merger, an event study is silent in showing how much of the valuation gain reflects market power and how much reflects productive efficiency. This paper proposes a decomposition analysis quantifying the relative importance of these two effects for airline mergers. First, we use the event study to estimate the wealth effect, which is a composite effect of market power and productive efficiency, of an airline merger. Second, we use the operating statistics to compute the cost saving from the merger, which is the part attributed to productive efficiency. Finally, we use the difference between estimated wealth effect and cost saving to be the part attributed to market power. We apply our model to a case study of the horizontal merger between China Eastern and Shanghai Airlines in 2009. Our results find that the productive efficiency contributed nearly four-fifths to the merged airline's increased market valuation, while increased market power contributed about one-fifth of the total increase.

Our paper contributes to the event study literature for examining the effects of an airline merger. Knapp (1990) conducts an event study for nine airline mergers proposed in 1986, in which positive abnormal returns for both merging airlines and rival portfolios support the market power hypothesis. Singal (1996) examines 27 airline mergers during 1985–88 and finds support for the market power hypothesis. Using data on the 1986 Northwest-Republic Airlines merger, Hergott (1997) event study finds a rise in market power of the merging airlines through increasing concentration at the airport level. Zhang and Aldridge (1997), which examines the potential merger between Air Canada and Canadian Airlines International for the period 1992–93, do not find any impact on US airlines. Flouris and Swidler (2004) finds that the acquisition of Trans World Airlines by American Airlines in 2001 had negative impacts on American Airlines shareholders. However, none of these studies explores the relative strength of market power and productive efficiency effects. In a companion paper, Ho et al. (2020) examines the sources of gain from merger between China Eastern and Shanghai Airlines. Relying on data from domestic competitors, international competitors and airports, among their results, the authors find that the merged airline gains market power in the domestic market and efficiency improvements in international markets. The study does not, however, examine the extent to which market power and efficiency improvements, respectively, contribute to the increased wealth of the merging firms. This paper extends the results of Ho et al. (2020) by proposing a decomposition methodology that enables us to calculate the proportion of the merger's total wealth effect due to market power and productive efficiency, respectively.

Section 2 present our decomposition methodology. Section 3 presents an empirical example. Section 4 concludes.

2. Empirical methodology

We first present a simple model to derive the equation for decomposing market power and productive efficiency effects of merger. Then, we discuss the empirical implementation of our decomposition method.

2.1. Event study analysis

The event study methodology is widely used to assess the wealth effect of a merger, it examines the reaction of a firm's stock price against the expected normal return at the time of a merger announcement. We estimate the following system of equations:

$$R_{i,t} = \alpha_{i0} + \alpha_{i1}R_{m,t} + \alpha_{i2}R_{m,t-1} + \alpha_{i3}R_{m,t+1} + \alpha_{i4}SMB + \alpha_{i5}HML + \alpha_{i6}UMD$$

$$+ \sum_{k=-4}^{4} \beta_{ik}D_k + \varepsilon_{i,t} \; for \;\; i \;\; = \;\; 1, \&, \;\; N \qquad (1)$$

The system of equations includes N firms that the merger potentially affects. The variable $R_{i,t}$ is the daily return of firm i on date t. $\varepsilon_{i,t}$ is the disturbance term of firm i on date t. To estimate the normal return, we adopt Carhart (1997) four-factor model, which relates the stock return of a firm to the market portfolio, market capitalization (SMB), book-to-market ratio (HML), momentum factor (UMD) and an idiosyncratic component. $R_{m,t}$, $R_{m,t-1}$ and $R_{m,t+1}$ are the daily returns of market portfolio on date t, t-1 and t+1, respectively. Carhart (1997) shows this four factor model improves the accuracy in measuring return compared to the Fama-French three-factor model (Fama and French, 1993, 1995), which in turn overcomes the limitation of the capital asset pricing model (CAPM). Further, as noted in Fama and French (2012) and MSCI (2013), academic and industry researchers widely use the Carhart four-factor model. .

