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Determinants of systematic financial risk exposures of airlines in North America, Europe and Asia

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A B S T R A C T

A five-factor asset-pricing model is employed to estimate the systematic financial risk exposure of airlines in North America, Europe and Asia between 1990 and 2010. Our panel data reveal that the risk to North America airlines is positively related to operating leverage and profitability, but while European and Asian airlines also have risk positively related to operating leverage, their risks are significant negative related to earnings growth. The most important systematic risk determinant for Asian airlines however is their size. Looking at the effects of operating leases and government ownership on Asian airlines' risk, we find that leasing is equally important as size but acts in the opposite sign; operating leverage is not significant while earnings growth is significant only for government owned airlines.

1. Introduction

Over the last few decades, the world airline industry has been exposed to frequent external shocks. Among others, the September 11 incident, the outbreak of SARS and H1N1, earthquake and tsunami that hit South and East Asian as well as economic based turbulences including the outbreak of the 1997 Asian Financial, the bursting of dot-com bubbles in the early 2000s, the 2008 subprime crisis, and the recent European sovereign debt crisis. In the US, the succession of troubles caused Northwest, US Airways, Delta Airlines and United Airlines to file for Chapter 11 bankruptcy protection in the last decade. American Airlines followed in 2011, after its share price plunged by more than 90% over ten years.

In finance, systematic risk occurs when investors are unable to fully diversify and is estimated using a capital asset pricing model (CAPM); basically the "beta" coefficient that relates the firm's stock return to the market portfolio Beta is used to estimate the weighted average cost of capital (WACC) that is used by business as the discount rate for project evaluations in capital budgeting and financial leasing.

Lee and Jang (2007) and Hung and Liu (2005)in looking at the determinants of systematic risk in aviation, focus on firm size, financial leverage, operating leverage, liquidity, profitability and growth, but do not consider off balance sheet factors, especially the effect of aircraft operating lease. Over the years, leasing of aircraft had been a common practice especially for small company; about half of the world's aircraft in operation are leased, with operating leases account for a third of these (Gavazza, 2010). As operating lease is not capitalized, airlines that operate leased aircraft will show substantial lower assets on their balance sheet as compared to others who own. This can cause a distortion in some of the potential systematic risk determinants, most notably firm size (measured by assets), profitability, financial leverage and operating leverage. We investigate this issue for Asian airlines.

Since the economic deregulation of airlines began in 1977 with the US domestic air cargo market, many airlines have privatized and rely more on external financing. In Asia this trend has been slower because of continued state interventions as part of larger trade and tourism policies as well as job creation and preservation (Chang and Williams, 2001). The general argument, however, is that private ownership can lead to better financial performance and resistance to cyclical downturns because government ownership limits the amounts of capital airlines can raise from other countries and prevents them merging with or taking over other airlines in other countries thus stymying their grow. What we know little about, are what firm-specific factors affect the systematic risk exposure of government-owned airlines, and how airline managers would control these factors to obtain more stable sources of capital.

2. Methodology and data

We examine systematic risk determination using three panels of listed airlines; 11 airlines from North America, 12 airlines from Europe and 18 airlines from Asia (Table 1).[1] We consider whether

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[1] The private airlines were all listed before January 2008.

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Table 1
Sample of airlines.

Airline	Assets (in $millions)	Airline	Assets (in $millions)
Group of North America airlines			
Southwest Airlines	14,179,000	WestJet Airlines	3,309,063
Air Canada	11,271,229	Republic Airways	3,239,658
US Airways Group, Inc.	7,421,000	AirTran Airways	2,098,776
JetBlue Airways	6,158,000	Pinnacle Airlines	1,362,346
Alaska Air	4,779,000	Hawaiian Airlines	973,710
SkyWest Inc	4,022,368		
Group of European airlines			
Air France	37,427,137	Turkish Airlines	5,589,795
Lufthansa	32,731,679	Aeroflot	4,525,900
British Airways	16,374,914	Air Berlin	3,274,765
Ryanair	8,550,153	Finnair	2,894,105
KLM	7,602,692	Aer Lingus	2,669,506
EasyJet	5,749,487	Cyprus Airways	286,475
Group of Asian airlines			
Japan Airline **	21,633,648	China Airlines *	7,402,677
All Nippon Airway **	20,825,502	Eva Air **	5,288,172
Singapore Airline *	19,338,575	Asiana Airlines	5,226,132
Korean Air	16,569,099	Jet Airways	5,200,964
Air China *	15,115,292	Malaysia Airlines *	2,966,974
Cathay Pacific	14,036,819	AirAsia	2,912,211
China Eastern Airlines *	11,025,791	Shandong Airlines	1,152,710
Thai Airways *	8,461,264	Skymark Airlines	221,824
Hainan Airlines	7,773,354	SpiceJet	168,177

