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The Determinants of Systematic Risk Exposures of Airline Industry in East Asia

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Abstract: There is a gap in understanding the sources of systematic risk exposure for East Asia airline industry. This study aims to fill in this gap using a panel regression of seven long established listed airline companies in the region. We find that only size and operating efficiency are positive and significant related to systematic risk, while airline safety is negative and significant and negative associated with the systematic risk. We also documented that East Asia airline's systematic risk are significantly higher during the 2000 Dot-Com crisis, but not significantly affected by the 1997 Asian financial crisis or the 2008 subprime crisis.

Key words: Airline・Systematic risk・Determinants・Equity・Asset pricing・CAPM

INTRODUCTION

Within the last few decades the East Asian airline industry has become exposed to frequent high systematic risk. Among these risks are: unpredictable oil price, outbreak of disease, financial crisis and economic recession. The share price of stock market listed airline companies can be vulnerable and influenced by these systematic risks, leading to unstable source of equity capital. Even though systematic risk arises from uncontrollable external factors, however, managerial decisions can change the degree of systematic risk exposure [1]. Managerial decisions on finance, operations and investments do affect financial performances, which in turn affect exposure to systematic risk. During an economic recession the airline can choose strategies that manage the extent to which economic slowdown has on its operating profits even though the airline cannot prevent the economic downturn itself. For example, plane leasing rather than ownership can shift toward a lower operating leverage.

This paper examines the determinant of systematic risk for the listed airline companies in East Asia. While many studies have investigated how different firm-specific factors affect the systematic risk of the listed airline companies, most of the literature had been focused on US or Western airlines. The airline business in East Asia is different to European or American markets [2]. We only encounter one study- [3] whom examined the potential factors affecting the systematic risk of Taiwan airlines, but their research is limited to two airline companies. This study extends the investigation to a greater number of airlines in a greater number of countries - a panel of seven listed companies from seven East Asian countries. With panel regression, we provide fresh empirical evidence on the determinant of systematic risk for the airline industry in the East Asia region as a whole.

The rest of this paper is organized as: literature review in Section 2, research model, framework of the analysis, data employed and sources in Section 3, results and findings in Section 4 and concluding comments in the final section 5.

Literature Review: In finance, Capital Assets Pricing Model (CAPM) has been widely used in asset pricing. When employing CAPM for the estimation of expected equity returns, the regression beta (coefficient) which represents the relative volatility of individual stock returns against market returns is taken as the measure for systematic risk. Previous studies have shown that several firm specific fundamentals have influence on systematic risk exposure, i.e. the beta. Based on the literature, the potential list of determinants for beta include: firm size, liquidity, profitability, financial leverage, operating leverage, business cyclicality, operating efficiency and growth.

It is well documented that large firms tend to have a lower beta as large firms are likely to be well diversified and therefore less prone to financial distress [4]. However, previous studies within the airline industry show a

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different result. While [3] found that firm size has no significant influence on an airline's beta, [1] found that firm size is negatively correlated with beta during a recession. Major airlines suffer from high fixed-costs which make them prone to suffer loss and hence suppressed stock price. While their argument may be true, we think the method of measurement for firm size (measured by total assets) play a part here. In order to understand this, one would have to look at a unique operation practice of airline industry. Over the years leasing of aircraft had been common practice, especially for small companies [2]. For the past decade around half of the world aircraft under operation are leased [5, 6]. Operating lease account for one third of total lease and it is the most preferred type of lease [6]. While leasing offers better flexibility in capacity management where airlines can return the aircrafts to leasor during recession, it has a negative effect during booming period. During expansion, when airlines capacity is needed the most, they would have to pay highest lease cost [5]. Thus, major airlines usually prefer to purchase their own aircraft. As operating lease is not capitalized, airlines that operate leased aircraft will show substantial lower total assets on their balance sheet as compared to others who owned aircrafts.