The dummy variable D_k equals one on the date that is k days away from the date of the merger announcement (June 8, 2009).[3] The set of dummy variables tracks the return of those N firms over the period four days before and after the merger announcement. Equation-specific coefficients β_{ik} capture the reaction of firm i to the merger announcement during these 9 days. If the coefficient is significantly positive (negative), then the stock price of firm i is higher (lower) than the expected normal return. In other words, the coefficient β_{ik} is the abnormal return (AR) for firm i on day k. It is noteworthy that the set of dummy variables $D_{-4}, \ldots, D_{-1}$ captures whether investors anticipate the merger announcement. Insignificant coefficients of $D_{-4}, \ldots, D_{-1}$ from zero suggest that the merger announcement provides new information to investors. In our empirical analysis, we employ the cumulative abnormal return (CAR [-j,+j]) of firm i by summing up all of its ARs over the event window of [-j, +j]. CAR[-j,+j] is used to summarize the impacts of a merger announcement on firms. CAR can be more informative than AR because

[1] Aircraft movement 2017, source: https://aci.aero/data-centre/annual-traffic-data/aircraft-movements/2017-aircraft-movements-annual-traffic-data.

[2] For the mergers involving China Eastern, Chine Southern and Air China in 2002–04, data is more limited. It is because not all the major airlines were listed in early 2000s. For example, Air China went public only since 2006. Plus, airlines do not usually disclose operating statistics back to early 2000s. For Air China-Shenzhen Airlines in 2010, there is no capital market data for Shenzhen Airlines.

[3] Because the exchanges suspended stock trading for China Eastern and Shanghai Airlines, we set the day when trading resumed (13 July 2009) as 0, and so on afterwards.

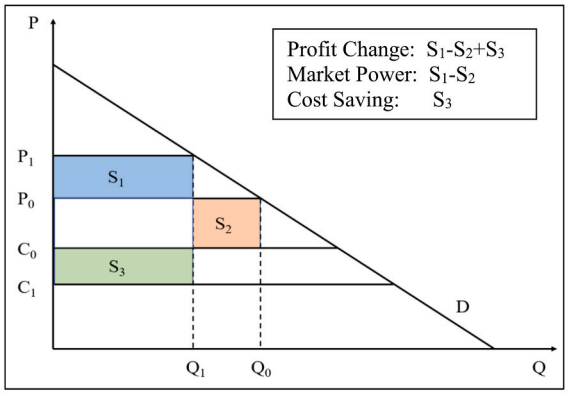


Fig. 1. Welfare analysis.
Note: This figure illustrates the decomposition of the wealth effect attributed to the increased marker power and efficiency improvement. Subscripts 0 and 1 denote ex-ante and ex-post, respectively. The variables P, C and Q represent price, average cost and output, respectively. We assume average cost equals marginal cost in this analysis. Colored rectangles represent the compositions of merging airlines' wealth effect.

Note: This figure illustrates the decomposition of wealth effect attributed to the increased marker power and efficiency improvement. Subscripts 0 and 1 denote ex-ante and ex-post, respectively. The variables P, C and Q represent price, average cost and output, respectively. We assume average cost equals marginal cost in this analysis. Colored rectangles represent the compositions of merging airlines' wealth effect.

CAR averages out idiosyncrasies on some days over the event windows.[4] Also, we choose a short event window (4 days before and after the event day) in order to avoid the contamination of other news, and to raise the power of statistics (Brown & Warner, 1985). According to the literature, a short event window does not usually extend beyond a trading week.[5]

The system of equations in (1) raises two concerns. The first concern is sample errors of different daily return equations can be positively correlated because our sample firms may share common input and output markets. Brown and Warner (1985) finds that adjusting for event clustering across stocks is important for statistical inference in an event study. To address this cross-equation contemporaneous correlation in error terms, we estimate the system of equations using the Seemingly Uncorrelated Regression (SUR) technique (Binder (1985)).[6] The second concern is non-synchronous trading. We follow Dimson (1979) and include lead, contemporaneous and lagged market returns in the CAPM model to mitigate non-synchronous trading issues. An advantage of Dimson's approach is that it is directly applicable to a multivariate framework. Further, Brown and Warner (1985) finds that the non-synchronous trading correction procedures of Dimson (1979) perform as well as the other approaches available.[7]

2.2. A decomposition model and its implementation

We consider the seminal merger analysis of Williamson (1968), which emphasizes the trade-off associated with horizontal mergers between the losses relating to higher prices due to stronger market power and gains resulting from lower production costs. Fig. 1 plots the outcome before and after an airline merger. We analyze a case in which the merger increases the price from P_0 to P_1, and assuming downward-sloping demand, output level decreases from Q_0 to Q_1. The increase of producer surplus is $(P_1 - C_1)Q_1$ - $(P_0 - C_0)Q_0$, which can be decomposed into three terms, namely an additional profit from a higher price S_1, a loss of profit from a lower output S_2, and an additional profit from a lower cost S_3. The increase of producer surplus is $S_1–S_2+S_3$, in which $(S_1–S_2)/(S_1–S_2+S_3)$ is the proportion from market power and $S_3/(S_1–S_2+S_3)$ is the proportion from productive efficiency.

