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Does the forward premium puzzle disappear over the horizon?

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ABSTRACT

This paper provides the first comprehensive study of the horizon effect in tests of the forward rate unbiasedness hypothesis. It estimates Fama regressions employing 1-month through to 10-year horizon data for the five most heavily traded US dollar currency pairs pre-crisis 1980–2006. In contrast with extant studies, it fully deals with the econometric problems of long horizon regressions by means of a novel heteroskedastic- and autocorrelation-consistent bootstrap. The regression results confirm a clear horizon effect in that the slope coefficient approaches unity as the forward contract maturity is extended. The puzzle disappears at the 3-year horizon and beyond for all currencies.

1. Introduction

The forward rate unbiasedness hypothesis implies that the forward rate is an unbiased predictor of the corresponding expected future spot rate under the assumptions of risk neutrality and rational expectations. More specifically, while a regression of the spot exchange rate return on the forward premium should yield a slope coefficient of unity, such regressions typically yield negative coefficients.[1] The counterintuitive implication is that, contrary to uncovered interest parity (UIP), high interest rate currencies are predicted to appreciate rather than depreciate. Despite widespread tests across different time frames and currencies, this result has remained stubbornly robust and has become known as the forward premium (FP) puzzle or anomaly.[2] The persistence of the puzzle is recognized by market participants and is consistent with apparently profitable carry trade, momentum, and technical trading strategies.[3]

Most empirical studies have employed short horizon data typically at the 1-month frequency to examine the FP puzzle.[4] The results are consistent with the well-known exchange rate disconnect puzzle since they imply that fundamentals represented by the forward premium – or interest rate differentials assuming covered interest parity (CIP) holds – cannot predict even the direction of exchange rate changes. The disconnect puzzle was originally documented by Meese and Rogoff (1983) and stresses that fundamental exchange rate models cannot outperform a random walk in predicting exchange rates in the short run.

Our paper builds upon the Flood and Taylor (1997) insight that UIP holds and so fundamentals matter in the long run. It does this by extending the horizon of FP tests in the spirit of a number of recent contributions.[5] However the approach to resolving the puzzle by running regressions at longer horizons ($k > 1$) comes with attendant econometric problems stemming from the disjuncture between the sampling frequency of the data employed – typically monthly – and the extended horizon of the regression variables. The data overlap means that such regressions suffer from two sources of serial correlation in the error term. The first arises from sampling the k-month exchange rate changes on a monthly basis leading to a moving average structure out to k months even if monthly frequency sampling leads to some improvement in the efficiency of the estimators (Boudoukh and Richardson, 1994). The second source is the serial correlation that stems directly from using a lagged k-month

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[1] For a survey, see Froot and Thaler (1990).

[2] The puzzle has spawned a voluminous and ongoing literature (see, *inter alios*, Engel, 1996; Sarno, 2005).

[3] For example see Burnside et al. (2007), Darvas (2009), Baillie and Chang (2011), and Jordà and Taylor (2012).

[4] The term 'horizon' in this context represents the time to maturity of the relevant forward contract.

[5] See Alexius (2001), Clarida et al. (2003), Killian and Taylor (2003), Chinn and Meredith (2004), Chinn (2006), Bekaert et al. (2007), and Boudoukh et al. (2012).

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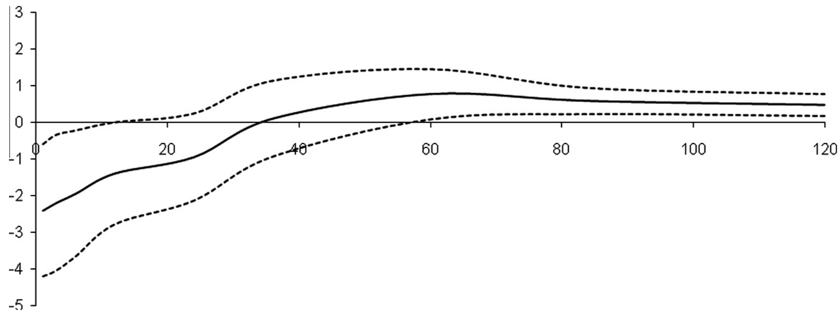

Fig. 1. GBP/USD Eq. (1) slope coefficient estimates with 10% rejection bands. Notes: The *y*-axis represents the slope coefficient and *x*-axis represents the forward contract horizon. The solid line represents the estimated forward premium slope coefficients from regressing the logged *k*-month change in the spot rate on the logged *k*-period forward premium as in Eq. (1) for $k = 1, 3, 6, 12, 24, 36, 60, 84, 120$. Standard errors calculated using Newey and West (1987), dashed lines represent the rejection bands at the 10% significance level. Span: 01:1980–12:2006. Source: Thomson DataStream.

regressor, akin to the situation in *k*-step ahead predictive regressions.

