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RISK NEUTRALITY AND THE TWO-TIER FOREIGN EXCHANGE MARKET: EVIDENCE FROM BELGIUM

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ABSTRACT

Most of the literature on two-tier exchange markets is built around models in which domestic policy can exert a powerful influence on the spread between the current account exchange rate and the capital account exchange rate. We show that if optimizing agents are risk neutral, domestic policy has no significant influence on the spread. Our work with Belgian data suggests that a risk neutral specification for Belgian residents acting in the two-tier market is hard to reject, and we also find evidence that domestic variables do not affect the Belgian spread.

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I. Introduction

Many countries have experimented with separate exchange markets for current account and capital account transactions as a way to deal with possibly volatile capital flows and to insulate goods-market transactions from capital-market disturbances. Such a regime, known as a dual, or two-tier, exchange market, has been in place in the Belgium-Luxembourg Economic Union since 1956 and was adopted in modified form by France and Italy during the breakdown of the Bretton Woods system. The strategy of separating exchange market transactions by type of transaction has also been tried periodically by other developed countries and has been recently used by several Latin American countries. 1/

There have been many theoretical studies of two-tier markets. These range from Fleming's (1971) seminal piece to more recent work that examines the two-tier market within an explicit utility-maximizing framework. 2/ Yet there have been practically no rigorous tests of the theories. 3/

One reason for the absence of empirical work is the transitional nature of most two-tier regimes. Most data sets are either too short for time-series econometric procedures or agents' beliefs about the temporariness of the regime build into the data elements that are very difficult to model either in time series or in cross section. A second

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1/ See Lanyi (1975) for a summary of two-tier exchange markets in the 1970s and Kiguel (1988) or Dornbusch (1986) for details of the more recently adopted regimes.

2/ For example, see Obstfeld (1986), Adams and Greenwood (1985), Kaminsky (1987), Frenkel and Razin (1986), and Tornell (1988).

3/ Some empirical work has been done by Phylaktis (1988) and Gros (1988).

reason is that the countries adopting two-tier markets are seldom among the more sophisticated in data collection.

Belgium, however, presents neither problem. It has been operating its two-tier exchange market for over 30 years and it has a well developed data base. To begin checking our theories for consistency with the data, we start by looking at the Belgian experience. While Belgium's long and continuous experience with two-tier exchange rates may also be contaminated by agents' beliefs in the temporariness of the regime, particularly after the commitment to create a single European market by 1992, our a priori belief is that the level of such contamination is less serious in a longer experience than in shorter ones.

The paper will proceed as follows. In Section II we develop an explicit utility-maximizing model of the two-tier market. In Section III we use Hansen's (1982) General Method of Moments estimator to explore the adequacy of a risk neutral utility function for modeling agent's choices in the Belgian data. In Section IV we impose theoretical restrictions on the agent's Euler equation in light of our empirical findings. After some simple manipulations of the amended Euler equation, the theory yields a powerful prediction. For a small country, the spread should be invariant with respect to domestic exogenous variables. Many standard explanatory variables in previous theoretical work, such as Belgian fiscal, monetary or output variables, should have no impact on the spread. Section V compares the model's predictions with the evidence. We find empirical support for the proposition that domestic policy and nonpolicy variables are unimportant in explaining the spread. Section VI contains some theoretical extensions and conclusions.

II. The Model

Consider a representative agent living in a country that operates a two-tier exchange market. In order to purchase a security denominated in foreign currency, the agent abstains from consumption today, using the freed resources to purchase the security at its world price converted to domestic currency units at the capital account exchange rate. After holding the security for one period, the interest is repatriated at the current account rate and the principal at the capital account rate. Both of these elements of return enable the agent to augment consumption next period or in some future period. The agent's welfare is maximized when the marginal disutility from foregoing current consumption is equal to the expected present value of the marginal utility of the future consumption the agent may enjoy as a result of his asset purchase.