Several researchers suggest a negative relationship between beta and liquidity [7-10]. This means firms with higher liquidity are expected to have less exposure to systematic risk. However, [3] found that liquidity has a positive and significant effect on the betas. An unusual finding, probably due to the small sample problem as they only covered two Taiwanese airlines. Previous studies also showed a negative relationship between beta and profitability [8, 10]. The reason is with higher profits, firms are less likely to face bankruptcy. This is especially true for firms that are highly leveraged. Profitability is usually measured by return on asset (ROA) as unlike return on equity (ROE), it is not affected by the company's capital structure.

[11, 12] suggested that the degrees of operating and financial leverage are significant determinants of beta also. Operating leverage measures the percentage changes in earnings before taxes and interests (EBIT) for a given percentage change in sales or revenues [12]. Operating leverage can also be defined through the relationship between fixed cost and variable cost. A business that has a higher proportion of fixed costs and a lower proportion of variable costs is said to have used more operating leverage. Firms whose revenues that are highly responsive to business cycle and operating leverage are likely to have high beta. Operating leverage is an important issue in airline industry. As mentioned earlier, usually airlines engage in either leasing of aircraft or purchasing it. During economic downturn, as people travel less oftern the number of airline passengers and airline revenues fall. This will greatly reduce the profit of those airlines that have high fixed cost.

[13, 14] proposed that beta is positively correlated with debt over equity ratios, a measure for financial leverage. A lot of empirical studies supported this notion, including [8, 11, 15, 16]. For operating efficiency, however, [8, 17] suggested that it is negatively correlated with beta. The reason is firms that are highly efficient in generating revenues with their assets will be more likely to be profitable and less likely to suffer loss, hence lower beta.

Depending on the variables used to measure growth, growth can have a contrasting relationship with beta. When growth is measured by assets growth or revenues growth, studies often show a positive relationship with beta. According to [18], firms often commit to debt leverage to obtain resources for investment in growth opportunity. As high leverage leads to higher financial risk, growth becomes positively correlated with beta. On the other hand, when growth is measured by earnings before interest and taxes (EBIT), it usually shows a negative relationship with beta [1, 17]. As investor value growth opportunities, firms with high growth usually maintain high stock prices whereas firms with low growth may see their stock prices more volatile.

A special variable that has received increasing attention in this line of literature is airline safety. Comparing to other businesses, the performance of the airline industry is exposed to the rate of accident that causes airline companies to suffer financially. [19] found that specific airline's share price drop by 1.17% and 0.93% on the day of the event and on the following day. [20] found similar result where share price decline 1.35% on the day following disaster. They further conclude that consumers switch from an airline involved in an accident to their competitor, resulting in increased share price of competitors. [3] reported that air crashes significantly increased the beta of the airlines involved. In other words, airline safety level is negatively correlated with the systematic risk of airline companies. In fact, [1] used a different measure for airline safety level instead of air disaster, but their finding still concurs to the above causality. Nevertheless, [21] point out that the direct cost of a plane crash fall onto the insurance company; evidence of market responses to other accidents apart from the case of the 1979 McDonnell Douglas DC-10 is weak to non-existent.

Methodology and Data: CAPM implied that the expected rate of return on a stock is given by adding risk free rate to the stock risk premium. This relationship can be estimated using the following empirical regression:

$$\text{CAPM: } R_i - R_f = \alpha_i + \beta_i(R_M - R_f) + \varepsilon_i \quad (1)$$

Where:

R_i is expected rate of return of company I, R_f the risk free rate (treasury bills), R_M the return of market portfolio. The coefficients α_i and β_i are the estimated intercept and coefficient, respectively; and ε_i is the regression residual. The systematic risk or beta of the firm is captured by $_i\beta$.

[22] argue that CAPM may not be a good model for estimating airline betas. They found that R^2 obtained from CAPM has a low explanatory power. [3] estimated two betas for airline companies using CAPM and a more advance asset pricing model - the Fama-French 3-factor model (FF3F), and find that the values of the systematic risk could be significantly different. However, both CAPM and FF3F assume the local equity market is segmented from the world. We believe that the airline industry is a global business that connects the world, and hence these beta measures that assume a segmented world stock market are not really accurate to capture the systematic risk of the airline companies. Instead, airline companies should expose to world systematic risk. As such we employ a hybrid of the popular International CAPM (ICAPM) by [23] with FF3F. We shall call it the International FF3F (IFF3F):

$$\text{IFF3F Model: } R_i - R_F = \alpha_i + \beta_i (R_W - R_F) + \tau_i \text{SMB} + \lambda_i HML + \varepsilon_i \quad (2)$$

