

Modeling time variation and asymmetry in foreign exchange exposure

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Abstract

Many recent studies suggest that exchange rate exposure is unstable over time and exhibits asymmetric behavior during currency appreciations and depreciations. This paper proposes a dynamic framework for the study of such questions and our empirical findings show that exchange rate exposure of U.S. stocks is time varying. Using decile and sector portfolios, we find asymmetric exposure to be pervasive across the decile portfolios as well as the financial and industrial sectors. Moreover, the response of return variance to past innovations is asymmetric for the majority of cases. The dynamic exchange rate exposure parameters are found to be mean-reverting with low persistence, generally ranging from 1 to less than 2 days. The average time-varying exposure is statistically significant for the size-based and sector-based portfolios. Lastly, the variability in the time-varying exposure is smaller (larger) for the largest (smallest) firms and for industrial (technology) firms.

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1. Introduction

There has been a significant amount of effort devoted to investigating the impact of foreign exchange (FX) risk on firm value over the past 15 years. Much of this interest stems from the

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question of whether portfolio managers and corporate managers are able to diversify FX risk. To the extent that FX risk is not diversifiable, exposure to this risk is of concern to portfolio managers and corporate financial managers in constructing asset portfolios and in hedging strategies. While initial studies did not find FX risk to be priced (e.g., Jorion, 1991), recent studies that allow for time variation in the pricing of exchange rate risk have found FX risk to be priced (e.g., Dumas and Solnik, 1995; De Santis and Gerard, 1998).

Concurrent with this literature, studies began to analyze the magnitude and determinants of exposure to FX risk. The first prominent study that empirically estimated FX exposure was conducted by Jorion (1990). Modifying the Adler and Dumas (1984) approach by including a market portfolio return, he found only 5% of U.S. multinational firms to have significant return sensitivity to an exchange rate index. Subsequently, several studies have attempted to improve upon the methods used to estimate exposure.² One of our primary objectives is improving the estimation methodology by allowing exposure to vary over time.

Several studies have shown improvement in the detection of foreign exchange exposure. Chow et al. (1997) assert that long-horizon regressions more readily identify significant exposure, based on their view that market participants likely make errors in assessing the longer-term consequences of FX risk. Due to asymmetric pricing behavior, hysteresis, and asymmetric hedging, Koutmos and Martin (2003a,b), Bartram (2004), Carter et al. (2005), and Tai (2005) evaluate asymmetric responses to appreciations and depreciations and improve upon the detection of exposure. Choi and Prasad (1995) and Di Iorio and Faff (2000) also provide some evidence of asymmetric responses to currency appreciations and depreciations. It has also been argued that due to an averaging out effect, broadly defined exchange rate indexes may obscure the detection of exposure (e.g., Bartov and Bodnar, 1994; Martin et al., 1999; Allayannis and Ofek, 2001; Koutmos and Martin, 2003b). Lastly, Bodnar and Wong (2003) recommend using size-based portfolios to control for market conditions when estimating foreign exchange exposure.

In addition to the studies above that show time variation in exposure by incorporating the possibility of asymmetric responses to appreciations and depreciations, there are studies that provide evidence that exposure is more generally time dependent. Brunner et al. (2000) find the exposure coefficients of the German market and German corporations are not stable over time. Allayannis and Ihrig (2001) show that exposure varies with industry markups; Williamson (2001) concludes that exposure of automotive firms changes with market share; while Bodnar et al. (2002) demonstrate that exposure varies with pass through. Patro et al. (2002) find the exposure of OECD equity markets vary year to year due to imports, exports, credit ratings and tax revenues. Bodnar and Wong (2003) show that exposure estimates generated from a model that controls for market movements (i.e., residual exposures) are more stable over time than exposures estimated without controlling for market movements (i.e., total exposures). Lastly, Ihrig and Prior (2005) find some firms have significant exposure only during crisis periods.

None of the studies thus far, however, provide a simple and unifying framework for the study of the dynamic properties of foreign exchange exposure. We propose a dynamic vector GARCH framework that allows for simultaneous estimation of the daily time-varying exposure parameter as well as potential asymmetries in the exposure mechanism. While Koutmos and Martin (2003a,b) model asymmetries with respect to appreciations and depreciations, they do not test for time

² Given that empirical estimates of exposure are measured net of hedging, firms that effectively hedge can reduce their exposure which limits the ability to detect significant exposure. For example, Allayannis and Ofek (2001) find that financial hedging with currency derivatives reduces exposure and Martin et al. (1999) find that operational hedging by repositioning operations reduces exposure.

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