Let us place the agent in a very simple setting in which there is a single composite consumption good and no cross-market foreign-exchange leakages. In that setting, the representative agent maximizes an intertemporal utility function subject to a sequence of budget constraints:

$$\text{Max} \quad E_t \sum_{j=0}^{\infty} U(c_{t+j}) \, \rho^j$$

subject to

$$P_{t+j}c_{t+j} + X_{t+j}B^*_{t+j} = P_{t+j}y_{t+j} + S_{t+j}i^*_{t+j-1}B^*_{t+j-1}$$

$$+ X_{t+j}B^*_{t+j-1}; \quad j=0,1,2\ldots$$

where $U(\cdot)$ is the period utility function, c_t is consumption in period t, ρ is the subjective discount factor, and E_t is the mathematical expectation operator conditional on full information at time t. In addition, B_t^* represents net domestic holdings of foreign currency denominated bonds at the start of period t and X and S are respectively the exchange rates for capital and current account transactions (domestic currency/foreign currency). There is no *a priori* assumption about whether the current account rate is pegged or not. Finally, y is domestic output, P is the domestic price level, and i* is the nominal interest rate on foreign currency denominated bonds. The home country is small so that it takes the foreign interest rate as exogenous.

In each period the agent purchases an amount of bonds that will maximize his utility. The agent's first order condition relating time t to time t+1 is: 1/

$$U'(c_t)\,\frac{X_t}{P_t} = \rho E_t \left\{ \frac{U'(c_{t+1}) \left[X_{t+1} + i^*_t S_{t+1} \right]}{P_{t+1}} \right\} \tag{1}$$

III. Specification Tests

In this section, we conjecture that Belgian agents are risk neutral and we use Belgian data in an attempt to reject this hypothesis. Note that if Belgian residents are risk neutral, the marginal utility of consumption is constant across time and is known to all agents. Hence, the marginal utility terms divide out of each side of equation (1) to yield, with some rearrangement:

1/ There may be other assets in the agent's portfolio, but it would not alter the form of equation (1).

$$1 = \rho E_t Z_{t+1} \tag{2}$$

where

$$Z_{t+1} = \frac{P_t\left[X_{t+1} + i_t^* S_{t+1}\right]}{X_t P_{t+1}}$$

The term Z_{t+1} is the real return on foreign currency denominated assets. Now let

$$\rho(Z_{t+1} - E_t Z_{t+1}) = u_{t+1} \tag{3}$$

where u_{t+1} cannot be predicted by using any variable in the agent's information set at time t under the hypothesis of rational expectations. Hence the covariance between u_{t+1} and any variable in the time t information set is zero. Using equation (3) in equation (2) gives:

$$u_{t+1} = \rho Z_{t+1} - 1 \tag{4}$$

We shall test how well equation (4) holds for Belgian annual, quarterly, and monthly data. Our test is a test of the joint null hypothesis that agents are risk neutral and form their expectations rationally.

We estimate equation (4) with Hansen's Generalized Method of Moments (GMM), an instrumental variable technique that delivers overidentifying restrictions when the number of instrumental variables exceeds the number of parameters to be estimated. The data we use come from the IMF's International Financial Statistics tape dated September 1988. Annual observations run from 1955 through 1987, quarterly observations go from 1957 through 1988 and monthly observations run from mid-1964 through the end of 1987. The exchange rates (francs per dollar) and interest rates (percent) are period averages the price level, which is measured by the Belgian consumer price index, is constructed using some intertemporal averaging. 1/ Since the model is not specific about the currency denomination of the foreign security, we let any "foreign" variables be proxied by U.S. variables. 2/ Hence the foreign interest rate is represented by the U.S. T-bill rate.

We follow convention and generally choose as instrumental variables a constant and a lagged value of the return variable or components of the lagged return since values dated t and earlier are not correlated with the disturbance under the null hypothesis. Precise instrument sets differ across regressions and are reported in detail in the tables below.