All figure are based on exchange 31st December 2010 exchange rates; *denotes airlines with government ownership; **denotes airlines not included in the investigation of the impact of government ownership on systematic risk exposure in for Asia airlines.

Table 2
Explanatory variables.

Variable	Measurement
Firm size	Total assets
Liquidity	Quick Ratio
Profitability	Returns on Assets
Financial leverage	Debt ratio: debts/assets
Operating leverage	$\frac{\Delta \text{EBIT}}{\text{EBIT}} \times \frac{\text{Sales}}{\Delta \text{Sales}}$
Growth	EBIT (earning) growth: annual % change in EBIT
Operating lease	Operating lease expense

systematic risk determinants vary across the regions, that in aggregate account for 80% of global airline business, and across the whole market allowing us to see whether the determinant changes generally as well as by region. In particular we are concerned with the role of operating leases and ownership.

There are some issues concerning the estimation of risk. Turner and Morrell (2003) argue that CAPM may not be a good model for estimating airline betas because of its weak statistical powers, while Hung and Liu (2005) estimate betas for airlines using CAPM and the Fama–French 3-factor model (FF3F) that includes a value and a size premium, found that the values of the systematic risk could be significantly different. More recent studies, however, have show that the FF3F model fails to captures momentum and industry-related anomalies. Jegadeesh and Titman (1993), for example, find that stocks that outperform the average over the last three to 12 months tend to continue their uptrend trajectories for the next few months, and stocks that underperform continue to do poorly. This momentum effect is different from the value effect captured by book-to-market equity and other price ratios. To account for this, we include a momentum premium in estimating systematic risk. This is the difference in average return between winner and loser portfolios (winner minus loser).[2]

We estimate an augmented FF3F model that account for both the momentum factor and industry-related factor, but as with the CAPM model, assume the local equity market is segmented from the world because of the segmented international financial market. Since the airline industry is a global business, beta measures that assume a segmented world stock market do not really capture the systematic risk of the airline companies that are expose to world systematic risk. Thus, a global, capital asset pricing model would be more relevant where the beta of each stock is measured with reference to the global capital market index and the market premium to be used is the global equity risk premium. We thus use a hybrid of the International CAPM (ICAPM) and the augmented FF3F model that accounts for both the momentum and industry factors; the International 5-factor model:

$$R_i - R_F = \alpha_i + \beta_i(R_W - R_F) + \tau_i \text{SMB} + \lambda_i \text{HML} + \kappa_i \text{MOM} + \gamma_i \text{IND} + \varepsilon_i \quad (1)$$

where R_i is expected rate of return of company i, R_F is the international risk free rate, R_W the return of world market portfolio (proxy by the MSCI US Price Index), SMB is the small minus big factor (market capitalization) or the size premium, HML is the high minus low factor (book to market value) or the value premium, MOM is the momentum premium, IND is the industry-related premium and $\tau_i, \lambda_i, \kappa_i$ and κ_i are estimated coefficients. The latter are positive if investors expect to be compensated with a positive risk premium on each loading factors.α_i and β_i are the intercept and coefficient; and ε_i the residual. The systematic risk or beta of the firm is captured by the β_i.[3]

Based on Equation (1), the annual betas over the period of 1993–2010 are calculated with three-year rolling parameters of monthly firm stock returns for January 1990 to December 2010. We assume markets are internationally integrated and hence the risk premium is common across the globe. We utilize size, value, momentum and industry premiums of the US market as a proxy for the world risk premiums for the various factors.[4]

