The Impact of Merger and Acquisition on Value at Risk (VaR): A Case Study of China Eastern Airline

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The Impact of Merger and Acquisition on Value at Risk (VaR): A Case Study of China Eastern Airline

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This paper attempts to examine the impact of merger and acquisition on Value at Risk (VaR) of China Eastern Airline. The VaR is estimated for the whole sample and pre-merger periods by three methods: RiskMetrics^{TM}, AR-GARCH and Generalized Extreme Value (GEV). The regression-based model reports the highest VaR followed by RiskMetrics^{TM} and GEV. All models report a low VaR after the 11 June, 2009 merger, indicating a negative impact of merger and acquisition on VaR.

Keywords: Value at Risk, merger and acquisition, GARCH

JEL Classification Codes: G11, G34

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1 Introduction

RiskMetrics^{TM} , first established by J.P.Morgan in 1989, is a popular model to estimate Value at Risk (VaR) by professionals in the industry. Nonetheless, the underlying assumptions (for instance, Integrated Generalized Autoregressive Conditional Heterskedasticity (IGARCH) and zero mean equation) have been challenged by empirical evidences. This paper is a case study of estimating the VaR of China Eastern Airlines, with the purpose of comparing the performances of Risk Metrics, regression-based approach and the semi-parametric Generalized Extreme Value (GEV) methods.

1.1 Challenges of China Airline Industry

Civil aviation in China began in the People's Republic of China in 1949 with the establishment of the General Administration of Civil Aviation of China. In 1987, the Chinese government took an aggressive step to break the airline operations of General Administration of Civil Aviation of China into a number of state-owned enterprises. The regulatory role was retained by the General Administration of Civil Aviation of China which is now known as Civil Aviation Administration of China. Ever since then, the China's passenger airline industry has been experiencing startling growth.

In 2009, passenger throughputs of all nationwide airports reached 486.063 million (up by 19.8%) annually while cargo and mail throughputs reached 9.456 million tons (up by 7.0%). The number of airports with passenger throughput over one million person-trips was 51, which was four more over previous year. Besides, the number of airports with cargo and mail throughput over 10 thousand tons was 45, an increase of one relative to 2008. Moreover, 51 airports had over 10 thousand takeoffs and landings annually, increasing by four as compared with last year.

In spite of all these, tepid profit growth is expected for China's airline industry in 2013. According to the Civil Aviation Administration of China, profits for the airlines industry in 2011 rose only by 5.1 percent, which was far less than the real Gross Domestic Product (GDP) growth. One of the factors was the rivalry from high-speed trains which had created a headache for airline carriers when it came to domestic routes, even if the authorities had decided to slow the rate of expansion of railway lines amid concerns about safety and excess capacity. For instance, domestic airlines plying some air routes, notably between Beijing and Shanghai, had to cut prices as a result of growing competition from fast trains, while other routes had closed. Other factors that dimmed the business prospects for China's airline industry were slackening global air market, rising oil prices, weak capabilities of air companies to cope with rising challenges, and the inability to fulfill international safety standard. These unfavorable factors clearly increased the market risk of China's airline industry.

1.2 History of China Eastern Airline

China Eastern Airlines is China's second-largest carrier by passenger numbers and the

world's third-biggest carrier by market value[1]. In 2010, China Eastern Airlines carried 64.93 million domestic and international passengers with an average load factor of 78% and reported a net profit of CNY5.3 billion ($807 million). It is headquartered in the China Eastern Airlines Building, on the grounds of Shanghai Hongqiao International Airport in Changning District, Shanghai, China. It is a major Chinese airline operating international, domestic and regional routes. Its main hubs are at Shanghai Pudong International Airport and Shanghai Hongqiao International Airport, with secondary hubs at Kunming Changshui International Airport and Xi'an Xianyang International Airport.

On 11 June 2009, it was announced that China Eastern Airlines would merge with Shanghai Airlines. The merger was expected to reduce excess-competition between the two Shanghai-based carriers and to consolidate Shanghai's status as an international aviation hub. In February 2010, the merger was completed and Shanghai Airlines became a wholly owned subsidiary of China Eastern Airlines. However, Shanghai Airlines would retain its brand and livery. The new combined airline was expected to have over half of the market share in Shanghai, the financial hub of China. Other than estimating the VaR of China Soutern Airline, the 2009 acquisition was treated as a natural experiment to test the impact of merger on VaR.