The remaining part of this sub-section outlines the procedure to compute the profit gain $S_1–S_2+S_3$ and the cost saving S_3 from the merger. Empirically, we directly observe the profit increases from the financial statements for airlines listed in stock exchanges. Thus, $S_1 - S_2 + S_3 = (P_1 - C_1)Q_1 - (P_0 - C_0)Q_1$ is observable.

The productive efficiency effect (cost saving) S_3 is

$$S_3 = (C_0 - C_1)Q_1 = \left(\frac{1}{1 + \%\Delta C} - 1\right) C_1 Q_1, \text{ and } \%\Delta C = \frac{C_1 - C_0}{C_0} \tag{2}$$

where Q_1 is the post-merger volume and C_0 and C_1 is marginal cost in the period before and after merger, respectively. The reference to marginal cost in this analysis is due to the assumption that marginal and average cost are constant over the quantity, i.e. MC = AC. Post-merger operating cost C_1Q_1 is observable in financial statements, but the percent change, $\%\Delta C$, is unknown. The challenging part is to compute the percentage reduction in marginal cost because we cannot directly observe airline marginal costs in any official report. Brander and Zhang (1990, 1993), we exploit particular operating statistics unique to the transportation industry to compute route-specific marginal cost

$$MC_{ktc} = CPK_{tc}\left(\frac{AFL_{tc}}{Distance_k}\right)^{\theta} Distance_k$$

$$\Delta lnMC_{ktc} = \Delta lnCPK_{tc} + \theta \Delta lnAFL_{tc} \tag{3}$$

where $Distance_k$ is distance (kilometers) on route k, AFL_{tc} is the average flight length for airline c in period t, CPK_{tc} is airline c's cost per revenue passenger-kilometer in period t, and θ is an elasticity parameter ranging from 0 to 1. Note that marginal cost is route-specific (depends on k) but that its percentage change is airline firm-specific (depends on c, t). This allows us to calculate the yearly $\Delta lnMC_{ktc}$ knowing only the changes in CPK_{tc} and AFL_{tc}. Given the information of S_3 and $S_1–S_2+S_3$, we compute the contributions of market power and productive efficiency with $(S_1–S_2)/(S_1–S_2+S_3)$ and $S_3/(S_1–S_2+S_3)$, respectively.

[4] In our context, CAR may be more meaningful than AR because the CSRC imposes a stock price limit (±10% for normal stocks) for the Chinese stock markets, which restricts the within-day stock price from conveying all investor information. In fact, when China Eastern and Shanghai Airlines delivered their merger announcement, the stocks of both companies traded under the condition of special treatment (ST) because they suffered from financial losses for two consecutive years. Under the ST, the CSRC imposed more rigorous limits on the companies' stock price fluctuations (±5%).

[5] See Singal (1996) and Hergot (1997) as examples of using short event window to study airline mergers.

[6] Cameron and Trivedi (2005, Chapter 6). We examine the correlation matrix of residuals after the SUR estimation. According to Breusch-Pagan test of independence, we reject the null hypothesis that the errors are uncorrelated, which justifies our application of the SUR model. The results are available upon request.

[7] Another commonly used approach is Scholes and Williams (1977), which is a two-step single equation approach and is not readily to be applied in our setting.

Table 1
Background information and descriptive statistics.

Firm	Trading Code	Market Capitalization*	Listed Exchange	Daily Return				
				Obs	Mean	Min	Max	S.D
Merging Airlines								
China Eastern	600115.SH	3360.205	Shanghai	241	0.002	−0.100	0.100	0.031
Shanghai Airlines	600591.SH	771.804	Shanghai	241	0.002	−0.100	0.101	0.028
Competing Airlines								
Air China	601111.SH	8600.456	Shanghai	241	0.004	−0.091	0.101	0.035
China Southern	600029.SH	3556.207	Shanghai	241	0.003	−0.100	0.101	0.033
Market portfolios								
HS300 Index			Shanghai	241	0.003	−0.071	0.067	0.021

Note: This table presents the basic information and market capitalization of all the stocks used in the event study estimation, and the summary statistics for all the stock returns and market return used in the baseline estimation ([-120, +120] window). The daily return is calculated as $R_t = (P_t - P_{t-1})/P_{t-1}$. The market capitalization is calculated based on the number of outstanding shares on June 30, 2009.
Unit: RMB billion. Data source: WIND.

