Time-Varying Exchange Rate Exposure on Non-Financial Firms

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Abstract

This paper investigates whether a large non-financial firm in selected Asian frontier and emerging markets has time-varying exchange rate exposure using the interactive time dummies in the regression with a GARCH specification. The findings revealed that exchange rate exposure changes over time, particularly in Indonesia, Bangladesh, and Pakistan. Furthermore, there was a high percentage of firms were exposed during the Global Financial Crisis (GFC) period, particularly in Indonesia, the Philippines, Bangladesh, and Sri Lanka. In practice, the findings of this study benefit interested parties such as firms and governments by giving information about stylised exchange rate exposure, which can be utilised to design effective strategies for dealing with exchange rate uncertainty.

Keywords: Asian countries, GARCH, non-financial firm, time-varying exposure

1. Introduction

Theoretically, exchange rate movements should affect a firm's value regardless of its level of international involvement (Adler & Dumas, 1984; Aggarwal & Harper, 2011; He, Liu, & Zhang, 2021a; Ihsan, Rashid, & Naz, 2018). The goods market theory indicates that the competitive environment significantly impacts foreign exchange rate exposure (Adler & Dumas, 1984; Aggarwal & Harper, 2010; Bartram, Dufey, & Frenkel, 2005; Lily, Bujang, Karia, & Kogid, 2018). A large body of research has been conducted on exchange rate exposure theory, and empirical evidence indicates that the theory has mixed support. This scenario is known as the exchange rate exposure puzzle since the percentage of exposed firms was lower than predicted by theory (Bartram & Bodnar, 2007; Bartram, Brown, & Minton, 2010; Baur & Miyakawa, 2014; Dewenter, Higgins, & Simin, 2005; Kang, Kim, & Lee, 2016; Makar & Huffman, 2013; Snaith, Termprasertsakul, & Wood, 2017).

The previous exchange rate exposure literature revealed that some previous studies had overlooked issues that contributed to the inefficiency of exchange rate exposure models (Berner, 2010; Jayasinghe, Tsui, & Zhang, 2014; Lin, 2011; Parsley & Popper, 2006; Ye, Hutson, & Muckley, 2014). For instance, some previous studies overlooked the exchange rate exposure's time-varying properties. The exchange rate exposure varies over time due to firms continually altering their risk structures, including their currency risk exposure to respond to the internal and external changing environment (Bartram et al., 2010; Parsley & Popper, 2006). Previous studies have shown support for time-varying exchange-rate exposure (Pierdzioch & Kizys, 2010; Verschoor & Muller, 2007). However, these studies focused primarily on the issue of time-varying exposure in developed markets, leaving a gap in the literature, especially in emerging and frontier countries. Thus, this study investigates evidence of time-varying exposure on firms in emerging and frontier countries.

There are three key contributions to this study. Firstly, there were only a few comparative studies have been undertaken on the large non-financial firms' time-varying exchange rate exposure in Asian emerging and frontier markets (Du, Hu, & Wu, 2014; Lily, Bujang, Karia, et al., 2018; Lin, 2011; Muller & Verschoor, 2007; Parsley & Popper, 2006; Ye et al., 2014). Cross-country analyses in Asian regions have primarily focused on emerging and developed markets. Therefore, examining the exchange rate exposure from both frontier and emerging market countries is necessary to add a body of knowledge if there is support for time-varying exposure in these markets.

Secondly, this paper extends the method of estimation to investigate the varying exposure of the firm's exchange rate time. There are two characteristics linked with financial time series that most earlier studies have overlooked. To begin with, financial time series exhibit time-varying volatility and persistence of volatility (Bacha, Mohamad, Zain, & Rasid, 2013; Chou, Lin, Hung, & Lin, 2017; Verschoor & Muller, 2007). Conditional heteroscedasticity will affect the exchange rate exposure model's ability to capture a firm's exchange rate risk parameter (Jayasinghe et al., 2014; Kang et al., 2016). Furthermore, non-normal distributions in financial time series, such as stock and currency returns, are widely recognised (Jayasinghe et al., 2014). Most previous studies mainly address the first issue. For example, researchers such as Bacha et al. (2013) and Ye et al. (2014) employed the GARCH specification to address the heteroscedasticity issue. However, they assumed that the model's error term would follow a normal distribution. Therefore, this study applied an orthogonalised regression model, which included the addition of yearly interactive time dummies with a GARCH specification to address both time-varying coefficients and heteroscedasticity issues. The interactive annual time dummies reflect the firm's exchange rate exposure temporal stability (Parsley & Popper, 2006).