The first and main contribution of this paper is that it uses monthly data to provide the most comprehensive test to date of a horizon effect in the Fama regressions. It does so by employing interest rates across the spectrum of maturities extending from the typical 1 month all the way out to 10 years. The great merit of this approach is that it enables one to observe the adjustment to equilibrium path as the interest rate horizon is extended and to test at precisely which horizon equilibrium is attained or the unbiasedness hypothesis cannot be rejected.

Our approach is illustrated by Fig. 1 which shows the Fama (1984) regression slope coefficients and related 10% standard error bands for horizons from just 1 month through to 10 years for the British pound (GBP) exchange rate against the US dollar (USD).

Fig. 1 shows that the slope coefficients start off with large negative values such as −2.4 at the 1-month horizon. These negative coefficients persist and only turn positive at the 36-month horizon when the unbiasedness hypothesis cannot first be rejected or unity falls within the standard error bands. Thereafter the coefficients remain positive and in the zero to one range. This result generalizes to the Deutsche mark (DEM), Japanese yen (JPY), and Swiss franc (CHF) currency pairs 1980–2006 relative to at least one of two base currencies used (USD and GBP), with the Canadian dollar (CAD) notable as the sole exception. Overall the results show a clear cut and novel pattern where the strong rejection of the unbiasedness null at the short horizon is predominantly overturned at the 3-year horizon and tends to hold thereafter. Thus the paper is the first to establish strong evidence of a horizon effect as an explanation for the FP puzzle. Our results vindicate the oft-quoted maxim of Flood and Taylor (1997) that "fundamental things apply as time goes by."

The second contribution of this study is that it directly confronts the serial correlation and related problems arising from data overlaps in medium and long horizon regressions. None of the extant long horizon studies in a Fama regression framework adequately addresses these problems while others try to circumvent them by employing a vector autoregression (VAR) framework where long-run results are inferred from short-run dynamics.[6] However, a VAR framework is not well suited to testing for a horizon effect as it imposes a specific model on the system under consideration. As Boudoukh et al. (2011) emphasise, if the model is incorrect, it is unclear how to interpret the long-run forecasts.

Instead this study proposes a novel bootstrap solution to the data overlap problem in Fama regressions, similar to that found in predictive regressions in both foreign exchange and stock markets (Killian and Taylor, 2003; Rapach and Wohar, 2005). The procedure generates heteroskedastic and autocorrelation consistent (HAC) *t*-statistics from pseudo data forming an empirical distribution against which the original *t*-statistic can be compared. The associated *p*-values can be used to draw statistical inference even in the presence of long data overlaps. Two recent studies have confronted the data overlap problem. Chinn and Meredith (2004) employ serial correlation corrected standard errors in the context of the Fama (1984) regression. Boudoukh et al. (2012) employ the Newey and West (1987) HAC estimators to see if information in the term structure of forward interest rates can help predict annual exchange rate changes up to 5 years ahead.[7] They attempt to sidestep the worst of the overlap problem by restricting analysis to annual spot returns and 12-month forward rates out to 5 years. Both these approaches fall short of fully dealing either with the econometric problem, or employing the full range of horizons from 1 month to 10 years, respectively.

The remainder of this paper is organized as follows. Section 2 provides a discussion of the FP puzzle and the related long horizon literature. Section 3 outlines the econometric methodology and presents the data and empirical results. Section 4 summarizes the conclusions from the paper.

2. The forward premium puzzle

There is already a huge literature on the FP puzzle. This section presents a selective literature review by focusing on Fama regression and long horizon studies.

2.1. Fama (1984) regressions

The FP puzzle arises in testing the unbiasedness hypothesis or forward exchange market efficiency. Researchers typically estimate the Fama (1984) spot return regression:

$$\Delta s_{t+k} = a_k + b_k(f_{t,t+k} - s_t) + u_{t+k} \tag{1}$$

where k is the horizon or maturity of the forward contract, s_t and f_t, respectively, are the logarithms of the spot and forward exchange rates at time t, and u_{t+k} is a zero-mean error term. Under unbiasedness, one would expect $a_k = 0$, $b_k = 1$ and u_{t+k} to be serially uncorrelated so that an investor cannot earn excess returns. Empirical studies typically find that the slope coefficient on the forward premium is significantly negative. Future spot returns, rather than adjusting one-for-one with interest rate differentials, instead move

[6] See, for example, Clarida et al. (2003) and Bekaert et al. (2007). Boudoukh et al. (2011) offer a critique of VAR approaches in this context.

[7] See their Monte Carlo results. The use of the bootstrap means that our study is not restricted in the range of horizons of either the dependent or independent variables for the Fama regressions.