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Foreign exchange market inefficiency and exchange rate anomalies

Jing Li*, Norman C. Miller[1]

Department of Economics, Miami University, 800 East High Street, Oxford, OH 45056, United States

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ABSTRACT

This paper develops a perfectly general non-linear Uncovered Interest Parity, UIP, framework with foreign exchange (fx) market inefficiency. The latter means that there is always some "unexploited profit" which tends to generate a negative value for Fama's beta coefficient. However, as ID decays over time, this tends to generate a positive value for beta. The sign of beta is uncertain. It is shown that this result implies that the existence of fx market inefficiency is consistent with many puzzling facts about exchange rates, and that the model's implied values for beta are consistent with those obtained via actual data.

1. Introduction

According to the concept of Uncovered Interest Parity, UIP, in an efficient fx market the currency of a high interest rate country will appreciate in the period when its interest rate increases, and depreciate in future periods. The initial appreciation brings about ex ante UIP and the ensuing depreciation generates ex post UIP. The UIP puzzle (or forward bias puzzle) is that the currency of a high interest rate country often appreciates in the period immediately after its interest rate increases. The empirical tests on this subject obtain estimates of the relationship between the home minus foreign nominal interest rate differential, ID, and the percentage change in the spot rate one period later. This relationship is embodied in a regression coefficient that is commonly called Fama's β.[2] The latter should be plus unity if UIP holds.

Scholarly studies find that: (a) beta is often negative with an average value close to minus unity, i.e., the UIP puzzle[3]; (b) estimates of beta are extremely variable over time, sometimes going from negative to positive for the same country[4]; (c) estimates of beta are often positive when only outlier values for ID are used (i.e., there is "extreme support" for UIP),

* Corresponding author. Tel.: +1 513 529 4393; fax: +1 513 529 6992.
E-mail addresses: lij14@miamioh.edu (J. Li), millernc@miamioh.edu (N.C. Miller).

1 Tel.: +1 513 529 2863; fax: +1 513 529 6992.

2 See Fama (1984), and more recently Baillie and Bollerslev (2000), Gourinchas and Tornell (2004), Chaboud and Wright (2005), Chinn (2006), Sarno et al. (2006), and Burnside et al. (2009).

3 Froot and Thaler (1990) report an average value for β of −0.88 in more than 70 Fama type regressions.

4 See, for example, Baillie and Bollerslev (2000).

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but are negative when only smaller (non-outlier) IDs are used[5]; and (d) the currency of the high interest rate country tends to appreciate for many periods following an increase in its interest rate, but it depreciates eventually; that is, "delayed overshooting" occurs.[6]

The thrust of the literature dealing with these puzzling facts has focused on the possibility that a Fama regression has a missing variable such as a risk premium or an exchange rate prediction error.[7] Froot and Thaler (1990) suggest that the fx market is sometimes inefficient. Along these lines, Huisman et al. (1998) estimate Fama regressions twice: (a) first using only outlier values for ID, then (b) using relatively smaller (non-outlier) IDs. In (a) the estimates of β are often positive and not significantly different from +1, thereby generating what has been called "extreme support" for UIP. Apparently, the UIP puzzle does not exist when speculation is sufficiently profitable. However, in (b) the estimates of β are very negative. Therefore, one key toward solving the UIP puzzle might be to explain why β is very negative for non-outlier values for ID, when, presumably, little or no speculation takes place. Sarno et al. (2006) point out that we do not know the answer to this important question.

The paper by Huisman et al. (1998) represents a non-linear econometric UIP framework with discontinuous jumps from one state (outlier IDs) to another (non-outlier IDs). More recently, Baillie and Kilic (2006), Sarno et al. (2006), and Baillie and Chang (2011) have estimated smooth transition non-linear econometric UIP models, wherein the degree to which the fx market satisfies ex ante UIP varies in a continuous manner. Their results are consistent with those of Huisman et al. (1998) in that they find that Fama's β is often positive when sufficient profit opportunities exist. Furthermore, they find that Fama's β is negative when expected returns are low, as, for example, when interest rate differentials are not large. All of these non-linear econometric UIP frameworks are consistent with the hypothesis that the fx market becomes progressively more inefficient as the expected return from speculation decreases.