Thirdly, this study contributed to the theoretical understanding of exchange rate exposure theory by demonstrating that a firm may have stylised exchange rate exposure, such as time-varying exposure. Since changing environments may affect a firm's risk structure, including exchange rate risk exposure, it is improbable that a company's exchange rate risk stays consistent throughout time (Bartram et al., 2010; Parsley & Popper, 2006; Pierdzioch & Kizys, 2010). Thus, the findings will provide an alternative explanation for the exchange rate exposure puzzle. The following is the paper's outline: The following section discusses the methodology, followed by the results and discussion. The final section expands on the conclusion and recommendations.

2. Methodology

2.1 Data

The sample firms of this study are large non-financial firms from two markets (emerging and frontier) in the Asian region. According to the exchange rate exposure hypothesis, large companies are predicted to have a significant exchange rate exposure due to their broad worldwide activities (El-Masry, Abd-Elsalam, & Abdel-Salam, 2007). Nonetheless, larger firms may be less vulnerable to exchange rate fluctuations because of their competitiveness and diversification strategies (Flota, 2014; He, Liu, & Zhang, 2021b; Lily, Bujang, & Karia, 2018). Additionally, they have the necessary personnel and knowledge to mitigate their exchange rate (He et al., 2021b; Lily, Bujang, Karia, et al., 2018; Riaz, Mohd, & Wan, 2021).

In this study, Malaysia, Thailand, Indonesia, and the Philippines are a sample of the emerging market, while Bangladesh, Pakistan, Sri Lanka, and Vietnam represent frontier markets. Morgan Stanley Capital International (MSCI) market classification was used for this research. The monthly data from August 2005 to December 2016 for share prices, market prices, Trade Weighted Index (TWI) were obtained from Thomson DataStream. The data covered the pre (August 2005 – December 2007), during (January 2008 – December 2010) and post (January 2011 – December 2016) GFC, 2008 (Atahau & Cronje, 2020).

The study used a sample period that began in August 2005, following the reform of the peg exchange rate regime in Asian countries such as China and Malaysia in July 2005 (Lin, 2011). Furthermore, the exchange rate policy for other frontier sample countries such as Bangladesh, Pakistan, and Vietnam is less strict after 2005 (International Monetary Fund, 2012). This study classified 2008 as the beginning of the GFC following the collapse of the investment bank, Bear Stearns (Lin, 2011). Table 1 illustrates the final sample firms across the sample countries.

Table 1. Sample firms

Country	Index	Number of firms (Non-Financial)
Indonesia	LQ-45 index	24
Malaysia	FTSE Bursa Malaysia KLCI	16
The Philippines	PSEi 30	16
Thailand	FTSE SET 50	27
Bangladesh	DSE30 index	10
Sri Lanka	S&P SL 20	15
Pakistan	KSE 30	22
Vietnam	HNX 30	12

Source: Country's stock exchanges.

2.2 Modelling the Exchange Rate Exposure

The orthogonalised augmented two-factor model (Jorion, 1990) with interactive time dummies and GARCH (1,1) specification was used in this study as follows:

Mean equation

$$SR_{j,t} = \beta_0 + \beta_1 OMR_t + \beta_2 REER_t + \sum_{n=1}^{r} \beta_{i,n} D_t + \sum_{n=1}^{r} \beta_{k,n} D_t * REER_{k,t} + \varepsilon_t \qquad (1)$$

Variance Equation

$$\mu_t = v_t \sigma_t^2 = v_t \sqrt{h_t} \qquad (2)$$

$$h_t = \alpha_0 + \delta h_{t-1} + \gamma \mu_{t-1}^2 \qquad (3)$$

Where β_0 is a constant, $SR_{j,t}$ is the firm's j share return, over the period of t and OMR_t is the

orthogonalised return of the market, which reflects the portion of market return that is independent of the foreign exchange rate return (Chou et al., 2017; Lily, Bujang, Karia, et al., 2018; Priestley & Ødegaard, 2007).