Where:

R_F is the international risk free rate, R_W the return of world market portfolio (commonly proxy by the US market factor), *SMB* the Small minus Big factor (Market Capitalization) or so called the size premium, *SML* the High Minus Low factor (Book to Market Value) or the value premium, and τ_i and λ_i are the estimated coefficients for the size and value premiums. The first factors in FF3F model is the usual market premium as in CAPM. The second factor represents the size premium. It is the difference in returns between portfolios of small capitalization firms and big capitalization firms; or commonly known as SMB (small minus big) factor. The third factor represents book-to-market premium, captured by the difference in returns between portfolios of high book-to-market and small book-to-market firms; HML (high minus low) factor. All these 3 world factors are proxy by the factors from the US market. This is because the US market has been commonly referred to as the world benchmark in asset pricing literature.

Some recent asset pricing studies shows that the FF3F model fails to captures the momentum anomaly, see for example [24]. Thus, we also estimate an augmented IFF3F model that account for the momentum factor. We shall call it the international 4-factor (I4F) model. The fourth factor is the momentum premium, which is the difference in average return between winner and loser portfolios (winner minus loser). We hope this additional setting can provide a means to robust checking in estimating the systematic risk, and also to ensure that the determinant investigation in the next section is robust to different construction of systematic risk. The I4F model is given as below:

$$\text{I4F Model: } R_i - R_F = \alpha_i + \beta_i (R_W - R_F) + \tau_i SMB + \lambda_i HML + \kappa_i MOM + \varepsilon_i \quad (3)$$

Where:

MOM = the momentum premium and κ_i the coefficient for the momentum premium.

We derived annual beta from 3-year rolling regression of weekly firm stock returns according to the 3 models described above. We use Wednesday stock price data to avoid day-of-the-week effect as documented in many stock anomaly literature. We then estimate a panel regression of the annual betas with the annual determinant series. The Panel model we established to explain the systematic risks of the East Asia airline companies are given as below:

$$\begin{aligned} \beta_{it}^{J} &= \delta_0 + \delta_1 FS_{it} + \delta_2 LQ_{it} + \delta_3 PF_{it} + \delta_4 OL_{it} \\ &+ \delta_5 FL_{it} + \delta_6 OE_{it} + \delta_7 GR_{it} + \delta_8 AS_{it} + \delta_9 D9799_{it} \\ &+ \delta_{10} D0002_{it} + \delta_{11} D0809_{it} + \eta_i + \varepsilon_{it} \end{aligned} \quad (4)$$

Where:

J = betas estimated from CAPM, IFF3F and I4F models. The details and abbreviations for the variables are listed in Table 1. The list of the coefficients (δ) are the sensitivity of the airline betas to its various potential systematic risk determinants. Based on the literature review in section 2, we can expect a positive sign for firm size (FS), operating leverage (OL), financial leverage (FL), while the coefficients for liquidity (LQ), profitability (ROA), operating efficiency (OE), and growth (GR) are expected to follow negative sign. There is still a lack of

Table 1: Name and Measure of the Explanatory Variables

Variable	Abbreviation	Measurement
Firm size	FS	Total assets
Liquidity	LQ	Quick Ratio
Profitability	PF	ROA
Operating leverage	OL	$\frac{\Delta EBIT}{EBIT} x \frac{Sales}{\Delta Sales}$
Financial leverage	FL	Debt ratio: total debts/total assets
Operating efficiency	OE	Asset turnover ratio: total revenue/total assets
Growth	GR	EBIT growth: annual percentage change in EBIT
Airlines safety	AS	Dummy variable for year with accident = 1
Asian Financial Crisis	D9799	Dummy variable for 1997-1999
Dot-Com Bubble Burst	D0002	Dummy variable for 2000-2002
Global Subprime Crisis	D0809	Dummy variable for 2008-2009

