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The forward premium puzzle in the interwar period and deviations from covered interest parity

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ABSTRACT

We revisit the forward premium puzzle in the interwar period and find that, as the deviation from covered interest rate parity increases, the coefficient on the forward premium in the standard Fama regression tends towards zero.

1. Introduction

Numerous researchers using data from the postwar 1971 floating period have replicated the forward premium puzzle, which is that the forward premium is inversely related to future exchange rate changes or the excess return, as initially documented by Fama (1984).[1] In an important insight, Lyons (2001) provided a further reason to explain the forward premium puzzle. Lyons pointed out that the forward bias will not attract speculative funds until this trading strategy is expected to generate an excess return per unit of risk that exceeds that of other trading strategies. As a consequence, there is a band of inaction in which the forward bias will persist until the bias is sufficiently large to attract speculative funds.[2]

Recently, Sarno et al. (2006) have reported estimates of nonlinear models for the recent floating period that capture this band of inaction. Their empirical results provide support for the Lyons hypothesis. Given this, it seems worthwhile to provide further empirical evidence on this hypothesis using data for a different time period when trading conditions were radically different and there were apparently large departures from covered interest arbitrage. This period is the interwar floating period.

In order for the forward exchange rate to provide an unbiased predictor of the future spot rate it is necessary that both covered and uncovered interest parity hold. In postwar data this is found to be the case for covered interest arbitrage, up to small fractions, in studies employing high quality data (see e.g. Taylor, 1987, 1989; Akram et al., 2008). However, this does not appear to be the case for periods of the interwar float.

In a recent paper, Peel and Taylor (2002) present a study of covered interest arbitrage in the interwar foreign exchange market of the 1920s. In particular, employing weekly data on spot, forward rates and interest rates, they provide evidence on a conjecture primarily due to Keynes (1922, 1923) and given further emphasis by Einzig (1937, 1961, 1962). What may be termed the Keynes–Einzig conjecture has two components. First, that covered arbitrage between the major financial centres in the interwar period was only triggered once the deviation from covered parity exceeded about $\frac{1}{2}$% (that is, fifty basis points) on an annualized basis. Second, that even when arbitrage was triggered, deviations were arbitraged away only slowly because of the less than perfect elasticity of supply of arbitrage funds. For instance, Einzig writes “Deviations of a lasting nature were liable to arise, however, among other reasons, because the liquid capital available for arbitrage was not unlimited and at times it was not large enough to bring about readjustment” (Einzig, 1962, p. 275).

Peel and Taylor (2002) report empirical results consistent with the Keynes–Einzig conjecture. Given that arbitrage only occurred when deviations from covered interest arbitrage were sufficiently large it follows *a fortiori* that the uncovered arbitrage will not hold so that the forward rate will not be an unbiased predictor of the future spot rate

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[1] For a comprehensive survey see, e.g., Engel (1996).

[2] Other well known reasons include a time-varying risk premium, peso problems, systematic feedback rules or statistical properties of the data.

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except by chance. Given this point we re-examine the relationship between excess returns and the forward premium making allowance for deviations from covered interest arbitrage employing weekly data for the period December 1921 until May 1925. The rest of the letter is structured as follows. In Section 2 we set out our model. In Section 3 we describe the data, the empirical method and present the results. Section 4 is a brief conclusion.

2. Forward premium puzzle

A standard regression estimated in the literature to determine the predictability of foreign exchange excess returns n periods ahead is (e.g. Fama, 1984)

$$s_{t+n} - f_t = \alpha + \beta(f_t - s_t) + v_{t+n} \quad (1)$$

where s_{t+n} is the logarithm of the spot exchange rate at time $t+n$, f_t is the logarithm of the forward rate for horizon n, α, and β are positive constants, and v_{t+n} is an error term that can follow up to an $n-1$ moving average error term under the null of efficiency. The *ex-post* excess return is $s_{t+n} - f_t$, and $f_t - s_t$ is the forward premium. When agents are risk-neutral, have rational expectations, and covered and uncovered parity hold we would obtain estimates of β and α that do not differ significantly from zero.

The essence of the hypothesis of Lyons is that limits to arbitrage imply that within a certain band the forward bias does not attract capital and, as a consequence, the spot and forward rate may not mover together.