Meanwhile, $REER_t$ is the real effective exchange rate return, D_t the time dummy variable, r the number of

subperiods, and ε_t is the error term. At yearly intervals, the $\beta_{k,n}$ parameters denote the firm exchange rate

exposure. For the GARCH model, the variance is influenced by their past shock values and variations.

A time dummy variable with annual intervals was utilised to allow for changes in exposure rate over time. The time dummy variables in their general form, D_n, represent the entire sample year. For example, D_0 is a time dummy variable that takes $D = 1$ in the sample period of 2005:M08 to 2005:M12 and $D = 0$ otherwise; D_1 is a time dummy variable takes $D = 1$ in the sample period of 2006: M01 to 2006: M12 and $D = 0$ otherwise; and so on. Except for Bangladesh and Vietnam, which have sub-periods of 11 and nine due to the limited data availability, the entire sample was divided into twelve sub-periods. The dummy variable for the first yearly interval for each sample firm was left out of the model to avoid the dummy trap.

The ARCH LM test was employed to test the existence of heteroskedasticity in the error terms. If the error terms show indications of heteroskedasticity, a GARCH (1,1) specification will be utilised to estimate the exchange rate exposure parameters. In addition, in the GARCH model, the study applied the variance-covariance matrix using the quasi-maximum likelihood approach to address the non-normal distribution (Bollerslev & Wooldridge, 1992). If convergence fails, the GARCH specification model's student's *t*-distribution will be used (Alberg, Shalit, & Yosef, 2008). If there is no evidence of heteroskedasticity, the ordinary least squares (OLS) model is applied to estimate exchange rate coefficients. Meanwhile, the serial correlation will be corrected using the Newey–West (Newey & West, 1987) approach (Lily, Bujang, Karia, et al., 2018).

2.3 Unit Root Analysis and Diagnostic Tests

The Augmented Dickey-Fuller (ADF) (Dickey & Fuller, 1979), and Phillips-Perron (PP) tests are used to formally assess the unit root hypothesis (Phillips & Perron, 1988). This study used the lowest Schwarz Information Criterion (SIC) value to identify the optimal lag length. Diagnostic tests such as the serial correlation test, heteroscedasticity, and stability tests (CUSUM, CUSUMSQ, and Ramsey's test) were used to assess the exposure model's adequacy.

3. Results and Discussion

3.1 Firm-Specific Exposure

Table 2. Firm exchange rate exposure by sub-periods analysis

	Full Sample 2006-2016	Pre-GFC 2006-2007	GFC 2008-2010	Post-GFC 2011-2016
Emerging Market (n=83)[81.9%]				
Indonesia (n=24)	22 [91.7%]	10 [41.7%]	16 [66.7%]	19 [79.2%]
Malaysia (n=16)	11 [68.8%]	7 [43.8]	7 [43.8%]	8 [50.0%]
Philippines (n=16)	14 [87.5%]	9 [56.3%]	13 [81.3%]	11 [68.8%]
Thailand (n=27)	21 [75.0%]	16 [57.1%]	16 [57.1%]	20 [71.4%]
Frontier market (n=59)[72.9%]				
Bangladesh (n=10)	9 [90.0%]	4 [40.0%]	6 [60.0%]	8 [80.0%]
Pakistan (n=22)	16 [72.7%]	11 [50.0%]	12 [54.5%]	16 [72.7%]
Sri Lanka (n=15)	11 [73.3%]	4 [26.7%]	7 [46.7%]	10 [66.7%]
Vietnam (n=12)	7 [58.3%]	-	2 [15.4%]	7 [58.3%]
Total (N=142)	111 [77.6]	61 [42.7%]	79 [55.2%]	99 [69.2%)

Note. The value in parentheses and brackets denote the number of observations and the percentage respectively. The number of firms represents the firms with exchange rate exposure {at the 5% level) at least for one interval year.