To investigate the determinant of the systematic risk we estimate a panel regression of the annual betas with the annual series of the explanatory variables:

$$\beta_{it} = \delta_0 + \delta_1 \text{FS}_{it} + \delta_2 \text{LQ}_{it} + \delta_3 \text{PF}_{it} + \delta_4 \text{FL}_{it} + \delta_5 \text{OL}_{it} + \delta_6 \text{GR}_{it} + \eta_i + \xi_t + \varepsilon_{it} \quad (2)$$

where δ, the list of the coefficients is the sensitivity of the airline betas to various potential systematic risk determinants. Definition for the variables are in Table 2.

Information was collected from the annual report of individual airlines from 1993 to 2010, but due to data availability and inconsistencies, the period is shorten from 1997 to 2010 for the investigation on the effect of operating lease and government ownership[5] on Asian airlines.

The panel model also controls for a cross-firm effects, captured by η_i and period effects captured by ξ_t. The inclusion of firm effects is to allow companies to have various level of systematic risk due to different aviation policies in each country. Similarly, the panel

[2] Companies within the same industry may show higher comovements in their stock returns because their shares have more common fundamentals than companies across different industries. Chou et al. (2012) finds that industry portfolios carry significant risk premiums that provide additional explanatory power for stock returns beyond size, book-to-market, and momentum effect.

[3] As we use rolling regression method to generate a time series of beta for every firm, we do not report the estimations in this paper to conserve space.

[4] These data are available at http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.

[5] The list of government ownership airlines in Asia is based on Gibson and Morrell (2010).

Table 3
Descriptive statistics.

	Mean	Maximum	Minimum	Std. dev.
North America (122 Obs)				
Beta	0.16	7.97	−20.47	2.54
Firm size	14.18	16.71	8.20	1.42
Liquidity	1.10	3.80	0.09	0.71
Profitability	0.72	30.72	−391.91	36.64
Financial leverage	36.50	89.01	0.00	18.96
Operating leverage	−10.84	959.60	−1987.36	209.62
Growth	58.90	1262.30	−479.17	223.22
Europe (131 Obs)				
Beta	1.41	35.97	−1.24	3.33
Firm size	15.41	18.34	12.18	1.37
Liquidity	1.12	3.19	0.37	0.56
Profitability	4.42	19.17	−24.53	5.66
Financial leverage	32.49	62.59	0.07	13.55
Operating leverage	−10.11	577.71	−2787.67	261.15
Growth	97.66	6348.00	−626.66	610.63
Asia (209 Obs)				
Beta	0.72	6.59	−10.16	1.51
Firm size	18.52	23.64	13.89	2.34
Liquidity	0.65	2.12	0.09	0.38
Profitability	2.85	17.34	−32.26	6.73
Financial leverage	49.37	128.06	0.00	23.04
Operating leverage	−3.09	1851.69	−2670.51	264.33
Growth	86.72	7193.34	−1588.07	689.75
Full sample (462 Obs)				
Beta	0.77	35.97	−20.47	2.46
Firm size	16.49	23.64	8.20	2.67
Liquidity	0.90	3.80	0.09	0.58
Profitability	2.73	30.72	−391.91	19.59
Financial leverage	41.18	128.06	0.00	21.05
Operating leverage	−7.13	1851.69	−2787.67	249.61
Growth	82.48	7193.34	−1588.07	577.15

systematic risk equation is likely to change over time because market conditions vary from year to year. Economic crisis represent a systematic shock that might correlated with operating and financial policies of airlines as airlines readjust their policies. Therefore, such systematic shocks would correlate with the error terms and the estimator would be biased. To avoid such bias, we introduced time period effects.

3. Results

Table 3 provides a summary of descriptive statistics of the estimated betas and the six variables examined. The average beta for the subsample of North America airlines is lower than both the values of European and Asian airlines indicate that the former have the lowest systematic risk exposure. The range of systematic risk levels across airlines is wide, as documented by the minimum and maximum beta values.

