



## Animal spirits in the foreign exchange market

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### ABSTRACT

It is traditionally assumed in finance models that the fundamental value of an asset is known with certainty. In this paper we depart from that assumption. We propose a simple model of the exchange rate in which agents have biased and unbiased beliefs about the fundamental rate. We show that such a model produces waves of optimism and pessimism unrelated to the underlying fundamental value. In addition, the model shows that in a world characterized by the existence of heterogeneous beliefs about the fundamental, exchange rate movements can be remarkably complex even if only fundamentalist traders operate in the market.

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### 1. Introduction

Beliefs are important forces, not only in everyday life, but also in financial markets. Changes in beliefs shape events even if there is no change in the objective forces affecting reality. Economists have long recognized this in the past. Keynes (1964), for example, wrote about ‘animal spirits’ influencing reality and creating waves of optimism and pessimism. More recently, Kindelberger (2005) in his celebrated study ‘Manias, panics and crashes’ analyzed the way in which agents develop beliefs and how these beliefs move stock prices.

Beliefs also matter in the foreign exchange market. A few years ago two sets of beliefs emerged about the fundamental value of the U.S. dollar. The first set was represented, among others, by Obstfeld and Rogoff (2005) and Obstfeld (2005). According to this view the large current account deficits of the U.S. observed since the second half of the 1990s were unsustainable. A major decline in the value of the dollar would be the consequence of adjusting the current account balance to a sustainable level. These authors estimated that restoring the balance in U.S., European and Asian current accounts would imply a 30% depreciation of the dollar against the Euro and a 35% depreciation against a basket of Asian currencies respectively. It turned out later that these authors were right, but at that time there were also other beliefs about the fundamental value of the dollar. One was developed by Hausmann and Sturzenegger (2006). In this alternative view there did not arise a problem of sustainability. These authors detected ‘Dark Matter’ in the international financial markets, i.e. attributes present in certain assets (the U.S. dollar in this case) that could not properly be measured. Corrected for the amount of ‘dark matter’ these authors came to the conclusion that there was in fact no net foreign US debt, and thus

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that the dollar was correctly priced. Similar differences in beliefs about other exchange rates have been observed. For example, economists disagree about the fundamental value of the Renminbi against the dollar and other currencies.

There can be little doubt that these differing beliefs about the fundamental value of currencies are realities that can affect the market exchange rates. In this paper we develop a systematic analysis of beliefs in the foreign exchange market. Traders in our model have divergent beliefs about the value of the fundamental exchange rate. They form their expectations adaptively and interact with each other selecting the trading strategy that is most profitable. Put differently, traders in our model develop beliefs about the underlying fundamental value of the exchange rate, but they are willing to change these beliefs and switch to another one if the latter turns out to be more useful (profitable). Thus traders are willing to learn about the world in a 'trial and error' fashion. In this way we introduce an evolutionary type of discipline, so as to avoid that 'anything can happen'. That is, trading strategies are not just selected in an ad hoc way but according to a disciplining algorithm, which is consistent with the idea of utilitarianism, whereby the most useful beliefs are favored.

We deviate from the rational expectations paradigm for several reasons. First, rational expectations implies that agents have full knowledge of the underlying model, whatever its complexity, and that they know the objective probability distribution of all exogenous shocks. In such an environment there is no room for divergent beliefs about the underlying fundamentals.<sup>1</sup> Second, there is a large body of evidence showing that humans are boundedly rational. Broadly speaking, psychologists divide our actions between two types: intuitive and rational. A large amount of studies suggest that many of our actions correspond to the first type and therefore they are spontaneous rather than deliberate and rational (Epstein, 2003; Gilbert, 2002; Wilson, 2002). Furthermore, Tversky and Kahneman (1974) show that humans base a large share of their decisions on a limited number of simple heuristic rules. All together this suggests that people tend to use fast associative thinking instead of spending a large amount of time in making effortful rational decisions. This means that traders might make systematic mistakes, particularly so under situations of uncertainty. At the same time however, making decisions based on heuristics allows humans to save large amounts of computational time. Using adaptive expectations does not mean, however, that we move into a world of irrationality. As mentioned in the previous paragraph, the second, rational dimension of human behavior is given its due role in our model. Traders are willing to learn from their mistaken beliefs in an evolutionary fashion. They adjust their behavior dropping their mistaken beliefs in favor of newer ones when the latter outperforms the former.

Our paper belongs to the heterogeneous agent literature that has developed over the last years (Brock and Hommes, 1997, 1998; Chiarella, 1992; Chiarella and He, 2002; De Grauwe and Grimaldi 2006a,b; Frankel and Froot, 1986, 1990; Lux and Marchesi, 1999). Only a few papers in this literature however model the uncertainty about fundamentals in a systematic way: De Grauwe and Rovira Kaltwasser (2007), Diks and Dindo (2008), Manzan and Westerhoff (2005), Rovira Kaltwasser (2010), Westerhoff (2003). Also in Heitger (2010) there is an interesting treatment of fundamentalist traders with different degrees of risk aversion as well different perception levels of the excess return of assets.<sup>2</sup> We begin with a very simple model of the exchange rate, which is extended later. The model deviates from the standard chartist-fundamentalist approach by assuming that no trend followers participate in the market but only traders following a fundamentalist rule. We show in this very simple setup how cycles of optimism and pessimism emerge in the foreign exchange market, even in the absence of innovations to the true fundamental.

The remaining of the paper is organized as follows: in Section 2 we present the basic theoretical model of the exchange rate, in Section 3 we extend the basic setup by allowing traders who observe the underlying fundamental without any bias. In Section 4 we augment the model by including trend followers. Section 5 offers a brief analysis of the statistical properties of the data generated by the model in a noisy environment and Section 6 concludes.

## 2. A simple model of animal spirits

Based on the empirical evidence presented in the introduction, our starting point will be to assume that traders do not observe the true underlying fundamental. Instead they form beliefs about the fundamental and they use these beliefs rather than the true unobserved fundamental to take positions in the market. That is, they take positions in the FOREX market, so as to correct any misalignment of the market exchange rate with respect to their perceived fundamental value. For simplicity we will assume that there are only two types of traders, optimists and pessimists, where the label optimist-pessimist refers to traders that systematically overestimate or underestimate the fundamental rate respectively.<sup>3</sup>

An optimist trader expects the value of the exchange rate to increase whenever the market exchange rate  $e_t$  is below  $e_{opt}$ , where  $e_{opt}$  is the optimistic belief about the fundamental. Pessimists behave accordingly apart from the fact that their

<sup>1</sup> There is another interesting branch of the literature that departs from rational expectations, which assumes that agents update their information by means of statistical learning. This approach adds flexibility to rational expectations and it has offered interesting insights (Evans and Honkapohja, 2008; Cogley and Sargent, 2005; Sargent, 1993).

<sup>2</sup> Bacchetta and Van Wincoop (2006) develop a rational expectations model of the exchange rate where traders have incomplete and heterogeneous information. As a consequence traders put excessive weight on a particular observed fundamental variable. Opposed to the literature in heterogeneous agents though, in their setup traders do not switch between the different information sets. It will become clear in the next section that this is a main ingredient of our paper.

<sup>3</sup> This assumption will be relaxed in the following section where we extend the model by allowing for the existence of traders who are able to observe the true underlying fundamental.

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