Table 2 shows the number of exposed firms in each sample country's sub-periods. More than 70 per cent of the studied firms were influenced by exchange rate changes throughout the period, with Indonesia having the highest percentage rate (91.7%) and Vietnam having the lowest (58.3%). The exchange rate movements affected 81.9 per cent of sample firms in emerging market countries while 72.9 per cent in frontier market countries. The number of exposed firms to exchange rates increased significantly during the GFC period compared to the pre-GFC, particularly in Indonesia, the Philippines, Bangladesh, and Sri Lanka. For example, the number of firms exposed to exchange rates increased to 81.3 per cent during the GFC period from 56.3 per cent in pre-GFC in the Philippines. On average, the increase is by 20 per cent. Except for the Philippines, there is an increasing trend in exposed firms in almost all sample countries in the post-GFC, especially in Bangladesh, Indonesia, and Pakistan.

The findings support the argument on time-varying exchange exposure by the previous studies (e.g., Al-shboul & Anwar, 2014; Parsley & Popper, 2006; Pierdzioch & Kizys, 2010). Some explanations behind the arguments include the firm's competitive position, operating structure, and hedging strategies in response to the changes in its internal and external environment (Bartram et al., 2010; Parsley & Popper, 2006; Pierdzioch & Kizys, 2010).

There were many exposed firms during the GFC period for most sample firms across the sample of countries except for Malaysia, Sri Lanka, and Vietnam. The findings again supported the argument that besides an internal firm's structure, external macroeconomic conditions such as a financial crisis can be a significant factor in determining a firm's exchange rate exposure (Lin, 2011; Mozumder, De Vita, Larkin, & Kyaw, 2015; Parsley & Popper, 2006). Besides, it implied that the GFC 2008 dramatically changed the characteristics of Asian markets.

There are two possible reasons why Malaysia and Vietnam have a low percentage of firms that were exposed to exchange rates. Firstly, the sample firms may actively mitigate their aggregate foreign exchange rate exposure (Lily, Bujang, Karia, et al., 2018; Lin, 2011, 2012). Secondly, it might be due to diversification impacts, mainly when a firm's currency exposure is mixed. (Varga, 2013). Employing a currency index represents the average currency environment faced by a company. It could be that an international firm may trade in several countries as an exporter or importer, simultaneously causing the inability of the currency index to capture the individual effect of the exchange rates on firm value (El-Masry et al., 2007; Parsley & Popper, 2006).

4. Conclusions and Recommendations

The study investigates if there is evidence of time-varying exchange rate exposure in Asian frontier and emerging countries. With more than 70 per cent of the studied firms being affected by the exchange rates, the findings implied support for the exchange rate exposure theory. Their exposure does not appear to be diminishing in the subperiod analysis. Thus, the results suggest that time-varying exposure may be an alternative explanation for the literature's puzzle regarding exchange rate exposure. However, the significance of the exchange rate towards firm value could be country dependence because each country varies in terms of its

capital markets and international trade openness.

In practice, the findings revealed that exchange rates could be one of the essential macroeconomic factors in policy decision making either at the firm or country level. In addition, the results also show that firms, regardless of their level of foreign business activity, are no longer immune to exchange rate movements. For this reason, given the GFC's impact on many firms' exposure to exchange rates, firms should budget their financial plans for future macroeconomic shocks to limit the prospective loss from the implications of exchange rate instability.

For limitation, this study focuses on the foreign exchange rate exposure of listed large non-financial firms from eight Asian countries. Thus, the sample firm and countries can be expanded to include other Asian or developed market firms for future research. In addition, the foreign exchange risk exposure of domestic firms should be explored to understand better how exchange rate fluctuations influence domestic firms.

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Conflict of Interest

The authors declare no conflict of interest.

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