In terms of assets, Asian airlines are the largest, and North American airlines the smallest. Liquidity is substantially higher, on average, for North America and European airlines than for Asian airline companies. During the study period, European airlines on average have the highest rate of return on asset which measure profitability, follow by Asia and North America airlines. The mean level of financial leverage adopted by Asian airlines is the highest with European carriers having the lowest. Regarding operating leverage, airlines in North America and Europe have almost the same average levels while Asian airlines have substantially lower mean operating leverages. However, the operating leverage of Asian airlines ranging from −2670% to 1851% indicating that some of the Asian airline adopted operating policies that favor high fixed-cost over variable-cost. The average growth rate in earnings before interest and taxes (EBIT) for European airlines is substantially higher than North America airlines, at almost two times the level of North America airline companies.

We find the mean and range of systematic risk for the full sample indicates an average systematic risk of less than unity and that the stocks of the airlines could be viewed as defensive in nature over the period. The simple arithmetic mean of firm size shows a wide variation across carriers, reflecting the inclusions of major airlines with global presences to regionals that mainly serve small and isolated communities in domestic markets. The liquidity ratio represent a rough measure of a company ability to use its cash, cash equivalent and other quick assets to pay back current liabilities; a company with a quick ratio of less than one suggests it does not have the ability to pay back its current liabilities and in danger of bankruptcy. For the average airline, the mean liquidity ratio is 0.90 and many have a lower value.

The returns-on-assets gives an idea how efficient an airline management in using company assets to generate earnings. It is an airline's annual net income as a percentage of its assets. The considerable dispersion of values, and the low mean, for the period highlight the challenges most airlines through. The mean of debt ratio is 41.18 varies from no financial leverage to 128.06 suggesting that most airlines are highly leveraged with debt on average exceeding assets by an order of 40.

The operating leverage ratio shows that a small percentage change in sales will result in a significant change in airlines' EBITs. The mean of EBIT growth rates and their ranges indicates that despite airlines on average reported net annual losses, their EBIT is growing at a rate of about 82% a year and the low returns-on-assets is probably due to high interest expense due to leveraging.

Fig. 1 shows the average beta values the full sample; 17 carriers have values between zero to one, which is consistent with Turner and Morrell (2003). Eight airlines have average beta value in between 1.01 and 2 and nine a negative mean beta value. The remaining seven airlines have beta value exceeding two. Turner and Morrell point to a number of possible reasons why the average beta values are on the whole much lower than the market. One of the possible reasons is an airline's stocks might not have sufficient trading volume to respond sufficiently to changes in the market. If high propositions of an airline's stocks are hold by parties such as government, institutions or other airlines who are not interesting in trading actively, the airline returns may not be as sensitive to shocks in the market. The result of this is the airline returns might become less correlated with the market returns, and therefore has a lower beta value. Alternatively, the lower beta values may be the result of the market has becoming more volatile over time. During the past decades, there are increasing numbers of IT and telecommunications listing in the stock market. These companies' stocks are considered as highly volatile stocks. As such, the airline industry may have become relatively less volatile due to the present of these highly volatile stocks. Since the beta values measures the relative volatility in stock returns between individual companies and the market, the beta values for airlines may indeed have fallen. On the other hand, exceptionally high beta value of certain airlines might be due to IPO premium.

Table 4 reports panel regression estimates; these are different across regions because of variations in airline operating characteristics and market conditions. The analysis provides are reasonably good fits compared Lee and Jang (2007) and Hung and Liu (2005).[6] The estimations show systematic risk determinants vary

[6] The results of the fixed-effect *F*-test also imply the imposition the fixed effects is correct When applying the panel based model to North America airlines, profitability and operating leverage are the significant beta determinants in the two-way fixed effect model. But this fails to pass redundancy testing and the result show that period fixed effect can be excluded. With the two-way model, profitability and operating leverage are significant but there is over fitting. Using a one-way fixed effect model again leaves the redundancy testing showing the period effect is not significant.

