



Exchange rate risk management: What can we learn from financial crises?



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ABSTRACT

Since most present studies on exchange rate risk have pointed out that it does exist, firms need to hedge all currencies in use. However, by examining the discrepancy between cost-side and revenue-side exposures across two major financial crises for Taiwanese firms, we find that the exposure mainly comes from the revenue side during the subprime crisis, while that comes from the cost side during the Asian crisis. Our results offer an applicable implication that as long as the cost-based or revenue-based hedging strategy can acquire same hedging benefit and effectively reduce hedging cost.

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1. Introduction

The 2007–2008 subprime mortgage crisis destroyed the confidence of market investors, leading to a significant collapse in stock and exchange rate markets worldwide. Inevitably, these combined impacts affected firm exposure to exchange rates, as well as its determinants. When crises produce sudden shocks, firms formulate or adjust hedging strategies to manage exchange rate risk efficiently. Today, a wealth of literature exists, empirically documenting the evidence that financial crises produce structural changes in the exchange rate (see, for instance, Jeon and Seo, 2003; Benson and Faff, 2004; Kaminsky, 2006; Mazouz et al., 2009; Melvin and Taylor, 2009). Given the reality of exchange rate risks, the assumption is that firms need to hedge all currencies in use. Nonetheless, adopting any hedging strategy is not without cost. If firms, however, can determine the source of exposure to be revenue-side or cost-side, they can effectively manage their exchange rate risk with lower hedging costs.

The subprime mortgage crisis followed the Asian financial crisis in 1997. These are the two most significant financial events in their respective decades, and they have already received considerable international attention. The two debacles have in common their destructive impact on stocks. However, there are two important ways in which the two crises differ. First, the Asian financial crisis was regional, whereas the impact of the subprime mortgage crisis was global. Second, the cause of the global subprime crisis was the clustering of default on subprime mortgage contracts embedded in asset-backed security derivatives, whereas the Asian crisis was induced by the so-called double mismatch problem.¹ Since present literature on exchange rate risk analyzes only one event, these approaches cannot provide a satisfactory answer to

the interesting question of how differences between the two crises have affected the dynamic of the returns (in terms of both the exchange rate and a firm's stock price). Hence, this paper compares the firm's exchange rate exposure and the determinants of this exposure during the two crises.

This study contributes to the body of literature concerning the management of exchange rate risk in practice. A novelty in this study is the introduction of a firm's exposure as based on its cost and revenue sides. The main objective is to present empirical evidence for the discrepancy between cost-side and revenue-side exposures across two major financial crises, and assess risk management with lower hedging costs.

Inspired by the asymmetry between the two crises, we divided this study into three time periods: (i) the period of the Asian financial crisis (July 1997 to December 1998); (ii) the period of the subprime mortgage crisis (July 2007 to December 2008); and (iii) the intervening non-crisis period (January 1999 to June 2007). This study is aimed at answering the following questions: (i) Are there any significant discrepancies in firms' exchange rate risks between the subprime (global) crisis and the Asian (regional) crisis? (ii) How do the different geographical scopes of the two crises explain differences in the exposure to exchange rate risk, as assessed by a cost-/revenue-based exposure analysis? (iii) What is the interaction between the type of industry and the characteristics of exchange rate risk of a firm representing that industry, controlling for the coverage of the crisis?

2. Literature review

Exchange rate risk is generally defined in literature as the sensitivity of a firm's value to fluctuations in exchange rates. To understand this effect theoretically, researchers typically model the structure of the joint dynamic effects of profits and exchange rates with reference to a specific setting defined by market supply and demand (see, for instance, Bodnar and Marston, 2002; Bodnar et al., 2002; Bartram et al., 2010).

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¹ See Goldstein (1998) for more details about "double mismatch".

Then, the value of exchange rate risk is derived using a differentiation operator. Most exchange rate risk theories operate on the plausible assumption that firms with foreign operations face the greatest exposure to exchange rate risk.

The issues surrounding exchange rate risk have inspired a number of empirical studies. In these studies, the estimates of exchange rate risk are primarily obtained by a time-series regression with the return on the per-share stock price as the dependent variable, changes in the exchange rate as the independent variable, and the return on the market index as the control variable. An early example of how to derive an empirical estimate of exchange rate risk is given by Jorion (1990), whose analysis was based on U.S. data. Jorion (1990) discovered that the ratio of multinationals with significant exposure to the total sample was fairly low (ca. 10–25%) and positively correlated with a firm's degree of foreign involvement. This low ratio has been found to hold for other single countries and regions, including Japan (He and Ng, 1998), Taiwan (Chiao and Hung, 2000), Germany (Bartram, 2004), the American-Euro zone (Bartram and Karolyi, 2006), and the American-European-Asian zone (Doidge et al., 2006).

The results of the ratio test, of significant exchange rate risk, reported in most empirical studies are inconsistent with the traditional theories, maintaining that firms with foreign operations must experience considerable exchange rate risk. This is the so-called exchange rate exposure puzzle (Bartram and Bodnar, 2007), and several attempts to solve it are present in literature. These solutions involve the following hypothesized effects: (i) *the mixture offset effect*, a tradeoff in using the average value of exposure as the measure of exposure level, while not distinguishing between positive and negative exposure (see, for instance, He and Ng, 1998; El-Masry and Abdel-Salam, 2007); (ii) *the industrial grouping effect*, the underestimation of the exposure ratio across industries caused by the inability of the analysis to cope with heterogeneity in industries' foreign involvement (Miller and Reuer, 1998). To date, as evidence indicates that the abovementioned hypotheses are commonly weak and not supported by robust tests, the exposure puzzle remains unsolved.

