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Estimating time-varying currency betas with contagion: New evidence from developed and emerging financial markets☆

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ABSTRACT

This paper examines the conditional time-varying currency betas from five developed and six emerging financial markets with contagion and spillover effects. We employ a trivariate asymmetric BEKK-type GARCH-in-Mean (MGARCH-M) approach to estimate the time-varying conditional variance and covariance of returns of stock market index, the world market portfolio and bilateral exchange rate between the US dollar and the local currency. The results show that the world market and currency risks are not only priced in the stock markets, but also time-varying. It is found that currency betas are much more volatile than the world market betas, and currency betas in the emerging markets are more volatile than those in the developed markets. We find empirical evidence of contagion effect and spillovers between stock market and foreign exchange market during the recent global financial crisis, and the effect is stronger in the emerging markets than that in the developed markets. Two applications are provided to illustrate the usefulness of time-varying currency betas.

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1. Introduction

Ever since the breakdown of the Bretton Woods system in the early 1970s, especially the increased globalization and recent global financial crisis, the volatility of exchange rates and its associated risks have become an increasingly important issue for international financial management. It is widely believed that firm value is sensitive to exchange rate movements as the fluctuations in exchange rates affect both the cash flow of a firm's operations and its discount rate employed to value a firm. However, empirical work on exchange rate exposure has found only limited support of a significant relationship between firm value and exchange rate changes. For instance, Jorion (1990) examines the exchange rate exposures of 287 US multinational corporations (MNCs) but finds that only a very small percentage exhibits significant exposure. Similarly, Bodnar and Gentry (1993) study industry-level exchange rate exposures for Canada, Japan and the USA, and find that only 9 of 39 two-digit industry portfolios exhibit significant exchange rate exposure at the 5% level from 1979 to 1988. A few empirical studies found significant exchange rate risk sensitivity under certain conditions. Bartov and Bodnar (1994) found that abnormal returns are related to lagged changes of exchange rates, which supports market inefficiency. The studies by Chow and Chen (1998) and Bodnar et al. (2002), show the association between firm value and exchange rate changes becomes significant when the time horizon is increased. Williamson (2001) incorporates changes in the industry competitive environment and finds substantial time-varying foreign exchange exposure.[1] Using a weighted market portfolios approach,

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[1] Allayannis (1997), Chiao and Hung (2000), Allayannis and Ihrig (2001), and Bodnar et al. (2002) employ pre-specified determinants of exposure coefficients to analyze the time-variation of exchange rate exposure, but the results are mixed. Bodnar et al. (2002) did not find evidence of time-varying exposure.

Bodnar and Wong (2003) are the first to demonstrate the importance of the definition of the stock market risk factor. They find that, because large firms are over-represented in these indices, value-weighted market indices induce a positive bias in exposure coefficients.

Recently several studies employ time-varying second moments to derive time-varying exchange rate exposure (see, for instance, Hunter, 2005; Lim, 2005; Tai, 2007, 2010; Jayasinghe et al., 2011). Hunter (2005) analyzes the time-varying exchange rate exposure of small and large firms using size-based portfolios of the Fama-French-type, and Lim (2005) derives both market and currency betas at country level, with allowance for non-orthogonality between risk factors. Using industry data for Japan, Tai (2010) finds strong evidence of time-varying foreign exchange risk premium and significant exchange rate betas based on the tests of conditional asset pricing models using MGARCH-M approach where both conditional first and second moments of industry returns and risk factors are estimated simultaneously. Furthermore, the financial crises since the 1990s, especially the recent global financial crisis (GFC) in 2008 have boosted research on financial contagion and the transmission of shocks across the financial markets. Forbes and Rigobon (2002) differentiate the concepts between spillover and contagion for financial market inter-linkages. Tai (2007) found strong contagion effects between stock market and foreign exchange market from three emerging Asian countries during the 1997–1998 Asian Financial Crisis. The most recent study by Walid et al. (2011) also found strong relationship between stock market and foreign exchange market by employing a Markov-Switching EGARCH model for four emerging countries over the period 1994–2009. Fu et al. (2011) use daily industry-level stock data over the period 1994–2007 to study volatility transmission between the Japanese stock and foreign exchange markets. Their results indicate that news shocks in the Japanese currency market account for volatility transmission in eight of the ten industrial sectors considered. It is observed that most of the early studies on foreign exchange rate exposures focus on the US stock market (with a few on Japan) and have generally ignored the possible impact of contagion and spillovers during the financial crisis period. It is also not clear how these empirical results relate to other countries, especially the emerging economies and markets.

