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Can the interaction between a single long-term attractor and heterogeneous trading explain the exchange rate conundrum?

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ABSTRACT

Over the last 15 years, exchange rate movements were relatively smooth, despite sharp shifts in the fundamental variables. In the large literature dealing with the high frequency exchange rate dynamics, the model that assumes heterogeneous trading strategies, where 'fundamentalists' coexist with 'chartists', plays a relevant if puzzling role.

We study the US dollar, the British pound and the Japanese yen vs the euro over the period 2002–2016 using weekly data and we find that both types of agents react to the same transition variable, viz. the absolute distance of the actual exchange rate to its relative PPP value. The spot foreign currency demand of fundamentalists is driven by the size of the misalignment both directly and through a transition function, which models the adoption of fundamental strategies by newcomers. The number of chartists also varies according to the absolute distance of the exchange rate change from its fundamental PPP value. Evidence supports the existence of stabilizing and destabilizing behaviour not only by chartists but also by fundamentalists.

1. Introduction

Modeling exchange rate dynamics has never been an easy task. Most fundamental models failed both to explain and to predict exchange rate movements in a consistent way over time and across currencies. A possible explanation is that there are important nonlinearities in the data, due to endogenous price movements which result from the interaction of heterogeneous bounded-rational strategies based both on technical and fundamental analysis.[1] The heterogeneity of these strategies could vary across agents and over time, and produce effects that properly match the actual exchange rate dynamics.

In a seminal work Frankel and Froot (1986) introduce the 'chartists-fundamentalists' approach in a foreign exchange model. They explain the movements of the US dollar in the eighties as the outcome of the interaction between fundamentalists' long-term trading strategies and chartists' short-term behaviour.

Brock and Hommes (1997, 1998) and Westerhoff (2004), among many others, assume that different groups of agents condition their behaviour on differing types of information and beliefs. Westerhoff and Reitz (2005), using a switching mechanism, analyse how deviations from a fundamental value weaken fundamentalists' beliefs changing the number of agents in the market, with consequences on stability. In their paper chartists were only of the 'trend follower' type.

Switching mechanisms may be based on past performances (Boswijk et al., 2007), fundamental prices (Manzan and Westerhoff,

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[1] See, among many others, DeGrauwe and Vansteenkiste (2007), Menkhoff et al. (2009), de Jong et al. (2010), Ellen ter et al. (2013), Chia et al. (2014) and Flaschel et al. (2015).

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2007), accuracy of past forecasts (de Jong et al., 2010, Prat and Unctum, 2015), business cycle indexes (Lof, 2012) and changes in expectations, due to unobserved factors in financial markets, governed by a Markov process (Chiarella et al., 2012).

This paper extends the previous literature by adding several features.

- Because of its size, depth and liquidity the foreign exchange market is a privileged field of analysis for heterogeneous agents models. Most empirical studies, however, impose too many ex-ante restrictions and are vulnerable to data snooping criticisms. We include almost no a-priori restrictions in our analysis and the selected specification is data driven.
- We allow for a differing behaviour among traders of the same category, be they chartists or fundamentalists. Some traders alter their reaction over time and account for a regime shifting component and others are impervious to changes and maintain their presence in the market, irrespectively of the regime. We introduce, in this way, a second classification between resilient and regime shifting market agents.
- Both fundamentalists and chartists may modify their behaviour over time and over regimes. Wan and Kao (2009) introduce contrarian noise trading in their analysis without relating it, as we do in our paper, to deviations from a chosen anchor value. Furthermore, we assume that fundamentalists too may behave as contrarians and have a destabilizing reaction to market disequilibrium. In periods of extreme financial turmoil, a stabilizing fundamentalist market reaction cannot be imposed a-priori and should be tested empirically.

Our empirical analysis shows that pricing efficiency is not the same across exchange rates. The US dollar euro exchange rate seems to be priced in a more efficient way, as its deviations from equilibrium are less persistent than the Japanese yen euro or the British pound euro rates.[2] We focus on the euro perspective since the European Monetary Union was affected by two consecutive crises, in 2008 and in 2011. The subsequent disruptive effects on exchange rate fundamentals make the euro well suited for a regime shifting analysis.

The paper is organised as follows. In Section 2 we introduce the model, the characteristics of trading agents as well as the effects produced by the simultaneous implementation of different strategies. We present the data and the non-linear transition econometric model in Section 3. The empirical results are set forth in Section 4. Section 5 concludes the paper.

2. The model: trading strategies and their impact on the exchange rate

In this section, we discuss how changes in the trading behaviour of heterogenous agents affect exchange rate determination. The usual distinction applies, if trading strategies depend only on the past dynamics of the exchange rate, agents are defined “chartists”, if they depend on external information used to assess a long- term fundamental value, agents are called “fundamentalists”. Chartists can be further classified as trend followers, if they trade following the trend, or contrarians, if they do the reverse. The final effect on the exchange rate depends on the interaction between different types of agents and varies over time since agents can decide to enter or exit the market according to a transition function, which is geared to the gap between the spot exchange rate and its long-term equilibrium value.

Given the high degree of uncertainty and disagreement, which characterizes the foreign exchange markets (Ellen ter et al., 2016), most agents review periodically their arbitraging performance and their beliefs. When substantial losses occur, short-termism applies. Agents may lose credibility (with their principals) or run out of liquidity and have to leave the market, without recouping an eventual shortfall. Furthermore, traders' confidence is likely to decline if the exchange rate persistently deviates from its expected long-term value. This fact is modeled introducing a confidence function (the transition function) that accounts for the shifts in the number of each type of active trader in the market. In our model, two Logistic Smooth Transition Autoregressive (LSTAR) transition functions, g^F and g^C, apply respectively to fundamentalists and to chartists.

2.1. Fundamentalists

The fundamentalists’ trading strategy assumes that the actual exchange rate will revert towards its fundamental value. Their foreign currency demand function reads as follows:

$$D_t^F = a_1 g_t^F(\Delta f_t - \Delta s_t) + a_2(\Delta f_t - \Delta s_t) \quad (1)$$

where f_t and s_t denote, respectively, the logs of the fundamental and spot exchange rates, quoted as number of units of domestic currency per euro. There is little consensus on the true drivers of the equilibrium exchange rate (Sarno and Taylor, 2002), even if most models use either the purchasing power parity (PPP) or the uncovered interest rate parity (UIP) as anchor value.

In this paper f_t is the equilibrium value of the spot exchange rate according to the relative PPP hypothesis. The selection of this specific anchor is motivated by both our empirical results and recent evidence found in the literature.[3] In Eq. (1) we assume that

[2] Our empirical findings corroborate previous results on the stronger efficiency of the Us dollar/DM-Euro exchange rate, originally documented by Longworth (1981), Hodrick (2001) and the literature mentioned therein.

[3] We tried to implement the model with a UIP or a Covered Interest Parity (CIP) anchor and obtained very poor empirical results. Indeed, several research papers – see Lothian (2016) and the literature quoted therein – find that the relative PPP performs well, using a large sample of currencies and across time. On the contrary, the explanatory power of the UIP and of the CIP is found, by Borio et al. (2016), Pippenger (2017) and Bräuning and Puria (2017), among others, to be less satisfactory and much more arbitrary. The systematic violation of the CIP has become one of the major puzzles of the recent foreign exchange pricing literature.