Table 2: Details of the Sample Listed Airline Companies

No	Country	Company Name	Year of Establishment	Company Size in 2010 (Total assets in million USD)
1.	Japan	All Nippon Airways (ANA)	1952	18,926
2.	Korea	Korean Airlines (KAA)	1962	14,606
3.	Hong Kong	Cathay Pacific Airways (CPA)	1946	14,612
4.	Taiwan	China Airlines (CAL)	1959	6,614
5.	Singapore	Singapore Airlines (SAIR)	1947	16,003
6.	Malaysia	Malaysian Airlines (MAIR)	1947	2,491
7.	Thailand	Thai Airways Intl (TAI)	1960	8,163

Notes: The company size is converted as of exchange rate on 31st December 2009

consensus on the sign for airlines safety (AS), but since we are using a dummy variable that capture frequency of air incidents and accidents, we hypothesize that airlines beta will increase, as interpreted by [3].

We also added 3 dummy variables to see if the systematic risks of the East Asia listed airline companies are expose to various regional (the 1997 Asian financial crisis) and world financial crises (the early 2000 Dot-Com crisis and the 2008 Subprime Crisis) that occurred during our sample period. The effects of some economic crisis are more domestic in nature such as the 1997 Asian financial crisis, while some are believed to have less effect on Asia countries such as the 2008 Subprime Crisis. We have no reference as to which direction and to what extend these financial crises affect the airline companies' systematic risks and hence we do not construct any specific hypotheses (despite to see if they are statistically significant) regarding these binary variables. Lastly, note that the model also allows for a cross-section (firm) effect, captured by η_i. This is to allow different company to have various level of systematic risk due to different aviation policy in each country[1].

We covered seven listed airline companies, one each from Japan, South Korea, Hong Kong, Taiwan, Singapore, Malaysia and Thailand. These are the major airlines listed in East and Southeast Asia stock markets for quite some time[2]. The details of our sample companies are reported in Table 2. The stock prices and company information of these seven listed airline companies are downloaded from Datastream. The size, value and momentum premiums of the US market are obtained from the website of Kenneth French (http:// mba.tuck.dartmouth.edu/ pages/ faculty/ ken.french/ data_library.html). To ensure our data is consistent in sample size, our data for stock prices spanned from March 1993 to December 2009. A 3-year rolling regression (36 observations) was then estimated

[1]Another feature of panel data is random effect. The fixed effect specification assumes that company-specific effects are fixed parameters to be estimated, whereas random effect assumes that the company effects are randomly distributed across the individual companies. With fixed effects, we are assuming there is no correlation between the fixed effects and the determinants. The random effect assumption is valid if the sample were drawn randomly from a large population. Obviously this is not the case for our sample. The random effects are latent variables that are not directly observable.

[2]Other airline companies are excluded because they do not have sufficient listing sample (listed after 1997) or simply they are not listed in the stock market. With these criteria, there is no representative from China, Indonesia and Philippines.

for each company to generate an annual beta. These betas are the dependent variable in the panel regression (4). The actual sample for the panel regression for the determinant model is 1996-2009.

RESULT AND DISCUSSION

Table 3 provides the estimated systematic risks from the three different models for the full sample and during the three different crises periods. For the full sample, obviously these airline companies are exposed to less systematic risk under IFF3F as compared to under the CAPM and I4F. The betas derived here are found to be within the range of the findings of [3] on Taiwan airlines but are vastly different with [1] findings on US airlines (beta=1.8). The differences in systematic risk might be due to the differences in the airlines operating characteristics and market conditions. For the 1997 Asian Financial crisis, all the three betas clearly are lower than the betas of the full sample, but they are higher for the other two crises, except for the drop in CAPM beta for the sub-prime crisis.

Table 4 shows the estimated coefficients for equation (4). Using CAPM systematic risk, only operating efficiency is found to be statistically significant out of the 11 variables included. The R^2 of the model is 61.15% while adjusted R^2 is only 51.87%. When IFF3F and I4F systematic risks are used, more determinant factors are found to be statistically significant, namely firm size, operating efficiency, airline safety and 2000 Dot-Com crisis. Financial leverage is also found to be a significant factor under I4F systematic risk. R^2 for these two regression models are 56.87% and 53.53% respectively; whereas their adjusted R^2 are 45.33% and 42.43%, respectively. Note that our regression models achieved quite reasonable explanatory power as compared to those in [1] which reported to be about 22.9% and [3] ranging from 31% to 82%. Looking at the F-statistics, all three determinant models for systematic risks are found to be significant in general. The result of the fixed-effect F-test also implies our decision to impose the fixed effects is correct[3].