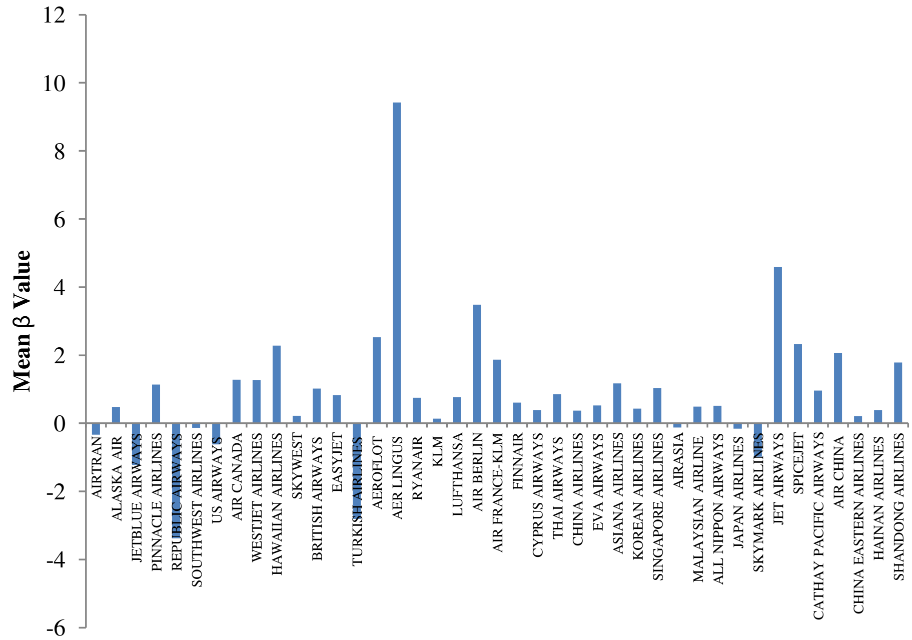

Fig. 1. Average beta of the airlines.

by region, with operating leverage the only variable that is positive significant in all of them that is consistent with the previous findings. For North America airlines, profitability is also significant positive, but European carriers, the EBIT growth is negative significant. For the Asian airlines, firm size is positive significant while EBIT growth is negative significant similar to European airlines.

For Asian airlines, operating leverage appears a significant systematic risk determinant for a different reason. In 2008, labor cost only accounted for 14.7% of their operating costs, compared to 22–25% for North America and Europe carriers, but they have on average 26.2% and 20.2% more assets compared to their North America and European counterparts. As a result of rapid economy development in Asia its airline industry is expanding rapidly and its airlines' profits were double those in the rest of the world in 2010 and their growth rates are stronger than their Europe and North America counterparts. Facing with rapid increases in demand, Asian airlines were purchasing more aircraft to take a larger piece of market share. Such policies, however, pose greater risk because of operating leverage.

The asset heavy policies could also be the reason why assets appear to be significant for Asian airlines. Around half of the world aircraft are leased (Oum et al., 2000), with operating lease account for one third of these (Gavazza, 2010). Leasing offers flexibility in capacity management where airlines can return the aircrafts to lessor during economic down times and thus reduce systematic risk exposure. During economic booms, when airlines need capacity, they have to pay highest lease cost. Faced with rising demand, airlines in Asia usually prefer to purchase their own aircraft making them more susceptible to systematic risk exposure.

For European and Asian airlines, EBIT growth is another significant determinant of systematic risk exposure. Over the 18 years study period, European airlines have enjoyed the highest EBIT growth, followed by Asian airlines. Their respective mean EBIT growths are substantially higher than that of North America airlines. The negative coefficient for EBIT growth supports the theoretical argument that high growth rate in EBIT provide a cushion for airlines to manage financial and operating leverage and thus helping to lower systematic risk exposure.

Profitability appears to be only significant for systematic risk exposure of North America airlines. The impact of profitability on systematic risk may be depending on corporate strategic decision. During the 18 years of our sample period, North America airlines recorded much larger range of profitability ratio compared to European and Asian airlines. During good year, highly profitable companies might soon accumulate a substantial amount of retained earnings. The earnings need to be distributed to shareholder as dividend or reinvested in opportunities that offer positive net present value of cash flow. However, in North America, most companies' compensation plan for management is tied to the size of the firm. In such case, management is likely to be more inclined toward reinvesting earnings. Those airlines may implement excessive growth strategies or over stretch the resources and thus be exposed to high systematic risk.[7]

Table 4
Systematic risks in US, European and Asian Airlines.