In our setting, we modify the Fama specification to endeavour to capture this effect as follows

$$s_{t+n} - f_t = \delta + \theta(f_t - s_t)e^{-\lambda(cip_t)^2} + e_{t+n} \quad (2)$$

where δ, θ and λ are constants, and e_{t+n} is the error term. We note that, if λ is zero in the above regression, we obtain the standard Fama regression (1), and therefore the Fama regression is nested.[3] It is also possible to rewrite Eq. (2) as the alternative Fama regression

$$s_{t+n} - s_t = \delta + \left(\theta e^{-\lambda(cip_t)^2} + 1\right)(f_t - s_t) + e_{t+n} \quad (3)$$

The assumption captured by Eq. (2) is that when deviations from covered interest parity are large, inducing speculative flows, the forward premium *per se*, will become a more accurate forecast of future changes in expected spot rates. Consequently, as deviations from *cip* become large in the above regression the coefficient on the forward premium becomes smaller, so that the bias of the forward premium as a predictor of future changes in spot rates becomes smaller.[4] The smooth transition adjustment captures the idea of heterogeneous traders with different trading limits.[5]

We also note that if it is assumed that the unobservable expectation of the excess return, $E_t s_{t+n} - f_t$, is proportional to deviations from covered interest parity (*cip*) we obtain the regression estimated by Sarno et al. (2006). That assumption would allow us in principle to solve for a consistent (rational) expectation which would be a complex function solely of the forward premium (see Peel and Venetis, 2005). Taking expectations of Eq. (2) generates the implied rational expectation in this model. However, no closed form exists for estimation purposes and therefore we estimate Eq. (2) directly.

[3] Similarly, one could write Eq. (2) using a first order approximation and obtain the following expression where the Fama regression is more explicitly nested when $\lambda = 0$ this equation

$$s_{t+n} - f_t = \delta + \theta(f_t - s_t) + \alpha(f_t - s_t)cip_t^2 + e_t + n$$

Note that $\alpha = -\lambda\theta$; and therefore when $\lambda = 0$ this equation becomes Eq. (1).

[4] Note that the transition function in Eq. (2), $e^{-\lambda(cip_t)2}$, is bounded between 0 and 1.

[5] For full details see Sarno et al. (2006).

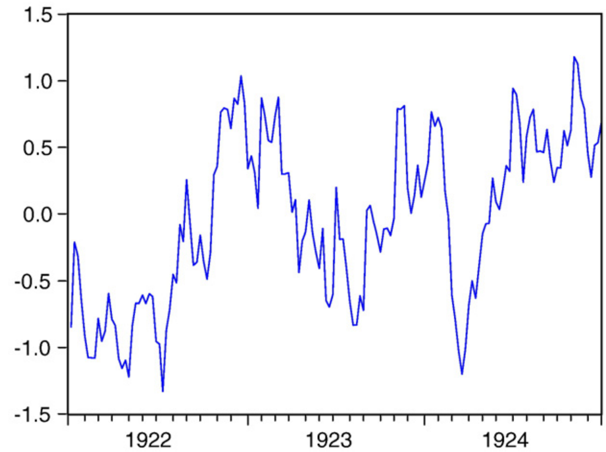

Fig. 1. Deviations from covered interest parity (cip) in the interwar period.

3. Data and results

The UK interest rate, *TB3*, quoted as an annual percentage is a ninety-day Treasury bill rate reported for Saturday in the London newspaper The Economist during the period. The US interest rate, *PBA*, quoted on an annual percentage, is for a Saturday quotation on the discount on ninety-day prime bankers' acceptances in New York City, published in Banking and Monetary Statistics, 1914–1941 (Board of Governors of the Federal Reserve System 1943). These interest rates are for similar assets of the same maturity and quoted at the same point in time.

Einzig (1937) provides weekly quotations for spot and three-month dollar–sterling forward exchange rates for each Saturday in the interwar period, originally gathered from the weekly circular of the Anglo-Portuguese Colonial and Overseas Bank.[6] Deviations from covered interest parity on an annual basis, *cip*, are calculated as follows

$$cip_t = TB3_t - PBA_t + 400 * fp_t \quad (4)$$

where fp_t is the forward premium calculated from the Einzig data as $fp_t = f_t - s_t = \log(S_t - (NY3/100)) - \log(S_t)$ where S_t is the dollar–sterling spot rate and *NY3* is the forward discount over 13 weeks quoted in cents. The excess return, for the three-month (or thirteen week) period is calculated as

$$s_{t+13} - f_t = log(S_{t+13}) - log(S_t - (NY3/100)) \quad (5)$$

In Fig. 1 we plot the deviations from covered interest arbitrage. We observe that deviations are persistent and varied between, approximately, 1.2 and −1.3% on an annual basis.

3.1. Empirical results

The use of multi-period overlapping horizons when computing returns induces dependence in the error term structure of regressions (1) and (2). Moreover, test statistics based on Newey–West standard errors can be seriously biased in small samples. A method that corrects for that bias is the block bootstrap. In particular, we use the moving block bootstrap method where blocks of length l are resampled from the residuals [7] so as to preserve the dependence structure of the data. [8] We follow the Politis and White (2004)[9]

[6] The data is available from the authors upon request.

[7] Where the residuals resampled are those from estimates of the restricted regression.

[8] Patton et al. (2008) show that the moving block bootstrap is more accurate than the stationary bootstrap of Politis and Romano (1994).