Table 2
Event study with the 4-factor model.

	Merging Airlines		*Rival Airlines*	
Variables	China Eastern SH	Shanghai Airlines SH	Air China SH	China Southern SH
Panel A: Model				
Rm,t	0.654***	0.539***	1.070***	0.852***
	(0.0885)	(0.0801)	(0.0757)	(0.0817)
Rm,t-1	0.149*	0.0874	0.0827	0.128
	(0.0893)	(0.0808)	(0.0761)	(0.0821)
Rm,t+1	−0.0592	−0.137*	−0.0667	−0.142*
	(0.0882)	(0.0796)	(0.0757)	(0.0818)
SMB	0.0489	0.164	0.186	0.244
	(0.210)	(0.192)	(0.177)	(0.190)
HML	−0.430	−0.654	−0.606	0.0487
	(0.497)	(0.455)	(0.414)	(0.444)
UMD	−0.0150	0.0191	−0.0250	−0.0731
	(0.0658)	(0.0620)	(0.0516)	(0.0540)
D-4	−0.0173	−0.0137	−0.0270	−0.000282
	(0.0290)	(0.0261)	(0.0251)	(0.0272)
D-3	−0.0124	−0.00549	−0.0196	0.00636
	(0.0292)	(0.0263)	(0.0252)	(0.0273)
D-2	−0.0215	−0.00737	−0.00559	−0.0127
	(0.0290)	(0.0260)	(0.0250)	(0.0271)
D-1	0.0121	0.0415	−0.0102	−0.00352
	(0.0289)	(0.0259)	(0.0250)	(0.0271)
D0	0.0607***	0.0622***	0.00181	0.00795
	(0.0220)	(0.0234)	(0.0219)	(0.0208)
D1	0.0471**	0.0472**	0.0720***	0.0354*
	(0.0217)	(0.0232)	(0.0218)	(0.0206)
D2	0.0278	0.0429*	−0.00918	−0.00668
	(0.0218)	(0.0232)	(0.0217)	(0.0206)
D3	0.0680***	0.0612***	−0.0321	−0.0275
	(0.0216)	(0.0231)	(0.0217)	(0.0206)
D4	−0.0138	−0.00735	−0.0194	−0.00489
	(0.0216)	(0.0231)	(0.0218)	(0.0207)
Panel B: CARs				
CAR[-4,-1]	−0.039	0.015	−0.062	−0.010
	[0.521]	[0.786]	[0.231]	[0.857]
CAR[0,0]	0.0607***	0.0622***	0.00181	0.00795
	(0.0220)	(0.0234)	(0.0219)	(0.0208)
CAR[0,+4]	0.190***	0.206***	0.013	0.004
	[0.000]	[0.000]	[0.798]	[0.931]

Note: This table presents the estimates of event study. Standard errors of coefficients in parentheses. ***p < 0.01, **p < 0.05, *p < 0.1. SMB, HML and UMD are size, book-to-market and momentum factors defined in Carhart (1997), respectively.

3. An empirical example

To illustrate our methodology, we analyze the horizontal merger between China Eastern and Shanghai Airlines in 2009. China Eastern is one of China's largest airlines with its headquarters in Shanghai. According to its 2008 income statement, China Eastern's operating revenue reached RMB 41.84 billion (or USD 6.15 billion). The target of the merger, Shanghai Airlines also has its headquarters in Shanghai and in 2008 generated over RMB 13.37 billion (or USD 1.97 billion) in revenues.