Achieving a deeper understanding of a firm's exposure to currency fluctuations requires the exploring of exchange rate risk determinants. This study summarizes the arguments in literature (including Jorion, 1990; Nance et al., 1993; He and Ng, 1998; Chiao and Hung, 2000) to present five exposure factors: (i) firm size (as a proxy for economies of scale in hedging costs); (ii) the ratio of foreign sales to total sales (as a proxy for the degree of foreign involvement); (iii) quick ratio (as a proxy for liquidity); (iv) book to market ratio (as a proxy for growth opportunities); and (v) debt ratio (a proxy for the likelihoods of financial distress). However, only consistent evidence on the positive correlation between the exposure level and the extent to which a firm is involved in foreign operations is revealed.

Whereas, the earlier studies primarily focus on individual exposure behavior, recent studies have shifted attention to the external effects induced by major financial events. For example, Allayannis et al. (2001) analyzed the exchange rate exposure of firms in eight East-Asian countries during the Asian financial crisis. They found that the onset of the financial crisis produced structural changes in the currency fluctuations and the pattern of exposure. Likewise, Parsley and Popper (2006) found significant increments in exchange rate risk during the Asian crisis, using data from the Asia-Pacific zone. Another financial event often addressed in academic papers on foreign exchange rate is the reform of the exchange rate mechanism. Motivated by the breakdown of the famous Bretton Woods system, Bartov et al. (1996) discovered apparent sharp increases in U.S. firms' exchange rate risk after the announcement of the floating exchange rate. El-Masry and Abdel-Salam (2007) found that adoption of the European exchange rate increased U.K. firms' exposure to exchange risk.

Despite the substantial development of exchange rate risk, most previous studies have analyzed only one event. Thus, whether there are any significant differences in the effects of two crises on exposure-related

behavior is still unknown. How differences in the coverage of crises explain the asymmetry in the impact of the crises on such behavior is another interesting question that helps motivate the present study.

3. Research data and methods

3.1. Sample selection and data collection

Following Jorion (1990) and He and Ng (1998), we selected Taiwanese multinational corporations with an export ratio of at least ten percent in the full sample period from 1997 to 2008.² As a result, 204 firms are included in the sample, two thirds of which (134) belong to eight major industries: 32 in fibers and textiles, 17 in computer equipment, 16 in semiconductors, 16 in plastics, 15 in iron and steel, 15 in electronic components, 12 in chemicals, and 11 in electrical equipment. Relevant stock prices and financial data are obtained from the Taiwan Economic Journal (TEJ) database. A summary of descriptive statistics of the sample data is compiled in Table 1. The firms with the largest average size (\$5975 million), quick ratio (2.21), and book-to-market ratio (67%) all belong to the semiconductor industry; the iron-and-steel firms had the highest average long-term debt-to-equity ratio (46%); the computer equipment firms had the highest average export ratio (86%).

Data on returns from the exchange rate were retrieved from direct quotations on the Oanda website (<http://www.oanda.com/>). To construct the trade-weighted exchange rate index, we took the weighted average of the five major bilateral exchange rates, defined as the number of New Taiwan Dollars per unit of the foreign currencies of China, Hong Kong, Japan, Korea, and the U.S., respectively. These weights, which represent each country's proportion of the five countries' total trade with Taiwan (see Table 2 for details), were computed using trade data from the Taiwan Directorate General of Customs. The data were ranked according to the following three criteria: imports, exports, and total trade. This procedure provides a thorough understanding of the discrepancies between a firm's cost-side and revenue-side exchange rate risk caused by the asymmetry in the geographical scope of the crisis. To further investigate whether there were structural changes in a firm's exchange rate risk during the crisis period, as well as the differential impact of the two crises on stock prices and the exchange rate markets, the analysis period was divided into three subperiods: July 1997 to December 1998, January 1999 to June 2007, and July 2007 to December 2008.

3.2. Exchange rate risk

Dumas (1978), Hodder (1982), and Adler and Dumas (1984) define exchange rate risk as the effect of exchange rate changes on a firm's value. Because a firm usually undertakes hedging activities for expected currency fluctuations, the analysis requires that first the unexpected changes are separated from total changes in the exchange rate. Following El-Masry and Abdel-Salam (2007), this can be achieved via a time-series autoregression:

$$ER_t = \delta_0 + \delta_1 ER_{t-1} + UER_t \quad (1)$$

where ER_t is the rate of total return on exchange rate at time t and the residual term UER_t measures the unexpected changes in the exchange rate. In estimating the exposure to exchange rate risk for firms, this study borrows the two-factor model from Jorion (1990):

$$SR_{it} = \beta_{0i} + \beta_{1i} UER_t + \beta_{2i} MR_t + \varepsilon_{it}, \quad t = 1, \dots, T \quad (2)$$

² We have also tried the import ratio as the criteria of sample selection but encountered difficulties in finding it, such as data unavailability and trial with other proxy variables.

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