Table 1 shows the results for the Euler equation of the risk neutral utility function using annual data. The Euler equation is estimated for adjacent periods. In specification (1), a constant, the lagged nominal return and the lagged price ratio are chosen as instruments. We find that the discount factor, ρ, is precisely and plausibly estimated. The estimated value is 0.9986 with a standard error of 0.01130. The chi-square statistic that tests the overidentifying restrictions lends support to the risk-neutral specification. The test statistic is χ^2 (2) = 3.1786 with a probability that the overidentifying restrictions

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1/ It makes little difference to our results if end-of-period data is substituted for period averages where available. Since end-of-period data is not available for all series, however, we confine our report to period-average data.

2/ In addition we tried letting the "foreign" country be Germany, the U.K., or France. Treating the U.S. as the foreign country was more favorable to one of our results and did not influence other results. We will discuss this issue later.

are not rejected of 0.3243. Consequently, the risk neutral specification tested in (1) seems to work well.

Specification (2) reports results when the lagged percentage change in real government spending is added as an instrument. Here the estimated discount factor is 1.0072 and the χ^2 (3) statistic is 8.13 with a probability of nonrejection of 0.105.

Suspecting that the discussions about 1992 may have altered the perceptions of Belgian agents about the permanence of the two-tier market, and hence contaminated some of the later observations, we truncated the sample, making the year 1982 our last observation. Specification (3) reports these results. The discount factor is once again precisely and plausibly estimated. Its value is 0.9983 and its standard error is 0.0088. The chi-square statistic for three degrees of freedom is 6.60373, with the probability that the risk neutral specification is unrejected at 0.1661.

We then proceeded to test the risk neutral specification using quarterly data. The results are reported in Table 2. Because of the additional observations obtained by moving from annual to quarterly data we expanded the instrument set as reported in the table. The discount factor is estimated precisely and reasonably. The estimated value is 0.9971 with a standard error of 0.0022. Moreover, the quarterly data does not lead to rejection of the null hypothesis. The $\chi^2(6) = 8.49887$, with a probability of nonrejection of 0.1825.

We also tested the risk neutral specification in equation 4 using monthly data. The results are reported in Table 3. Specification (1) includes observations for the 1980s whereas specification (2) does not.

In both runs the discount factor is precisely estimated. It is also moderately plausible. The estimated discount factor should be close to the inverse of the average real return on holding U.S. assets over the estimation period, and over the 1964-87 period Belgian residents earned an ex post average real rate of return of 1.000 (see Chart 1 and Figure 1). Neither run using monthly data leads to rejection of the null hypothesis. Specification (1) indicates a probability of nonrejection of 0.1477 while specification (2) assigns a probability of 0.1034. 1/

IV. A Theory of the Two-Tier Exchange Under Risk Neutrality

Since we are unable to reject the hypothesis that Belgian agents are risk neutral, we make the representative agent's first order condition consistent with this hypothesis. We also proceed with three simplifying assumptions which will be relaxed later:

(A1) There are no inter-market foreign exchange leakages.

(A2) The two-tier regime is expected to be permanent.

(A3) Purchasing power parity (PPP) holds at the current account rate, implying $P_t = S_t P_t^*$, where P* is the foreign price level. Under these assumptions, the first order condition in equation (1) becomes

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1/ While the risk neutral specification works well for Belgian data, a natural question is how well a nonlinear period utility function can explain the data. We examined a popular nonlinear utility function, constant relative risk aversion. The results of the investigation are presented in the Appendix. Three points about the results are noteworthy. First, the discount factor in each case is estimated precisely and reasonably. Second, the test of the overidentifying restrictions indicates that the probability of nonrejection of a nonlinear utility function is between 0.18 and 0.36, so that the nonlinear specification cannot be rejected. Third, the α parameter in the utility function is imprecisely estimated in each case, and its point estimate is outside of the region that implies a concave utility function. In our view, then, the risk neutral specification is the preferred one.