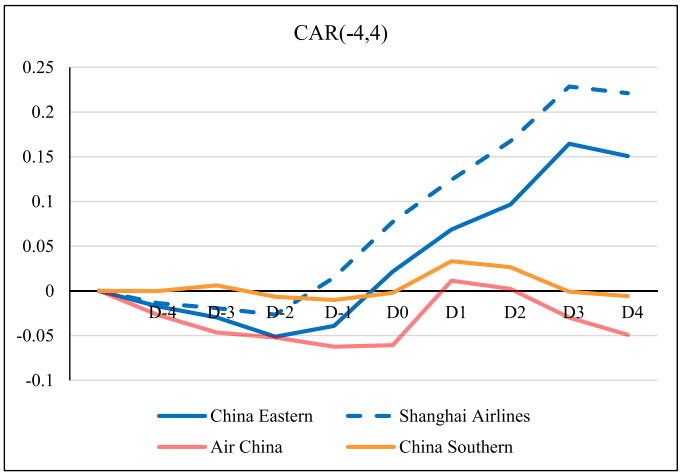
On June 8, 2009, China Eastern and Shanghai Airlines simultaneously announced the notice of trading suspension, claiming that they were undergoing a material reorganization. Investors interpreted the announcement as confirmation of the conjecture that China Eastern would acquire Shanghai Airlines as its subsidiary. With the approval of the regulatory authorities, including the China Securities Regulatory Commission (CSRC), Civil Aviation Administration of China (CAAC) and the State-owned Assets Supervision and Administration Commission (SASAC), the merger encountered little resistance. On February 25, 2010, the Shanghai Stock Exchange delisted Shanghai Airlines. With the merger completed on schedule, the new China Eastern Airlines began operations before the end of 2010.

3.1. Event study

We include two groups of listed firms in our empirical analysis: merging airlines and competitors. First, the merging airlines are China Eastern Airlines and Shanghai Airlines. Second, there are two competing airlines, namely Air China and China Southern Airlines, which are used as the control group. The event day is June 8, 2009. The estimation period includes trading days ranging from December 1, 2008 (120 days before the merger announcement) to December 2, 2009 (120 days after the announcement). The total trading days included in the sample for stocks is 241. Thus, for our analysis we construct a panel dataset with four trading stocks listed in Shanghai stock exchanges. The daily stock prices in our sample firms are from WIND database (http://www.wind.com.cn/en).

Table 1 reports details of stocks and market portfolios, and descriptive statistics for the daily returns in our sample period. We compute the return as $R_t = (P_t - P_{t-1})/P_{t-1}$, where P_t is stock price on date t and we adjust daily stock prices for stock splits and dividend payments before computing the daily return. All stocks and market portfolios show slightly positive average returns over the baseline window.

Table 2, Panel A reports the empirical results of Equation (1) and Panel B reports estimates of CAR[-4,-1], CAR[0,0] and CAR[0,+4]. These three CARs estimates summarize the abnormal returns before, on the day of, and after the event. Before discussing the main results, we present two results that indicate our specification is reasonable. First, the CAR[-4,-1] is insignificant in all cases. The absence of a significant reaction of our sample firms before the merger announcement suggests that the event providing new information content to investors, which is consistent with the presumption of using an event study. Second, all



Note: This figure depicts the average CAR of 4 stocks used in event study, China Eastern, Shanghai Airlines, Air China and China Southern, 4 days before and after the merger announcement. The CARs are computed based on the estimated coefficients of shown in Table 2.

Fig. 2. CAR (−4,4).
Note: This figure depicts the average CAR of 4 stocks used in event study, China Eastern, Shanghai Airlines, Air China and China Southern, 4 days before and after the merger announcement. The CARs are computed based on the estimated coefficients of shown in Table 2.

coefficients of market returns, R_{mt}, are significantly positive, consistent with the prediction of the CAPM model.

Turning to the results of merging firms, the first two columns in Table 2 report significantly positive abnormal returns for China Eastern and Shanghai Airlines after the merger announcement. In particular, the CAR[0,0] for China Eastern and Shanghai Airlines reaches 6.1% and 6.2%, respectively, suggesting that investors expected each would benefit from the merger. Further, CAR[0,+4] for China Eastern and Shanghai Airlines reaches 19.0% and 20.6%, respectively.[8] The positive stock price reactions for the two merging airlines is consistent with some event studies to analyze airline mergers in the literature (e.g. Knapp, 1990; Singal, 1996; Zhang & Aldridge, 1997). Further, the stock price reactions are consistent with theoretical expectations that firms do not enter mergers unless they expect these to be profit maximizing.

To demonstrate the robustness of our results against the choice of window of CAR, Fig. 2 plots the CAR over the whole event window. For the merging airlines, the rise in CAR starts close to the event date 0 and remains positive until four days after the event. This suggests that the CAR for the pre-event window would be close to zero, whereas the CAR in the post-event window would be positive. The absence of a further rise in CAR in days three and four after the event supports the choice of 4 days as the event window. For the competing airlines, the CAR remains near zero throughout the event window, which suggests that the CAR for pre-event and post-event windows would be close to zero. These results are consistent with our results reported in Panel B of Table 2.