Table 3: Estimated Systematic Risks across the Different Periods

Period	CAPM systematic risk	IFF3F systematic risk	I4F systematic risk
Full sample	0.9782	0.4528	1.0015
Crisis 1997-1999	0.8179	0.8402	0.7632
Crisis 2000-2002	0.9435	1.3895	1.2335
Crisis 2008-2009	0.9914	1.1437	1.1065

Table 4: Panel Regressions Explaining Systematic Risks in East Asia Airline Companies

	Dependent Variable					
Independent Variables	CAPM systematic risk		IFF3F systematic risk		I4F systematic risk	
Intercept	0.5877	(0.8244)	-19.3255	(0.0000)***	-16.8258	(0.0002)***
Firm Size	0.0038	(0.9781)	1.0184	(0.0000)***	0.8911	(0.0001)***
Liquidity	-0.1238	(0.3924)	0.1829	(0.4476)	0.1173	(0.6126)
Profitability	0.0033	(0.6446)	0.0082	(0.4933)	0.0075	(0.5151)
Operating leverage	0.0396	(0.4996)	0.1085	(0.2672)	0.1301	(0.1682)
Financial leverage	0.0017	(0.5116)	0.0062	(0.1505)	0.0071	(0.0908)*
Operating efficiency	0.6335	(0.0038)***	1.2868	(0.0005)***	1.1720	(0.0009)***
Growth	-0.0029	(0.4746)	-0.0096	(0.1605)	-0.0064	(0.3302)
Airlines safety	-0.1131	(0.2391)	-0.3347	(0.0384)**	-0.3710	(0.0177)**
D97	-0.1220	(0.2502)	0.2705	(0.1271)	0.1524	(0.3693)
D01	-0.0445	(0.6142)	0.5777	(0.0002)***	0.3753	(0.0096)***
D08	-0.1188	(0.2492)	-0.1781	(0.2988)	-0.2004	(0.2255)
R^2	0.6115		0.5587		0.5353	
Adjusted R^2	0.5187		0.4533		0.4243	
Regression F-statistic	6.5917	(0.0000)***	5.3008	(0.0000)***	4.8231	(0.0000)***
Redundant Fixed Effect	7.3102	(0.0000)***	6.6358	(0.0000)***	6.1865	(0.0001)***

Note: ***, **, and * denote significance at 1, 5 and 10% significant levels, respectively.

[3]This is a Chow test to identify the existence of fixed (firm) effects. If we reject the null hypothesis of homogeneous effects across firms and over time, then a model capturing individual heterogeneity is more appropriate.

As hypothesized, two coefficients for firm size and financial leverage are positive and significant, conform to the expected signs in earlier study [1, 3]. The result implies that while East Asia airlines grow larger, the exposure to systematic risk tends to be larger. This might indicates that when these companies grow in size, they will opt for purchasing of aircrafts as oppose to leasing it. Some may even engaged in financial leverage, using debt leverage to finance the purchase of aircrafts. As mentioned earlier, the positive side of this policy is increase in profits during economic boom. Although companies face substantial downside risk during economic downturn as they would have to bare higher fixed-costs. Thus, the practice leads to cyclicality in revenue and stock price, which leads to increased systematic risk.

The sign of another significant variable, the operating efficiency is inconsistent with [1]. The result show operating efficiency is positively correlated with systematic risk. This unexpected finding suggests that the higher the operating efficiency, the higher the systematic risk. This probably can be explained by the "skimping" hypothesis proposed by [25] in banking industry.

