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Asymmetric volatility in the foreign exchange markets

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ABSTRACT

We examine the presence or absence of asymmetric volatility in the exchange rates of Australian dollar (AUD), Euro (EUR), British pound (GBP) and Japanese yen (JPY), all against US dollar. Our investigation is based on a variant of the heterogeneous autoregressive realized volatility model, using daily realized variance and return series from 1996 to 2004. We find that a depreciation against USD leads to significantly greater volatility than an appreciation for AUD and GBP, whereas the opposite is true for JPY. Relative to volatility on days following a positive one-standard-deviation return, volatility on days following a negative one-standard-deviation return is higher by 6.6% for AUD, 6.1% for GBP, and 21.2% for JPY. The realized volatility of EUR appears to be symmetric. These results are robust to the removal of jump component from realized volatility and the sub-samplings defined by structural-changes. The asymmetry in AUD, GBP and JPY appears to be embedded in the continuous component of realized volatility rather than the jump component.

1. Introduction

It is well known that volatility in equity markets is asymmetric, i.e. negative returns are associated with higher volatility than positive returns. Robert Engle in his 2003 Nobel Lecture emphasizes the importance of asymmetric volatility. For a portfolio of S&P500 stocks, Engle (2004) shows that ignoring the asymmetry in volatility leads to a significant underestimation of the value at risk (VaR). In the foreign exchange markets, however, the consensus seems to be that there is no asymmetric volatility. Bollerslev et al. (1992) suggest that "[W]hereas stock returns have been found to exhibit some degree of asymmetry in their conditional variances, the two-sided nature of the foreign exchange market makes

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such asymmetries less likely." All of the studies in their survey adopt symmetric models for exchange rate volatility. Since then the theoretical advances in volatility models, together with the availability of intraday exchange rate data, led to a proliferation of studies of exchange rate volatility. Almost all of them do not consider asymmetric volatility models. Recently Andersen et al. (2001, 2003a) (ABDL hereafter) provide an extensive examination of the statistical properties, modelling and forecasting of realized volatility of foreign exchange rates. Again, the possibility of asymmetric volatility is not investigated in their articles.

The "two-sided nature of the foreign exchange market" is probably the primary reason for the overwhelming choice of symmetric models for exchange rate volatility. For bilateral exchange rates, because positive returns for one currency are necessarily negative returns for the other, "good news" and "bad news" appear indistinguishable. This implies that exchange rate volatility should have symmetric responses to positive and negative shocks in exchange rate return. Furthermore, it is unclear how the standard explanations for asymmetric volatility in equity markets, i.e. the leverage effect and the volatility feedback effect, apply to the currency markets. The debt-to-equity ratios in equity markets vary from zero to several hundred percents. With the exception of some small open economies, the debt-to-GDP ratios for most countries are below 5%, and the debt-to-national asset ratios are much lower.[1] If an investor anticipates higher volatility, say for USD/AUD rate, it is unclear whether she should sell USD or AUD if she holds both currencies. Empirically, the standard asymmetric GARCH models regularly detect asymmetric volatility in daily equity returns. However, these models typically fail to detect asymmetry in daily exchange rate volatility. This is probably another reason for favouring symmetric volatility models for bilateral exchange rates.

Despite the bilateral nature of exchange rates, there are at least two reasons for the presence of asymmetry in bilateral exchange rates. First, some currencies have greater economic importance than others. For example, many companies and financial institutions use the US dollar (USD) as the base currency for profit and loss calculations but few uses the Australian dollar (AUD). For these institutions, higher expected USD/AUD volatility implies greater risk in AUD-denominated assets but not necessarily in USD-denominated assets. This may lead to the sale of AUD-denominated assets, which lowers USD/AUD exchange rate. This base-currency effect is likely to be stronger in some currencies than in others, depending on the size and development level of the local economy. For example, the Euro (EUR) area and the United States are of similar sizes and levels of economic development. The base-currency effect should be weaker for the USD/EUR rate than for USD/AUD, because higher expected USD/EUR volatility may lead Europeans to sell USD-denominated assets and Americans to sell EUR-denominated assets. Second, a unique feature of the foreign exchange markets is central bank intervention. Most studies report that interventions lead to higher volatility.[2] Since central banks intervene on one side of the market but not the other, interventions may lead to an asymmetric relationship between exchange rate return and volatility. For example, if a central bank were concerned with the depreciation of its currency, it would buy its domestic currency and sell USD. As a result, the higher volatility from market intervention would be associated with past depreciation of the domestic currency. This could be the case when the Reserve Bank of Australia intervened to support AUD in mid-2001 when USD/AUD dropped to a historical low of 0.49 (Fig. 1). Conversely, if the central bank were to sell its domestic currency to slow down its appreciation, the resulting higher volatility would be associated with past appreciation. This could be the case for the Japanese yen (JPY) since the Bank of Japan is known to be a heavy seller of JPY over our sample period. Clearly this explanation does not apply to currencies that did not have any central bank intervention during the sample period, e.g. GBP.

Given the common perception against asymmetric volatility and the above arguments for its presence, this paper sets out to empirically test for asymmetric volatility in major currencies. The issue

[1] When external debt is denominated in the home currency, like the United States, there could be a reverse leverage effect: higher debt may lead to a currency depreciation, which would strengthen net export and enhance the country's ability to service its debt. This, in turn, may reduce exchange rate uncertainty. We thank the referee for this insight.

[2] Examples include Bonser-Neal and Tanner (1996), Dominguez (1998, 2006), Beine et al. (2002), Beine and Laurent (2003), Galati et al. (2005), Frenkel et al. (2005), and Beine et al. (2007). On the other hand, Beattie and Fillion (1999) report that unexpected interventions by the Bank of Canada reduced intraday volatility. Beine et al. (2003) find that when the market is highly volatile concerted interventions decrease volatility.