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Exchange rates and fundamentals: Co-movement, long-run relationships and short-run dynamics

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ABSTRACT

The present study builds upon the seminal work of Engel and West (2005) and in particular on the relationship between exchange rates and fundamentals. The paper discusses the well-known puzzle that fundamental variables such as money supply and interest rate, provide help in predicting changes in floating rates. It also tests the theoretical result of Engel and West (2005) that in a rational expectations present-value model, the asset price manifests near-random walk behaviour if the fundamentals are $I(1)$ and the factor for discounting future fundamentals is near one. The study explores the direction and nature of causal interdependencies among the most widely traded currencies in the world, their country-specific fundamentals and their US-differentials. A new VAR/VECM-GARCH multivariate filtering approach is implemented, whilst linear and nonlinear non-causality is tested and validated on simulated and empirical data. The evidence implies that there is no indication of a prevailing causal behaviour and when nonlinear effects are accounted for, the pattern of leads and lags changes over time. The variations in this linkage can be attributed to parameter instability in structural models, which may have little effect on FX forecastability over short horizons, yet it is significant for long-run cointegrating relationships. While it is difficult to reconcile these findings with the Rational Expectations hypothesis, the theory of Consistent Expectations or Bounded Rationality matches simulation and empirical findings more efficiently. Overall, fundamentals may be important determinants of FX rates, however there may be some other unobservable variables driving the currency rates that current asset-pricing models have not yet captured.

1. Introduction

In their seminal work Engel and West (2005) deal with the long-standing puzzle in international economics, i.e., the difficulty of linking floating exchange rates to macroeconomic fundamentals. It might well be that the exchange rate is determined by such fundamental variables, but in many occasions FX rates are in fact well approximated as random walks. Meese and Rogoff (1983a,b) first established the result that fundamental variables do not help predict future changes in exchange rates. They evaluated the out-of-sample behaviour of several models of exchange rates, using data from the 1970s. They found that forecast accuracy generally increased when the assumption of unchanged exchange rate was employed, compared to the predictions from the exchange rate models. While a large number of studies have subsequently claimed to find success for various versions of fundamentals-based models, sometimes at longer horizons and over different time periods, the success of these models has not proved to be robust. Cheung et al. (2002) show that no particular model/specification is very successful and conclude that it may be that one model will do well for one exchange rate, and not for another. Engel and West (2005) show analytically that in a rational expectations present-value model, an asset price manifests near-random walk behaviour if fundamentals are $I(1)$ and the factor for discounting future fundamentals is near one. They also argue that the data do exhibit a related link suggested by standard models and that the exchange rates help predict fundamentals. The implication is that exchange rates and fundamentals are linked in a way that is broadly consistent with asset-pricing models of the exchange rate.

The present study builds upon the seminal work of Engel and West (2005), and in particular on the relationship between exchange rates and fundamentals. In this paper a new line of attack is taken on the question of linear and nonlinear causality and

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co-movement between FX rates and fundamentals. The conventional class of asset-pricing models of Engel and West (2005) is utilized, in which the exchange rate is the expected present discounted value of a linear combination of observable fundamentals and unobservable shocks. Linear driving processes are posited for fundamentals and shocks. In their work Engel and West (2005) present a theorem concerning the behaviour of an asset price determined in a present-value model. They show that in the class of present-value models, asset prices will follow a process arbitrarily close to a random walk if at least one forcing variable has a unit autoregressive root and the discount factor is near unity. So, in the limit, as the discount factor approaches unity, the change of the asset price in time t will be uncorrelated with information known at time $t-1$. Hence, as the discount factor approaches unity the model puts relatively more weight on fundamentals far into the future in order to estimate the asset price. Transitory shocks in the fundamentals become less important than the permanent components. As the discount factor approaches one, the variance of the change of the discounted sum of the random walk component approaches infinity, whereas the variance of the change of the stationary component approaches a constant. Whether a discount factor of 0.9 or 0.99 is required to deliver a process statistically indistinguishable from a random walk depends on the sample size used to test for random walk behaviour and the entire set of model parameters. Engel and West (2005) present some correlations calculated analytically in a simple stylized model. This study begins by presenting correlations estimated from simulations based on the simple stylized model of Engel and West (2005). A simple univariate process for fundamentals is assumed, with parameters chosen to reflect data from recent floating periods and discount factors from 0.5 to 0.95, the latter of which suffice to yield near-zero correlations between the period t and $t-1$. An attempt is made to verify the theoretical conclusion of Engel and West (2005) that large discount factors account for random walk behaviour in exchange rates.