	North America	European	Asia	Full sample
Intercept	0.0438	15.1432	−9.3904	2.1459
Firm Size	0.0525	−0.9659	0.5443**	−0.0807
Liquidity	−0.3465	0.0403	0.2177	0.0443
Profitability	0.0064**	0.0858	−0.0083	0.0074**
Financial leverage	−0.0066	0.0240	−0.0014	−0.0023
Operating leverage	0.0020***	0.0007**	0.0006**	0.0006***
Growth	0.0002	−0.0005***	−0.0001**	−0.0001**
Adjusted R^2	0.1757	0.1598	0.3673	0.2135
F-statistic	2.6123***	1.7272***	4.0185***	2.9868***
Redundant fixed effect	2.2386***	2.0600***	4.6308***	3.1595***

*** and ** denote significance at 1 and 5% significant levels.

[7] The results do not fully agree with Lee and Jang (2007), who found positive financial leverage, negative profitability, positive firm size, negative growth and negative safety effects on US airlines. For North American airlines, we find that profitability and operating leverage are the only significant determinants. Besides the US, our sample includes airlines from Canada and only five airlines are in both the samples. By the end of 2010, most of Lee and Jang's airlines had ceased operation, merged or filed for Chapter 11 Bankruptcy. One would expect an airline struggling to stay afloat will have: highly debt leverage, over capacity, low profitability and low growth rate. It is these four firm characteristics that found to be significantly correlated with systematic risk in their study.

Table 5
Systematic risks in Asian airline companies.

	Full sample	With government ownership	Without government ownership
Intercept	−1.2377	−23.0979	−4.0625
Firm Size	0.2826**	1.4383	0.4000***
Liquidity	0.5884	1.2788	0.3257
Profitability	−0.0221	−0.0131	−0.0180
Financial leverage	0.0106	−0.0013	0.0113
Operating leverage	0.0001	0.0012	0.0000
Growth	0.0000	−0.0006**	0.0002
Operating lease	−0.2686***	−0.1169	−0.2326***
Adjusted R^2	0.6651	0.5644	0.7923
Regression F-statistic	7.8342***	3.4836***	10.5339***
Redundant fixed effect	8.1417***	3.8358***	9.5041***

*** and ** denote significance at 1 and 5% significant levels.

Comparing the results of subsamples with the full sample, we find that the results are pretty much as expected. For the full sample, profitability, operating leverage and growth are significant beta determinants. The results of our subsamples indicate that operating leverage - the dominant significant beta determinant of full sample, is the result of joined contribution by airlines in North America, Europe and Asia. The significance of profitability as the second most important beta determinant for full sample is probably due to the contribution of North America companies, while growth is probably jointly contributed by airlines in Europe and Asia as both variables are significant in our subsample analysis.

Table 5 shows the estimates for Asian airlines with the additional independent variable, operating lease, together estimates for subsamples with government ownership and without from 1997 to 2010. The results are fairly consistent across the estimates. In the full sample with operating lease, firm size and operating lease turn out to be significant variable. The negative coefficient of operating lease supports the hypothesis that leasing offers airlines better flexibility in capacity management where they can return the aircrafts to lessor during economy down time, thus helping airlines to weather crunch time and reduce their systematic risk exposure.

The results for airlines without government ownership are fully consistent with the results of the full sample. However, when applying the panel regression model to subsample of government ownership, only EBIT growth is significant with negative coefficient. The finding is somewhat expected as over the study period, airlines with government ownership recorded substantially higher EBIT growth than those without government ownership.[8] The inconsistency between the results of full sample and subsample with government ownership is probably because there are more than 50% airlines are without government ownership in the full sample, leading to the domination of the result from those of without government ownership airlines.

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[8] EBIT growth is substantially higher, on average, for airline with government ownership than for airline without government ownership.