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Intraday periodicity, calendar and announcement effects in Euro exchange rate volatility

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ABSTRACT

This paper provides an analysis of intraday volatility using 5-min returns for Euro–Dollar, Euro–Sterling and Euro–Yen exchange rates, and therefore a new market setting. This includes a comparison of the performance of the Fourier flexible form (FFF) intraday volatility filter with an alternative cubic spline approach in the modelling of high frequency exchange rate volatility. Analysis of various potential calendar effects and seasonal chronological changes reveals that although such effects cause deviations from the average intraday volatility pattern, these intraday timing effects are in many cases only marginally statistically significant and are insignificant in economic terms. Results for the cubic spline approach imply that significant macroeconomic announcement effects are larger and far more quickly absorbed into exchange rates than is suggested by the FFF model, and underscores the advantage of the cubic spline in permitting the periodicity in intraday volatility to be more closely identified. Further analysis of macroeconomic announcement effects on volatility by country of origin (including the US, Eurozone, UK, Germany, France and Japan) reveals that the predominant reactions occur in response to US macroeconomic news, but that Eurozone, German and UK announcements also cause significant volatility reactions. Furthermore, Eurozone announcements are found to impact significantly upon volatility in the pre-announcement period.

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1. Introduction

The analysis of high frequency financial market data in recent years has revealed a distinctive intraday volatility pattern, or 'intraday periodicity'.[1] Attempts to prove that this periodicity in volatility is neither sample nor market specific have led to investigation of a wide variety of alternative asset markets, and this literature has reinforced the importance, robustness and regularity of intraday volatility patterns across global markets and financial instruments.[2] The foreign exchange market has attracted particular attention in this context because the separation of the foreign exchange market across regional financial centres and disparate time zones permits continuous trading and offers an interesting and challenging context for the modelling of intraday periodicity. That is, the microstructure of the foreign exchange market dictates a 24 h pattern to intraday volatility governed by trading activity in the world's major financial centres, whereby volatility increases at market openings and when trading in the most active centres overlap, whilst this inherent pattern is disrupted by severe spikes immediately following the release of macroeconomic news.[3]

The filtration of high frequency returns volatility through modelling of the underlying pattern is therefore an essential precursor to the modelling of volatility, and any empirical analysis of, for example, the impact effects and dynamic responses associated with news. Andersen and Bollerslev (1998) provide a robust econometric methodology for capturing the distinct volatility components and isolating macroeconomic announcement effects. This involves adopting a deterministic intraday volatility pattern to capture high frequency volatility periodicity, and imposing a predetermined volatility response pattern associated with calendar and other effects. The filtration of absolute returns by such an intraday periodicity component, estimated by a Fourier flexible form (FFF), and standardisation by an estimated daily GARCH component to account for persistence at lower frequencies, reveals interesting patterns in the correlogram of absolute returns that are invisible prior to the periodic filtering. As well as successive U-shaped intraday patterns, autocorrelations at the daily frequency show a cyclical pattern, and decay slowly over the first four days only to increase slightly at the weekly frequency, signalling a minor day-of-the-week effect. The combination of recurring cycles at the daily frequency and a slow decay in the autocorrelations are explained by the joint presence of the pronounced intraday periodicity and strongly persistent daily conditional heteroscedasticity.

Whilst the FFF method has also been applied by Andersen et al. (2000) and Bollerslev et al. (2000) to different market settings, very few other studies tackle fully the complexity involved in the modelling of intraday volatility of exchange rates, electing instead to filter intraday periodicity by standardising the chosen measure of volatility using the average absolute or squared return for a particular intraday interval over the sample period. Such techniques do not lend themselves to the further modelling of macroeconomic announcement effects, which forms a key element of the empirical investigation here, since much of the announcement effect in the intraday interval following an announcement is removed by such an arbitrary filtering approach. Whilst the FFF method is parsimonious and allows for smooth volatility dynamics, it is rigid in functional form, and imposes a smooth cyclical pattern in the characterisation of intraday periodicity. An interesting alternative to the FFF method is provided by the cubic spline method previously utilised by Engle and Russell (1998), Zhang et al. (2001), Taylor (2004a,b) and Giot (2005) in the context of autoregressive conditional duration models applied to irregularly spaced transaction data, but which has yet to be applied to foreign exchange data. This alternative method allows different cubic spline functions to be estimated between selected points (termed 'knots') in the periodic cycle, such as the various market opening and closing times in 24 h foreign exchange trading, and offers the potential to more closely match the fitted intraday periodic pattern with the known times of opening and closing in the principal markets, so potentially enhancing the efficiency of tests for calendar and macroeconomic announcement effects.

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1 See Wood et al. (1985), Harris (1986), McInish and Wood (1990) and Lockwood and Linn (1990).

2 See, for example, Kawaller et al. (1990, 1994), Ekman (1992), Lee and Linn (1994), Daigler (1997), Tse (1999), Ballocchi et al. (1999), Bollerslev et al. (2000), Abhyankar et al. (1999), Cai et al. (2004) and Cyree et al. (2004).

3 See Baillie and Bollerslev (1990), Müller et al. (1990), Bollerslev and Domowitz (1993) and Andersen and Bollerslev (1997a,b, 1998).