This paper is structured as follows. Section 2 delineates the VaR estimation methodology. Section 3 is devoted to data description and summary statistics. Section 4 reports the results and section 5 concludes the article.

2 Methodology

The history of value-at-risk (VaR) was closely related to the finance sector, especially banking. In striving for financial stability, a first landmark decision (Basel 1988) accords with the central banks from the G-10 countries, that defines a minimum standard of capital requirements for commercial banks using a percentage of risk-weighted assets. As several definitions for VaR is illustrated, it basically indicates the greatest potential loss of a position or a portfolio, which can be verified with a certain probability, in a defined time horizon (Tardivo 2002; Best 1998). VaR summarizes the expected maximum loss (or worst loss) over a target horizon within a given confidence interval (Jorion 2002). These definitions already give hints on several important characteristics of VaR. First, it can be computed either for a single position or for a diversified portfolio. Second, it has some discretionary power, in which both the holding period (time horizon and target horizon) and the confidence interval need to be defined by the user. Formally, it can be defined as

$$p = \Pr[\Delta V(\tau) \geqslant VaR] = 1 - G_\tau(VaR)$$

where $\Delta V(\tau)$ denotes change of portfolio value over horizon τ; $G_\tau(VaR)$ is the cumulative distribution of loss.

[1] Air China, China Southern and China Eastern are known as the big three in China.

The J.P. Morgan RiskMetrics^{TM} is a popular methodology mostly due to its simplicity. The method assumes an IGARCH(1,1) structure with zero mean equation. With the assumption of normality, the return variance is proportional to time.

A more general approach is VaR augmented with a GARCH model. One-step ahead return and volatility can be easily derived from the estimated model to compute the quantiles. An advantage over RiskMetrics^{TM} is that heavy-tail can be estimated by non-Gaussian distribution like standardized Student-t.

A third approach is Generalized Extreme Value (GEV) whose Cummulative Distribution Function (CDF) is characterized by the shape (k), location (β_n) and scale (α_n) parameters. The sample is divided into n subsamples. Let $r_{n,i}$ be the minimun over the subsample. The Probability Density Function (pdf) of $r_{n,i}$ is defined as

$$f(r_{n,i}) = \frac{1}{\alpha_n}(1+\frac{k_n(r_{n,i}-\beta_{n)}}{\alpha_n})^{\frac{1}{k_n}-1} e^{(-(1+\frac{k_n(r_{n,i}-\beta_{n)}}{\alpha_n})^{\frac{1}{k_n}})} \quad \text{if} \quad k_n \neq 0$$

$$\frac{1}{\alpha_n} e^{(\frac{r_{n,i}-\beta_n}{\alpha_n} - e^{\frac{r_{n,i}-\beta_n}{\alpha_n}}))} \qquad \text{if} k_n = 0 \qquad (1)$$

The parameters can be estimated by maximium likelohood. These estimates are unbiased, asymptotically normal, and of minium variance under certain regularity conditions (Cles 2001). The VaR of holding a long position in the asset underlying the log return r_t is:

$$VaR = \beta_n - \frac{\alpha_n}{k_n}\{1-[-n\ln(1-p)]^{k_n}\} \text{ if } k_n \neq 0$$

$$\beta_n + \alpha_n \ln[-n\ln(1-p)] \qquad \text{if} \qquad k_n = 0 \qquad (2)$$

This VaR will be compared to those from RiskMetrics^{TM} and regression based models.

3 Data Analysis and Results

The stock price data were collected from the Shanghai Stock Index website[2] to compute the continuous daily returns. The sample period was from 1 September, 2006 to 13 November, 2012. Within the sample period, the stock price dropped from RMB 3.35 to RMB 1.79. Figure 1 showed the daily returns of China Eastern. There were large volatilties at the third quarter of 2007 and the 2008 financial crisis. Both are evidences of high VaR of the company.