Moreover, the important question of model validation arises from the FX rate unpredictability implied by the random walk behaviour of the present-value models. Surely much of the short-term fluctuation in FX rates is driven by changes in expectations about the future. Assuming that the models are good approximations and that expectations reflect information about future fundamentals, the exchange rate changes will be useful in forecasting these fundamentals. In other words, exchange rates Granger-cause the fundamentals. Engel and West (2005) find a unidirectional Granger causality from exchange rates to fundamentals and a far weaker causality from fundamentals to exchange rates. Overall, the statistical significance of the predictability is not uniform and suggests a link between exchange rates and fundamentals that perhaps is modest in comparison with the links among other economic variables. In this study we investigate the validity of Engel and West (2005) results and we discuss the implications of a possible unidirectional causality running from exchange rate to fundamentals and vice versa, or of a dynamic bi-directional causality. The plausibility of their conclusions is explored also in terms of cointegration detection and application of nonlinear forecasting models (Taylor et al., 2001; Kilian and Taylor, 2003).

2. Literature review

The dynamics of exchange rates have been extensively investigated in the literature. An interesting empirical finding that has emerged over the post-Bretton Woods era is the weak linkage between exchange rates and macroeconomic fundamentals. This represents what Obstfeld and Rogoff (2000) called "*the exchange rate disconnect puzzle*". This result was first derived and reported by the seminal work of Meese and Rogoff (1983a,b) who find that a simple random walk model shows better predictability than several structural FX models such as the monetary model or the portfolio balance model (Rogoff, 2002). For such debate, the evaluation of the statistical behaviour of the exchange rates is crucial. Several studies have focused on the statistical properties of exchange rates. For example, the presence of a unit root in exchange rates is mentioned in the work of Meese and Singleton (1982), whilst Cornell and Dietrich (1978), Mussa (1984), Hsieh (1988), Fong et al. (1997) and Belaire-Franch and Opong (2005), find evidence that FX rates are closely approximately by random walks, which could be considered a particular case of a unit root process. Nevertheless, the random walk behaviour does not seem to hold throughout time. For instance, Fong et al. (1997) reveal that there was not much evidence in support of the random walk hypothesis for the floating exchange rates in the 70s whereas in the 80s the opposite was true. This suggests that exchange rates dynamics undergone significant changes since the inception of floating rates in the 1970s. Such evidence has been supported and reinforced by an extensive stream of literature e.g., Alexander and Thomas (1987), Diebold and Nason (1990), Meese and Rose (1991), Flood and Rose (1995), Faust et al. (2003), Rogoff and Stavrakeva (2008), among other. In particular, Flood and Rose (1995) mention that positive results, when they are rarely found, are often either fragile, or unconvincing and doubtful of the value of time-series modelling of exchange rates at high or medium frequencies using macroeconomic models.

However, there are some successful attempts to beat the random walk in terms of forecasting performance. MacDonald and Taylor (1994), Chinn and Meese (1995) and Mark (1995) have all reported success in forecasting FX rates at longer horizons imposing long-run restrictions from monetary models. Groen (2000) and Mark and Sul (2001) find greater success using panel methods. Overall, most of these studies find evidence of predictability of exchange rates at longer horizons, while it seems that exchange rates behaviour varies across frequencies, being more predictable at low frequencies than at medium or high frequencies. Nevertheless, it should be noted that even predictability at low frequencies has also been questioned, for instance by Kilian (1999) who show that the results obtained by Mark (1995) do not hold when the sample is updated. In this respect, Rogoff and Stavrakeva (2008) report further research to determine the robustness of the long-horizon forecastability results with regard to using different sample periods. Finally, evidence is also provided in the literature of forecasting changes in exchange rates at various horizons using nonlinear methods, although beating the random walk has proven to be rather difficult (Müller et al., 1990; Pong et al., 2004). Kilian and Taylor (2003) suggest that models which incorporate nonlinear mean reversion can improve the forecasting accuracy of fundamentals models, though it proved difficult to detect the improvement in out-of-sample forecasting exercises. Thus, it seems natural to pursue the question of whether exchange rates can forecast fundamentals and vice versa or in general the nature and direction of causality between them. This paper investigates the validity of the results in Engel and West (2005) also in the direction of possible forecasting applications.

In regard to causality detection, the Granger test (Granger, 1969) is used as a benchmark in the literature. However, Baek and Brock (1992) note that parametric linear Granger causality tests have low power against certain nonlinear alternatives. In view of this, nonparametric techniques have been applied with success because they place direct emphasis on prediction without imposing a linear functional form. The test by Hiemstra and Jones (1994) which is a modified version of the Baek and Brock (1992) test is regarded as a test for a nonlinear dynamic causal relationship. Moreover, in later studies Diks and Panchenko (2005, 2006)