The purpose of this paper is to provide some new evidence on the foreign exchange rate exposures in both the developed and emerging markets by extending previous studies through the employment of an asymmetric trivariate BEKK-GARCH-in-Mean framework and the most recent daily dataset. We adopt the general framework of conditional international capital asset pricing model (ICAPM) proposed by Adler and Dumas (1983) and De Santis and Gerard (1998) to estimate the time varying currency betas and the time-varying market betas for eleven developed and emerging financial markets. Unlike the previous studies, we employ the Baba, Engle, Kraft and Kroner (BEKK) multivariate GARCH models of Engle and Kroner (1995) to estimate the conditional variance and covariance of return variables using a set of daily data spanning from 5 January 1999 to 25 July 2012. In particular, we compute the time-varying currency betas and market betas using estimates of the conditional variance and covariance of returns from country stock index, world market portfolio and changes in exchange rate of the trading country. We also examine the volatility transmissions from exchange rate shocks to conditional stock market returns volatility in different financial markets during the recent GFC. To the best of our knowledge, this is the first study that estimates such time-varying market and currency betas with contagion from an asymmetric trivariate BEKK-GARCH-in-Mean specification based on daily returns using the most updated dataset in both developed and emerging markets. The main advantage of the BEKK parameterization is that it guarantees the variance and covariance matrix to be positive definiteness during estimation, and the often alleged difficulty of interpreting parameters in BEKK models is not an issue. Our results indicate that currency betas are generally more volatile than the world market betas. In addition, currency betas in the six emerging markets are more volatile than those in the developed markets. We also find some evidence of long-memory in the estimated currency betas, and the existence of contagion effect between stock market and foreign exchange market for most of the financial markets during the recent GFC. These findings have important implications for investment and hedging strategies.

The rest of this paper is organized as follows. The conditional version of international CAPM is outlined in Section 2. Section 3 presents the methodology employed to estimate currency betas and market betas from the conditional variance and covariance of return variables. Section 4 presents the sample data and preliminary results. In Section 5 we report and discuss the main empirical findings, and assess the usefulness of the conditional time-varying betas series as a source of information for decision making. Some concluding remarks are given in Section 6.

2. The ICAPM framework

The standard capital asset pricing model (CAPM) analyses how investors are compensated for investing in risky assets in their country of residence, and hence, the different expected return is gained by taking the different risk levels. Based on CAPM, the international capital asset pricing model (ICAPM) proposed by Adler and Dumas (1983) and others[2] takes countries as stock portfolios in the global market. Under this setting the systematic risk of the portfolio could be decreased without decline in expected return by investing different capital markets since the stock prices are affected by domestic or local events. In other words, domestic systematic risk can be diversified away by investing internationally without paying a price in terms of lower returns. This has important implications for international portfolio investors. We highlight some of the salient features of conditional ICAPM as follows.

In a world of $(L+1)$ countries, the expected excess returns on equity/asset i can be expressed as:

$$E_{t-1}(r_{i,t}) = \lambda_{m,t-1} Cov_{t-1}(r_{i,t}, r_{m,t}) + \sum_{l=1}^{L} \lambda_{\pi,l,t-1} Cov_{t-1}(r_{i,t}, \pi_{l,t}) \qquad (1)$$

where $E_{t-1}(.)$ and $Cov_{t-1}(.)$ denote the expectation and covariance, conditional on the available information set I_{t-1} at time $(t-1)$. $r_{i,t}$ denotes the excess return on asset i in excess of a risk free rate of return in the currency of denomination in country l; $r_{m,t}$ denotes the excess return on the world market portfolio denominated in the reference currency; $\pi_{l,t}$ denotes the inflation rate in country l which includes the domestic inflation and changes in the exchange rate between the reference currency and the currency of denomination; $\lambda_{m,t-1}$ is the price of world market risk. The covariance between $r_{i,t}$ and $r_{m,t}$ measures the world market risk. In addition, $\lambda_{\pi,l,t-1}$ denotes the price of asset risk in country l and the covariance between $r_{i,t}$ and $\pi_{l,t}$ is used to gauge the inflation risk and the risk of exchange rate changes.

We consider two practical applications of the Adler and Dumas model. First, following Dumas and Solnik (1995) and De Santis and Gerard (1998), we assume non-stochastic inflation[3] so that the PPP deviations are mostly reflected in the exchange rate changes. Given

[2] Their model was initially known as international asset pricing model. Dumas and Solnik (1995) and De Santis and Gerard (1998) test the validity of conditional ICAPM.

[3] When inflation in a country is treated as stochastic, the expected returns are dependent on three premiums, namely, market, currency and inflation. See Moerman and van Dijk (2006) for details. However, we do not consider the inflation factor here.

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