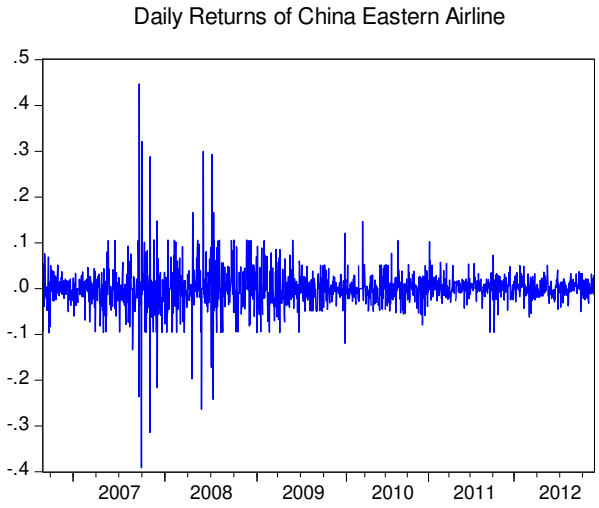
[2] http://www.sse.com.cn/

Table 1. VaR by Various Methods

	Whole Period	Pre-9,June 2009
RiskMetrics	0.029295	0.05915
GARCH	0.03248	0.07168
TGARCH	0.03129	0.06693
Extreme Value Theory	0.02225	0.03736

There was an acquisition of the Shanghai Airline on 11 June, 2009. The estimation was conducted for the pre-11 June, 2009 and the whole sample period to test the impact of acquisition on VaR. There were many literatures on the effect of merger and acquisition on profit growth or stock returns. According to Laabs and Schiereck (2010), who examined a sample of 230 merger and acquisition announcements made between 1981 and 2007, mergers and acquisitions played important roles in providing the significant positive returns to acquiring companies. These positive returns to companies represented an outstanding character of perceived synergy potential in this industry, especially in the short-term period. In addition, the study found a significant positive impact of companies' bidding experience on the long-term post-acquisition performance on net profit.

Figure 1



Additionally, Tsang and Leung (2009) reported that post-merger integration could make a right choice for an ambitious Chinese automobile company. Based on the analysis of more than 24,000 transactions between 1996 and 2006, the report showed that acquisitions during or just after the 2001-2002 recession period generated almost three times the amount of returns that was made during the preceding boom years. It also ensured that the valuation of acquisition target was fully justified on the companies' own net profit while all potential benefits from synergies could be seen as a bonus. However, King et. al (2004) got a robust result showing that the performance (jointly measured by return on assets, return on equity, and return on sales) was negatively affected after firms had made a merger or an acquisition. This paper takes a different approach that we

intend to examine how merger and acquisition affect risk.

Table 2a. AR(1)-GARCH Estimation Results (whole period)

		Mean equation	Variance equation			
		AR(1)	Constant	ARCH	GARCH	Threshold
GARCH	Coefficient	-0.04292	0	0.05068	0.9456	
	P value	0.087	0	0	0	
TGARCH	Coefficient	-0.0399	0	0.0204	0.953	0.0467
	P value	0.0942	0	0	0	0

Table 2b. AR(1)-GARCH Estimation Results (Pre-9,June 2009)

		Mean equation	Variance equation			
		AR(1)	Constant	ARCH	GARCH	Threshold
GARCH	Coefficient	-0.1194	0	0.0788	0.9244	
	P value	0.0014	0.0375	0	0	
TGARCH	Coefficient	-0.1124	0	0.0498	0.935	0.04226
	P value	0.0028	0.1021	0	0	0.0072

Using the RiskMetrics^{TM} method, the VaR are 0.01757 and 0.03586 for the whole period and pre-June 2009 period, respectively. Hence, we found a decrease in VaR after merger and acquisition. The 5% VaRs for a one-day horizon of the investor are 0.029295 and 0.05915 for the whole period and pre-June 2009 period, respectively. Nonetheless, while the assumption of zero mean is reasonable for daily return series, an integrated GARCH model and normally distributed error are subjected to question. We proceed to estimate the VaR by the AR-GARCH type regression-based model.

