



Central bank interventions and jumps in double long memory models of daily exchange rates

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Abstract

In this paper, we estimate ARFIMA–FIGARCH models for the major exchange rates (against the US dollar) which have been subject to direct central bank interventions in the last decades. We show that the normality assumption is not adequate due to the occurrence of volatility outliers and its rejection is related to these interventions. Consequently, we rely on a normal mixture distribution that allows for endogenously determined jumps in the process governing the exchange rate dynamics. This distribution performs rather well and is found to be important for the estimation of the persistence of volatility shocks. Introducing a time-varying jump probability associated to central bank interventions, we find that the central bank interventions, conducted in either a coordinated or unilateral way, induce a jump in the process and tend to increase exchange rate volatility.

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1. Introduction

Given the apparent lack of any structural dynamic economic theory explaining the variations in the first two conditional moments of daily and weekly exchange rates, econometricians have extended traditional time series tools such as Autoregressive Moving Average (ARMA) models for the mean to essentially equivalent models for the variance. The Autoregressive Conditional Heteroscedasticity (ARCH) models (Engle, 1982) and its numerous extensions are now commonly used to describe and forecast changes in volatility of financial time series (see Palm, 1996).

The estimation of these models is usually done by approximate Quasi-Maximum Likelihood (QML), assuming that the innovations are normally distributed. Indeed, even if unrealistic, the normality assumption may be justified by the fact that the Gaussian QML estimator is consistent provided the conditional mean and the conditional variance are specified correctly, see Weiss (1986) and Bollerslev and Wooldridge (1992) among others.

The first goal of the paper is to show, given the specification choice of the first two conditional moments, that the occurrence of outliers is primarily responsible for the rejection of the Gaussian assumption. In turn, these outliers may be caused by specific financial events like direct central bank interventions in the foreign exchange market. Therefore, the occurrence of these events have strong implications for the modelling strategies regarding these series. Accordingly, in order to model this feature, we introduce a normal mixture distribution, the Bernoulli-normal that allows for the possibility of endogenously determined jumps. We find that for three out of the four considered exchange rates, a mixture distribution turns out to be supported by the data.

While capturing the short-run dynamics of exchange rates, the constant jump probability specification yields few economic and financial insights. Building on the empirical literature on direct central bank interventions in the foreign exchange markets (Dominguez, 1998), we extend the basic normal mixture model and introduce a time-varying jump probability which is associated with the direct purchases and sales of foreign currency conducted by the major central banks. It is found that the central bank interventions, carried out either in a coordinated or in a unilateral way, induce a jump in the process and thus tend to increase exchange rate volatility.

The paper is organized as follows. Section 2 describes the specification choice retained for the conditional mean and the conditional variance, presents several test statistics and describes the dataset used in the empirical application. Section 3 is devoted to the outliers detection issue and presents the Bernoulli-normal distribution. Section 4 extends the previous analysis by modelling the jump probability while Section 5 concludes.

2. Double long memory models

Over the last decade, the analysis of high frequency financial time series data has focused on the long memory property. As an example, weekly and daily exchange rate returns have been found to be well characterized by fractionally integrated processes. Until recently, the empirical studies have been concerned with fractional roots in either the conditional mean or in the conditional variance of these returns.

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