According to skimping hypothesis, a bank that maximizes long-run profits may rationally choose to have lower costs in the short run. This can be done by skimping on the resources devoted to screening loan customers, appraising collateral and loans monitoring. This can make the bank appear to be cost efficient in the short run. Similarly, in the airline industry some airlines may choose to cut cost aggressively by attempting to reduce the amount of fuel remaining on board when a plane lands. They can also skimp on the resources devoted to training and safety equipment investments. These cost cutting measurements result in higher revenue but at the same time lead to higher systematic risk.

The estimated results also show that airlines incidents and accidents are negatively correlated with systematic risk. This finding is inconsistent with earlier research and the methodology we used for estimation of beta might contribute to this results. [26] found that stock price drop substantially after an airline accident, that reverse themselves to pre-accident prices within two days. So, when we derived our annual beta from rolling regression of weekly firm stock data, it might be due to this time interval difference and rapid reversal of stock price that cause the betas we derived to not capture the impact of accidents on systematic risk. Our dummy variable might actually capture a significant reversal effect in the prices after the accidents. Another explanation on the negative relationship between the proxy for safety and beta could be due to increases in firm-unique (non-systematic) risks and a drop in sensitiveness towards market movements (systematic risks) in the years where accidents occurred[4].

The results on the relationships between systematic risk and the crisis dummy variables are rather interesting. While intuitively the 1997 Asian financial crisis is expected to have an impact on East Asia airline systematic risk, the results show only the 2000 Dot-Com crisis are found to be positively correlated with East Asia airline systematic risk. This result could be due to cycles in the East Asia airline industry. We find that the Asian financial crisis reveal mixed-impact on the sample airlines. While Malaysia Airlines, Thai Airways, and Cathay Pacific Airways suffered losses, Singapore Airlines has continued to be profitable due to minimal debt, currency depreciation, effective cost control and increased visitors' number from Australia, China and India [27]. Also, [28, 29] have reported that reduction in load factors and dampening of revenue growth of Asian airlines are believed to be short term effect. Their view were supported by Boeing and Airbus, where both manufacturer expect Asia to be the biggest aviation market following quick restoration of demand to its pre-Crisis levels once economic start to recovery [30]. Furthermore, during the Asian crisis, European and North American markets remain buoyant. Moreover, the governments of Asian countries had signed open sky agreements with the United States; this certainly dilutes the negative impact of the Asian crisis. Nevertheless, Asian airlines were less fortunate in the event of Dot-Com bubble. Traditionally, Asian airlines order new aircraft one year after they experience a good year. Due to the high cost, aircraft manufacturers generally produce in line with the orders they received. Therefore, aircraft deliveries usually lag aircraft orders by 2-3 years [31]. Boeing order book shows that orders for new aircraft from Asian airline peaked around 1996/1997 [32]. Taking into consideration of delivery lags, Asian airlines received those orders around year 2000. Then was the start of economy deterioration in US due to bursting of Dot-Com bubble, and subsequently the events of September 11 that paralyzed the economy and a recession was inescapable [33]. During these periods, demand for air travel weakened. With the delivery of new aircrafts, airlines were facing overcapacity and eventually their earning yields eroded. Such negative impacts are so severe that it would induce bankrupt risk to them. Therefore, 2000 Dot-Com crisis shows positive correlation with systematic risk.

[4]We would like to thank an anonymous referee to point out this explanation.

CONCLUSION

This research investigates the determinants of systematic risk for East Asia airline industry. The systematic risk is proxy by betas estimated from CAPM, IFF3F and I4F models and the determinant model is based on existing wisdom from the literature. We employed a panel data of seven listed airline companies in East Asia (Japan, Korea, Hong Kong, Taiwan, Singapore, Malaysia and Thailand) from 1996-2009. Our estimated betas from the three models are found to be within the range of the findings of [3] reviewing Taiwan airlines. The estimated panel results are quite consistent. The estimation shows that among the fundamental firm factor, only size and operating efficiency are positive and significant related to systematic risk, while airline safety is negative and significant associated with the systematic risk. Another significant determinant is airline safety which is inconsistent with the literature. The outcome could be due to price reversal effect using the annual data or could be increases in firm unsystematic risk during year with airline accident. Last but not least, we documented that East Asia airline's systematic risk are significantly higher during the 2000 Dot-Com crisis, but not during the East Asian financial crisis or the recent Subprime crisis.

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