[9] The procedure we actually use is the correction of the Politis and White (2004) done by Patton et al. (2008).

Table 1
Standard Fama regression, 1921–1925.

3-month: $s_{t+13}-f_t=a+\beta(f_t-s_t)+\epsilon_t$			
a	β	s	R^2
0.0174 (0.0045)	−5.21 (1.49) [0.045]	0.0255	0.21

Notes: Figures in brackets are the Newey–West standard errors.
s denotes standard error of the regression.
Figures in square brackets represent the $p-$value of the coefficient obtained by Block Bootstrap simulation.
Block length $l=15$. using Patton et al. (2008).

Table 2
Nonlinear Fama regression, 1921–1925.

3-month: $s_{t+13}-f_t=\delta+\theta(f_t-s_t)[e^{-\gamma cip_t^2}]+\epsilon_t$				
δ	θ	γ	s	R^2
0.0178 (0.0044)	−7.56 (1.66)	1.42 (0.70) [0.042]	0.0249	0.25

Notes: See notes to Table 1.
Block length $l=14$. The γ coefficient has been estimated scaling it by the variance of the transition variable.

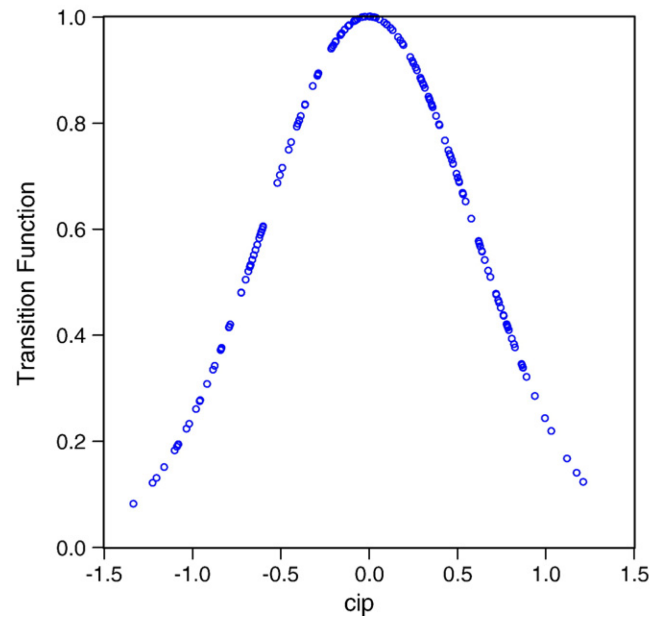

Fig. 2. Transition function and deviation from covered interest parity interwar period.

optimal block length selection procedure to deal with the critical issue of determining length l.

In Table 1 we report the standard Fama regression results. The forward premium has a negative point coefficient of −5.21, qualitatively similar to results for the postwar floating period and the coefficient is significantly different from zero on the basis of both the Newey–West and bootstrapped standard errors.

In Table 2 we report estimates of the nonlinear model (2).[10] We observe that, on the basis of the Newey–West or the Politis and White bootstrapped standard errors, the coefficient for the deviation from covered interest parity is negative and significantly different from zero at standard levels of significance.

Fig. 2 depicts the values that the transition function ($e^{-\gamma cip_t^2}$) takes in the sample period depending on the values of cip_t. This measures the impact of deviations from covered interest parity on the forward premium bias. The function is smooth and symmetric around zero and reaches its minimum values when deviations from covered are large (around 1% and −1%). The transition function lies in the range [0.08, 0.99] which implies that the coefficient on the forward premium, $\theta e^{-\gamma cip_t^2}$ in Eq. (2), will lie in the range of [−0.60, −7.48]. Whilst the coefficient does not take the value of zero, which could reflect the presence of a time-varying risk premium, it does take values much closer to zero than the one initially implied by the standard Fama regression. It is also worth pointing out that a value of −0.60 in $\theta e^{-\gamma cip_t^2}$ implies a coefficient of 0.40 in $(\theta e^{-\gamma cip_t^2}+1)$ and a stable error correction model in the Fama regression (3). Note that this result is in contrast to the implication of non-cointegration, *ceteris paribus*, which follows from the negative coefficient on the forward premium obtained in the linear estimation in Eq. (3).

4. Conclusion

Recent empirical work on the floating postwar period has demonstrated that nonlinear models that allow for bands of inaction due to lack of arbitrage funds, the Lyons hypothesis, can provide some explanation of the forward premium puzzle. The Lyons hypothesis seems to be particularly relevant to explain the forward premium puzzle in the interwar period when deviations from covered interest arbitrage were persistent and often large. We examined data for the interwar period for the dollar–sterling exchange rate and found that the degree of bias in the standard Fama regression varies significantly with the deviation from covered interest parity. When deviations are large, the degree of bias is much smaller than implied by the standard Fama regression.

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[10] Estimation of Eq. (3) yields identical results.