Overall, the results show that there is a positive wealth effect for the merging firms, which suggests an increase of producer surplus after the merger i.e. S_1–S_2+$S_3 > 0$. Using financial data, we compute the wealth effect in 2005 constant prices. Based on market capitalization in Table 1 and CAR[0,4] estimates in Table 2, we find the wealth effects of China Eastern and Shanghai Airlines reaches nearly RMB 7.91 billion. [9]

3.2. Decomposition analysis

This sub-section discusses the results of decomposition. We use a three-year average before the 2009 merger (2006–2008) to compute pre-merger values and a three-year average after the merger (2011–2013) to proxy post-merger values.[10] To make the pre- and post-merger figures comparable, we combine the values of China Eastern and Shanghai Airlines before the merger and compare the summed values to those of China Eastern after the merger. The key reason for not using the period 2009–2010 is that the data for those two years are highly fluctuating. There are two reasons for this. First, merger approval occurred in 2009 with merger completion before the end of 2010. Adjusting to a new equilibrium that reflects a cooperative rather than a competitive relationship takes time and Williamson's framework is only appropriate for comparative statics.[11] Second, in late 2007 the financial crisis plunged the economy into a major recession (December 2007–June 2009, www.nber.org), with lingering effects beyond the official end of the recession. During this period, greater fluctuations in oil prices cause marginal costs and airline profits to deviate from their equilibria, exacerbating the merger adjustment.[12]

Panel A of Table 3 reports that, on average, the annual operating profit of merging airlines was about RMB 3402 million and that of the merged airlines was about RMB 7543 million, an approximate 2.2 times increase. Panel B reports CPK and AFL before and after the merger. The cost per passenger-kilometer decreases about 8%, whereas average flight length increases by about 5%. Consistently, Ho et al. (2020) provide evidence that the cost per passenger-kilometer relates to the scale economies, and the average flight length increases relate to the development of international routes after the merger. We calibrate the parameter θ in Equation (3) to be around 0.4 according to Zhang et al.

[8] As expected, our results are very consistent with those in Ho et al. (2020), which employs a larger set of equations reflecting a large set of alternatives and airport stocks. One could interpret these results as a robustness check on the broader set of estimations in Ho et al. (2020). Econometrically, since SUR only affect the efficiency of estimation, but not its consistency, we expect similar coefficient estimates.

[9] Wealth effect = 3360.2 × 0.190 + 771.8 × 0.206 = RMB 7.97 billion.

[10] Our decomposition analysis is robust to the use of four-year average before (2005–2008) and after (2011–2014) the merger.

[11] PwC (2017) suggests that integrating the respective businesses functions of merging firms at least 1–2 years, even for successful mergers. . Less successful mergers are likely to take longer for post-merger integration.

[12] The variance in the global price of Brent crude (https://fred.stlouisfed.org/) was $4.2 per barrel in the 1990s, increasing to $18.9 in 2000–2006 and $24.8 per barrel in 2007–2008. The variance fell to $12 in 2009 and then nearly returned to 1990 levels in 2010 ($5.2).

Table 3
Decomposition analysis.

Panel A: China Eastern (Pre: CE + SA)			
	Operating Revenue	Operating Cost	Operating Profit
Pre-merger	46,860.30	43,458.52	3401.78
Post-merger	60,317.40	52,774.62	7542.78
% △	28.72%	21.44%	122.7%
	CPK	AFL	MC
Pre-merger	0.74	1425.50	
Post-merger	0.68	1492.93	
% △	−7.85%	4.73%	−6.13%
	Profit Change	Cost Saving	Market Power
Amount	4141.00	3449.27	691.73
%		83.30%	16.70%
Panel B: Air China			
	Operating Revenue	Operating Cost	Operating Profit
Pre-merger	44,509.84	37,919.88	6589.97
Post-merger	69,016.43	56,221.20	12,795.23
% △	55.06%	48.26%	94.16%
	CPK	AFL	MC
Pre-merger	0.63	1882.39	
Post-merger	0.61	1797.27	
% △	−3.80%	−4.52%	−5.56%
	Profit Change	Cost Saving	Market Power
Amount	6205.27	3312.61	2892.66
%		53.38%	46.62%
Panel C: China Southern			
	Operating Revenue	Operating Cost	Operating Profit
Pre-merger	47,303.63	42,043.06	5260.57
Post-merger	68,454.11	58,503.12	9950.99
% △	44.71%	39.15%	89.16%
	CPK	AFL	MC
Pre-merger	0.68	1270.40	
Post-merger	0.62	1566.84	
% △	−9.34%	23.33%	−1.41%
	Profit Change	Cost Saving	Market Power
Amount	4690.42	835.79	3854.63
%		17.82%	82.18%