The fx market might be inefficient for many reasons. Shleifer and Vishny (1997) say that investors might have institutional constraints on the size of fx positions. Gourinchas and Tornell (2004) and Ilut (2012) assume that investors incorrectly anticipate the persistence of nonzero IDs. Brunnermeier and Pederson (2008) believe that liquidity constraints often limit the volume of speculative funds. Burnside et al. (2009) construct a UIP model with heterogeneous exchange rate expectations. Finally, Bacchetta and van Wincoop (2010) present evidence that it is not cost efficient for investors to constantly determine their optimum fx position.

The objective of this paper is to develop a nonlinear UIP framework with fx market inefficiency modeled as simply as possible, and show that this is consistent with many fx market anomalies. This is done in a straightforward manner by assuming that the spot rate might not adjust enough within any one time period to bring about ex ante UIP. This is modeled via the assumption that, in any one time period, the speculative movement of funds eliminates only 100λ% of the expected profit from carry-trade, with $0 < \lambda \leq 1$. Furthermore, it is assumed that λ is positively related to the absolute value for ID; that is, the fx market becomes progressively less efficient as ID decreases in absolute value. This is consistent with Lyons (2001) "limits to speculation" hypothesis, and with the "extreme support" literature, i.e., the nonlinear models of Huisman et al. (1998), Baillie and Kilic (2006), Sarno et al. (2006), and Baillie and Chang (2011).

The intuition involved in this model of fx market inefficiency is straightforward. When the home, USA, interest rate increases in period t relative to the foreign rate, then ID(t) becomes positive, and funds flow from fx to dollars, thereby appreciating the dollar in period t. However, the spot rate does not move enough in period t to satisfy ex ante UIP; this means that unexploited profit exists at the end of period t. The existence of unexploited profit creates a tendency for funds to move again from fx to dollars in the next time period, $t+1$. This, in itself, serves to appreciate the dollar in $t+1$. This is called the "unexploited profit effect". However, all nonzero IDs tend to decay slowly over time. If ID decays somewhat between period t and period $t+1$, this tends to depreciate the dollar, which is called the "decaying ID effect". The net effect on the spot rate in period $t+1$ is uncertain, depending on the relative strengths of the opposing forces.

If the "unexploited profit effect" dominates, then the dollar appreciates again in period $t+1$, which is consistent with the UIP puzzle. This is more likely for smaller absolute values for ID. Thus, the model is consistent with the fact that smaller IDs generate negative betas in the "extreme support" literature. If the "decaying ID effect" dominates in period $t+1$, then the dollar depreciates in $t+1$, and this implies that Fama's β is positive. This is more likely for large absolute values for ID, as in the "extreme support" literature.

Estimates of Fama's β will vary over different time intervals if the relative frequency of absolutely larger versus smaller IDs varies. Finally, if the "unexploited profit effect" dominates initially (so that the UIP puzzle exists) then the dollar can continue to appreciate for many periods. However, the strength of the "unexploited profit effect" gradually approaches zero. Therefore, eventually the dollar is certain to start depreciating, as in "delayed overshooting".

The paper proceeds as follows. Section 2 first develops an UIP framework with fx market inefficiency in a perfectly general manner, such that all conclusions hold regardless of the reason(s) for inefficiency. Then Section 2 proves theoretically that

[5] Huisman et al. (1998).

[6] See Eichenbaum and Evans (1995). In Dornbusch (1976), an exogenous change in interest rates induces the spot rate to change instantaneously by more than any change in its expected long run equilibrium value. Then the exchange rate begins to return back toward its long run value in the very next time period. Delayed overshooting occurs if the spot rate begins to converge back toward its long run equilibrium value only after many time periods.

[7] More recently, Pippenger (2011) suggests two new missing variables that the existence of covered interest parity implies. See, however, Baillie (2011), Chang (2011), and Muller (2011).