Since serial correlation is detected for the daily returns, the mean equation is hypothesed to be auto-regressive of order one[3]. We use the GARCH and Threshold GARCH to estimate the predicted conditional volatilities. The latter can model asymmetry in return volatility[4]. Table 2a and 2b report the estimation results for the whole period and pre-June 2009 period. The AR(1) coefficients are significant at 10% in both periods and models. The sign of the coefficients are consistently negative. In the whole sample period, the one-step ahead predicted conditional volatilities are 0.000419 and 0.00039 for GARCH and TGARCH, respectively. Using pre-June 2009 sample data only, the one-step ahead predicted conditional volatilities are 0.001816 and 0.001578 for GARCH and TGARCH, respectively. The 5% VaR are reported in Table 1. The difference between GARCH and TGARCH is minor. Clearly, the volatilities are lower after the merger and acquisition - supporting evidence of negative merger and acquisition impact on VaR.

[3] A constant is not significant in the mean equation.

[4] Exponential GARCH was tried in the initial analysis. The results are similar.

Figure 2a. Residual plot -whole period

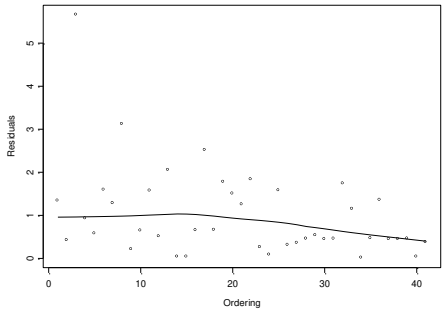


Figure 2b. QQ-plot- whole period

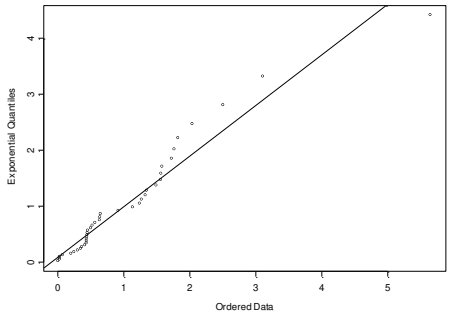


Figure 2c. Residual plot- pre-June, 2009

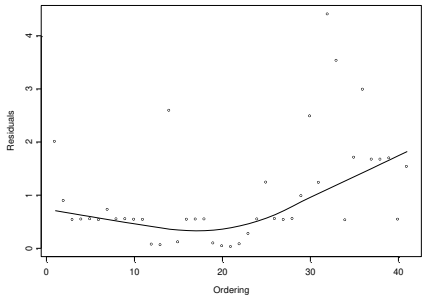
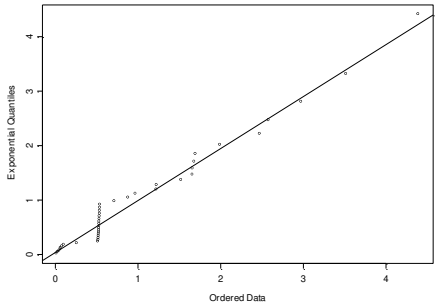


Figure 2d. QQ-plot- pre-June, 2009



The third estimation method is Generalized Extreme Value (GEV). The sample is divided into subsample. We choose 21 trading days - approximately one month. All the coefficients (except the shape) are significant at 5%. The VaR is reported in Table 1. The residual and QQ-plots of both sample periods are shown in Figure 2a to 2d. There is little serial correlation in the residuals. However, the GEV model for the whole period seems to be insufficient that the return does not resemble normal distribution.

From Table 1, the regression-based model reports the highest VaR, followed by RiskMetrics^{TM} and GEV. However, in all scenarios, the VaRs of pre-June 2009 period are higher, indicating that merger and acquisition reduce the risk of China Eastern.

4 Conclusion

This study examines the impact of merger and acquisition on VaR of China Eastern Airline. The VaR is estimated by three methods, namely RiskMetrics^{TM}, regression based approach and GEV. Although the magnitude of VaR from each model is different, there is a consistent evidence that VaR decreases after the merger and acquisition on 11 June, 2009. However, the QQ-plot indicates potential problem of non-normal distribution. Alternative estimation like Smith (1989) can be used to compute VaR for comparison purpose.

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