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ABSTRACT

This note tests the hypothesis that nominal interest differentials between similar assets denominated in different currencies can be explained entirely by the expected change in the exchange rate over the holding period. This proposition, often called the "Fisher open" hypothesis or the hypothesis of perfect asset substitutability, has been a major component of recent theories of exchange-rate determination, and has important implications for monetary policy. Tests on six major currencies allow rejection, at standard significance levels, of the joint hypothesis of perfect asset substitutability and foreign-exchange market informational efficiency.

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Introduction

This note tests the hypothesis that nominal interest differentials between similar assets denominated in different currencies can be explained entirely by the expected change in the exchange rate over the holding period. This proposition, often called the "Fisher open" hypothesis or the hypothesis of perfect asset substitutability, has been a major component of recent theories of exchange-rate determination, and has important implications for monetary policy.[1]

The Fisher hypothesis differs from the covered interest parity theorem enunciated by Keynes [11], and, unlike the latter, has received comparatively little attention in the empirical literature.[2] While covered interest parity equates the nominal interest differential between financial centers to a known premium or discount on forward foreign exchange, and is thus in principle riskless, Fisher parity involves risk in an essential way. The two conditions are equivalent only when forward exchange rates equal expected future spot rates. Recent theoretical work, for example that of Grauer, Litzenberger, and Stehle [8], Kouri [12], and Frankel [6], shows that this need not be the case when market participants are risk averse.

It should be emphasized at the outset that the tests conducted in this paper are really joint tests of the Fisher hypothesis and a weak form of foreign-exchange market informational efficiency. Levich [14] has argued that tests of market efficiency are always joint tests involving some hypothesized structure of "normal" equilibrium returns. Below, we assume informational efficiency and instead test Fisher's hypothesized arbitrage condition that nominal interest differentials equal expected percentage changes in exchange rates.

Combining equations (1) and (2), we obtain

$$s_{t+1} - s_t - r_t + r_t^* = \varepsilon_t. \qquad (3)$$

Since all variables on the left-hand side of (3) are observable ex post, we may test the Fisher hypothesis by testing whether the process $\{\varepsilon_t\}$ is white noise.[3]

Under a mean-variance theory of capital-asset pricing with risk-averse investors ε_t is the sum of an expectational error and a risk premium that accounts for a divergence between the interest differential and the expected rate of depreciation over the holding period.[4] In such a setting, domestic and foreign bonds will not be perfect substitutes. If covered interest parity holds identically, this risk premium may be expressed as the difference between the one-period forward rate and the expected exchange rate one period hence,

$$f_t = {}_t s_{t+1} + \text{risk premium},$$

where f_t denotes the logarithm of the forward rate.[5] Although the risk premium is not explicitly modelled here, we interpret serial correlation in $\{\varepsilon_t\}$ as providing indirect evidence of the existence of such a premium. Of course, the risk premium may be positive or negative and does not have to be stable over time. Thus, a failure to detect serial correlation in $\{\varepsilon_t\}$ is consistent with the existence of a risk premium that is itself serially uncorrelated.

This test differs in an important way from tests for the randomness of exchange-rate movements which have been carried out periodically since the original work of Poole [17].[6] The random-walk model of exchange-rate behavior is usually justified on the grounds that, "new information arrives randomly and independently of information received in the past" and speculators use this information to "bid the current price to a level equal to the expected future spot price."[7] But as (3) shows, this statement is true in a world perfect asset substitutability only when interest rates are equal across countries so that any exchange-rate changes are unanticipated. In a

$Q(k)$ is asymptotically distributed as χ^2 with k degrees of freedom under the null hypothesis that the ε_t are serially uncorrelated.[12]

Geweke [7] has suggested a likelihood ratio test having greater asymptotic power against some types of serial correlation than does the Q test. For this second test, we assume that the disturbances ε_t are normal with mean zero under either hypothesis and are generated by the autoregressive model

$$\Lambda(L)\varepsilon_t = \xi_t \qquad (4)$$

where $\Lambda(L) = \Sigma_{i=0}^{\infty}\rho_i L^i$ is a polynomial in the lag operator, $\rho_0 = 1$ and $\{\xi_t\}$ is a white noise process. The null hypothesis is just the hypothesis that $\Lambda(L) = 1$.

To test this hypothesis, we assume we may truncate the autoregressive process (4) at lag length k, where k is increasing in n, and test whether $\rho_1 = \rho_2 = \ldots = \rho_k = 0$ in the autoregression

$$\varepsilon_t = \sum_{i=1}^{k} -\rho_i\varepsilon_{t-i} + \xi_t. \qquad (5)$$

The appropriate test statistic is $n \cdot \ln(\hat{\sigma}_{\varepsilon}^2/\hat{\sigma}_{\xi}^2)$, which is minus twice the logarithm of the likelihood ratio and is asymptotically distributed $\chi^2(k)$. $\hat{\sigma}_{\varepsilon}^2$ is the estimated variance of the process $\{\varepsilon_t\}$, while $\hat{\sigma}_{\xi}^2$ is the sample variance of the residuals obtained from estimating (5) by ordinary least squares. The likelihood ratio is large when past values of ε_t provide significant help in predicting future values; this leads to rejection of the null hypothesis.

If the null hypothesis is not rejected for an autoregression of order k, we test the hypothesis $\rho_k = 0$ using the standard normal test, and if this is not rejected, we again perform the likelihood-ratio test for an autoregression of order k - 1. We continue in this manner until the log likelihood ratio exceeds the critical value we have chosen. It is important to realize that this procedure results in a nested sequence of tests, and that the probability of committing a Type I error at each stage must be calculated accordingly. If the critical value for each normal test on

Table I

Results of the Q Test

Test Statistic	U.S./Canada	U.S./France	U.S./Germany	U.S./Netherlands	U.S./Switzerland	U.S./U.K.
$\chi^2(16)$	38.87	33.77	28.10	40.75	27.28	25.97†

† Not significant at the five per cent significance level. The critical value for tests at the five per cent level is 26.3; the critical value for tests at the one per cent level is 32.0.

To summarize, the two statistical procedures we have employed yield essentially the same conclusions. Both suggest that the Fisher-parity relationship does not hold. Deviations from Fisher parity appear to be highly autocorrelated and so do not behave like expectational errors. The observed behavior of the series of deviations may be interpreted as evidence favoring the existence of a foreign-exchange risk premium for most major currencies. These findings lend support to recent theories suggesting that foreign-exchange market efficiency is consistent with the existence of risk premia at equilibrium.

11. One-months rates were used in the few instances when one-week-rates were not reported. The fact that interest rates and exchange rates, while observed on the same day of the week, are observed in different financial centers, gives rise to an alignment problem that may bias the tests.

12. See Box and Pierce [1].

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