Note: This table reports the decomposition of profit increase of merging airlines and their major rival airlines. In Panel A, pre-merger statistics are the sum of those for China Eastern and Shanghai Airlines; post-merger statistics are those of the new China Eastern. Operating profit = Operating revenue – Operating cost. CPK is cost per revenue-passenger-kilometer and AFL is average flight length, defined (revenue-passenger-kilometers/revenue-passengers). %△MC is computed on CPK and AFL according to Equation (3). Cost saving is computed with Post-Merger Operating Cost and %△MC. Marker Power = Profit change – Cost saving. Reported figures are three-year averages before and after the merger (pre: 2006–2008; post: 2011–2013). Operating revenue, cost and profit are deflated to 2006-constant prices using GDP deflator from World Bank. Unit: RMB million. Data sources: Annual reports of the four airlines.

(2014). We compute the change in marginal cost before and after the merger to be about −6%.

We then employ Equation (2) to compute the cost saving from the merger at RMB 3449 million. Following Fig. 1, an increase in profits after the merger comes from market power and cost saving effects. Given an RMB 4141 million increase in operating profit, the contribution of market power to that increase is RMB 692 million. The market power effect is consistent with the positive and significant reaction of Air China and China Southern on one day after the merger announcement between China Eastern and Shanghai Airlines. Further, the market power effect is consistent with the existing literature examining the 2009 merger between China Eastern and Shanghai Airlines, Zhang (2015) finds that average airfares on seven domestic Shanghai-based routes of China Eastern increased 22% two years after the merger, suggesting that the merger increased China Eastern's market power. Ma et al. (2020) finds an increase in airfares on routes China Eastern and Shanghai Airlines served after they merged.

Overall, the contributions of market power and cost saving to the increase in profit after the merger are 17% and 83%, respectively. Assuming the contribution of these two factors remain unchanged over time, the wealth effect from the merger between China Eastern and Shanghai Airline (RMB 7.97 billion) attributes nearly four-fifths to a market power effect and the other one-fifth to a productive efficiency effect.

4. Further analysis on competing airlines

Although our decomposition methodology only uses information on the merging airlines, a further look at the operating statistics and CARs of competing airlines (serving as the control group) will inform whether our decomposition result is merger-specific or common in the market. Here, we perform the same calculation for the two major competitors of China Eastern: Air China and China Southern.

Before the merger between China Eastern and Shanghai Airlines, China Eastern, Air China and China Southern were similar in size (in terms of operating revenue and operating cost). Yet after the merger, Air China and China Southern increase their size more than China Eastern. This phenomenon is consistent with the prediction of a Cournot model, which predicts that the merging firms lose market share to non-merging firms after the merger.[13] The non-merging competing airlines (Air China and China Southern) enjoy a larger increase in size. Nonetheless, the merging airline enjoys a larger rise in profit, which suggests the merger boosts the relative profit of China Eastern to the other two airlines.

Turning to the results on percentage changes in MC, the marginal costs of the two competing airlines decrease less than that of China Eastern. As a result, during the same period, the cost saving only contributes 53% and 18% of the profit increase for Air China and China Southern, respectively.[14] In sum, the decomposition analysis of competing airlines suggests that the cost-saving (efficiency improvement) contribution to profit and shareholders' wealth in the China Eastern and Shanghai Airlines merger is merger-specific.

5. Conclusion

Adding to the empirical literature on merger effects and specifically to the mixed evidence on China's airline deregulation policies, this paper proposes a decomposition framework for the wealth effects of airline mergers. To illustrate our methodology, we analyze the merger between China Eastern and Shanghai Airline in 2009. Our case study results suggest that productive efficiency produced nearly four-fifths of the merged airline's wealth effect (RMB 7.25 billion), while increased market power produced about one-fifth. Further, our results are consistent with the prior studies that identify a productive efficiency effect (Ho et al., 2020) and a market power effect (Ho et al., 2020; Ma et al., 2020; Zhang, 2015) of the merger. Relying only on publicly available data, our decomposition method is practical and offers policy makers a useful framework for understanding and evaluating the wealth effects of airline mergers.

