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Sudden changes in variance and volatility persistence in foreign exchange markets

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Abstract

Participants in the foreign exchange markets should be concerned with how a major event may lead to a sudden change in volatility as well as the role that shocks play in determining the persistence of volatility over time. This paper examines these issues by first identifying the time periods of sudden changes in volatility and then examining economic events surrounding those shifts. This research detects time periods of sudden changes in variance (i.e. regime shifts) by using the iterated cumulated sums of squares (ICSS) algorithm. Examining five major exchange rates from January 1990 to September 2000, it is found that accounting for volatility shifts in the GARCH model considerably reduces the persistence in volatility. The results suggest that many previous studies may have significantly overestimated the degree of volatility persistence that exists in financial time series.

JEL classification: F3

Keywords: Volatility; Exchange rates; GARCH; ICSS algorithm

1. Introduction

The volatility of exchange rates has been an important issue in financial economics since the collapse of the Bretton Woods system. Volatility in exchange rates may make the exchange rate-adjusted value of foreign sales less predictable, thus discouraging domestic firms from engaging in international trade. Engel and Hakkio

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(1993) show that high volatility in exchange rates can also hinder the flow of capital across countries. The disrupting effects of exchange rate volatility on international trade and the economy have been widely documented in the literature (see Eichengreen and Irwin, 1993; Kroner and Lastrapes, 1993; Caporale and Doroodian, 1994). Investors and policymakers may benefit from a better understanding of how major economic events can correspond to sudden changes in volatility in exchange rates and how shocks will affect volatility over time. The persistence in volatility is a key ingredient for accurately predicting how events can affect future exchange rate volatility and consequently its effects on international trade, capital flows and the economy.

The present paper studies these issues and examines weekly nominal exchange rates for five major countries from January 1, 1990 to September 6, 2000. An iterated cumulated sums of squares (ICSS) algorithm is used to identify the time periods of volatility shifts. Economic events surrounding the time points of increased volatility are then analyzed. These volatility shifts are then introduced in a GARCH model to compute the effect of a given shock on persistence of volatility. Porterba and Summers (1986) have developed an asset pricing model which explicitly shows that the amount of persistence in volatility directly affects the price of an asset. Specifically, they show that an increase in expected volatility persistence will reduce the current price of an asset. Since exchange rates are asset prices, finding the 'true' persistence in volatility in exchange rates is important for building accurate asset pricing models, forecasting future exchange rate volatility and will further our understanding of exchange rate markets.[1]

2. Literature review

While a number of techniques have been used to model volatility, the autoregressive conditional heteroscedasticity (ARCH) model developed by Engle (1982), and later generalized by Bollerslev (1986), is by far the most popular method used for analyzing high frequency financial time series data.[2] A common finding is that shocks to volatility are extremely persistent, implying that 'current information remains important for the forecasts of the conditional variances for all horizons' (Engle and Bollerslev, 1986, p. 27). However, Lastrapes (1989) applied the ARCH model to nominal exchange rates and found that the estimated parameters are sensitive to the monetary regime. He showed that there is a significant reduction in the estimated persistence of volatility from a given shock when controls for regime shifts are incorporated in the standard ARCH model. Hamilton and Susmel (1994), examining stock returns, made a similar argument using a (G)ARCH model. Their analysis employed a Markov switching model to account for structural/regime

[1] Andersen and Bollerslev (1998) using data from exchange rate markets show that ARCH models provide very accurate volatility forecasts provided volatility persistence is accurately estimated.

[2] See Bollerslev et al. (1992) for a detailed survey on GARCH models.