CRediT authorship contribution statement

Chun-Yu Ho: Conceptualization, Methodology, Writing- Original draft preparation. **Patrick McCarthy:** Writing - review & editing,

[13] We employ the prediction of Cournot model because the production of airline has capacity constraint. Thus, Cournot model can be used to analyze for both quantity and price competition (Kreps and Scheinkman, 1983).

[14] A larger contribution of cost saving to profit for Air China may be driven by its merger with Shenzhen Airlines in 2010.

Visualization, Supervision. **Yanhao Wang:** Formal analysis, Software, Validation.

References

Binder, J. J. (1985). Measuring the effects of regulation with stock price data. *The RAND Journal of Economics, 16*(2), 167–183.
Brander, J. A., & Zhang, A. (1990). Market conduct in the airline industry: An empirical investigation. *The RAND Journal of Economics, 21*(4), 567–583.
Brander, J. A., & Zhang, A. (1993). Dynamic oligopoly behavior in the airline industry. *International Journal of Industrial Organization, 11*(3), 407–435.
Brown, S., & Warner, J. (1985). Using daily stock returns: The case of event studies. *Journal of Financial Economics, 14*, 3–31.
Cameron, C., & Trivedi, P. (2005). *Microeconometrics*. New York: Cambridge University Press.
Carhart, M. (1997). On persistence in mutual fund performance. *Journal of Financial Economics, 52*(1), 57–82.
Dimson, E. (1979). Risk measurement when shares are subject to infrequent trading. *Journal of Financial Economics, 7*, 197–226.
Eckbo, B. E. (1983). Horizontal mergers, collusion, and stockholder wealth. *Journal of Financial Economics*, 241–273.
Fama, E. F., & French, K. R. (1993). Common risk factors in the returns on stocks and bonds. *Journal of Financial Economics, 33*(1), 3–56.
Fama, E. F., & French, K. R. (1995). Size and book-to-market factors in earnings and returns. *The Journal of Finance, 50*(1), 131–155.
Fama, E. F., & French, K. R. (2012). Size, value, and momentum in international stock returns. *Journal of Financial Economics, 105*(3), 457–472.
Flouris, T., & Swidler, S. (2004). American airlines' takeover of TWA: An ex-post analysis of financial market information. *Journal of Air Transport Management, 10*(3), 173–180.
Hergott, M. J. (1997). Airport concentration and market power: An events study approach. *Review of Industrial Organization, 12*(5), 793–800.
Ho, C.-Y., McCarthy, P., & Wang, Y. (2020). *Competition and countervailing power: Evidence from the China eastern and Shanghai airlines merger*. Working Paper.
Knapp, W. (1990). Event analysis of air carrier mergers and acquisitions. *The Review of Economics and Statistics*, 703–707.
Kreps, D. M., & Scheinkman, J. A. (1983). Quantity precommitment and Bertrand competition yield Cournot outcomes. *The Bell Journal of Economics*, 326–337.
Ma, W., Wang, Q., Yang, H., & Zhang, Y. (2020). Evaluating the price effects of two airline mergers in China. *Transportation Research Part E: Logistics and Transportation Review, 141*, 102030.
MSCI. (2013). Foundations of factor investing. *Research Insight* (December).
PwC. (2017). Success factors in post-merger integration: Deal makers share their recipes for success. *M&A integration survey report*.
Scholes, M., & Williams, J. (1977). Estimating beta from nonsynchronous data. *Journal of Financial Economics, 5*, 309–328.
Singal, V. (1996). Airline mergers and competition: An integration of stock and product price effects. *Journal of Business*, 233–268.
Williamson, O. E. (1968). Economies as an antitrust defense: The welfare tradeoffs. *The American Economic Review, 58*(1), 18–36.
Zhang, Y. (2015). Merger between airlines in financial distress: Does the merger save them? *Competition and Regulation in Network Industries, 16*(1), 66–81.
Yan, J., Fu, X., Oum, T. H., & Wang, K. (2019). Airline horizontal mergers and productivity: Empirical evidence from a quasi-natural experiment in China. *International Journal of Industrial Organization, 62*, 358–376.
Zhang, A., & Aldridge, D. (1997). Effects of merger and foreign alliance: An event study of the Canadian airline industry. *Transportation Research Part E: Logistics and Transportation Review, 33*(1), 29–42.
Zhang, Q., Yang, H., Wang, Q., & Zhang, A. (2014). Market power and its determinants in the Chinese airline industry. *Transportation Research Part A: Policy and Practice, 64*, 1–13.