$$\frac{X_t}{P_t}(1 - L^{-1}\rho) = \rho E_t(i^*_t/P^*_t) \tag{5}$$

where inverse lag operator L^{-1} is understood to operate on variables but not on the information set dating on the expectation operator. We then use (A3) again and invert $(1 - L^{-1}\rho)$ as in Sargent (1979) to obtain a measure of the spread (actually one plus the spread) between the capital account exchange rate and the current account exchange rate:

$$\frac{X_t}{S_t} = P^*_t \rho E_t \sum_{j=0}^{\infty} (i^*_{t+j}/P^*_{t+j+1})\rho^j \tag{6}$$

<u>We observe that the spread depends only on foreign variables and not on any domestic variables</u>. Moreover, this proposition is invariant to fixing or floating the current account rate.

According to equation (1) and (A1)-(A3), domestic variables affect the spread through their influence on the expected product of $U'(c_{t+1})/U'(c_t)$, the intertemporal marginal rate of substitution in consumption, and the return to domestic agents from holding foreign currency denominated securities. When we assume that agents are risk neutral, we make the intertemporal marginal rate of substitution a policy-invariant constant (unity) and remove the predictions of systematic correlations between the domestic policy variables and the spread. The theoretical work to date on two-tier markets brings domestic policy variables to bear on the spread implicitly by influencing the above correlation.

The analysis is even more stark--and more clear--when we assume in addition that agents in the rest of the world are risk neutral as well. Suppose foreign agents solve

$$\text{Max } E_t \sum_{j=0}^{\infty} U^*(c^*_{t+j})\rho^{*j}$$

subject to

$$P^*_{t+j}c_{t+j} + B^*_{t+j} = P^*_{t+j}y^*_{t+j} + (1 + i^*_{t+j-1})B^*_{t+j-1} \ ; \quad j = 0,1,2\ldots$$

Assuming that these foreign agents are risk neutral, the familiar first order condition at time t may be rearranged as:

$$\frac{1}{P^*_t}(1 - L^{-1}\rho^*) = \rho^* E_t(i^*_t/P^*_{t+1}) \tag{7}$$

Now divide equation (5) by equation (7) and rearrange to obtain:

$$\frac{X_t}{S_t} = \frac{(1 - \rho^*)\rho}{(1 - \rho)\rho^*} \tag{8}$$

Equation (8) reveals the two-tier market at its most basic level. <u>The spread acts as a wedge, filling any taste-determined gap between the domestic and foreign discount rates</u>. If these discount rates are time invariant, then so is the spread. If these discount rates are identical, then the two exchange rates will be identical also. Note that a narrow spread between the two exchange rates need not imply that the authorities have been unsuccessful in partitioning the foreign exchange market. Contrary to popular belief, a narrow spread can persist even when there are no leakages across markets. Note also that a small difference in rates of time preference across countries can generate large spreads. For example, if $\rho = 0.95$ and $\rho^* = 0.9$ then X/S = 2.111.

Before examining how well the model predicts the determinants of the spread, it would be useful to address the appropriateness of the three assumptions (A1)-(A3).

Predictions were derived assuming no cross-market foreign exchange leakages (A1). In practice, however, some purchases and sales of foreign bonds may be conducted using the current account exchange rate and some repatriation of interest income may be made using the capital account rate. Such leakages may be officially sanctioned or fraudulently undertaken. We tried to estimate a modified Euler equation with leakages parameterized linearly (i.e., only some fraction of the flow goes through the appropriate exchange market). Unfortunately, we were unable to find precise and plausible estimates for the leakage parameters and so decided to abandon the strategy. Leakages can provide an alternative explanation for a narrow spread. It may well be the case that intermarket leakages are so fast and so strong that any spreads that do develop are usually corrected by the end of the month. However, the data is not sampled finely enough to test this alternative explanation. 1/

The predictions were also generated assuming that agents expect the two-tier exchange market to be permanent (A2). Since the Belgian two-tier market has been in operation for over 30 years, this assumption seems plausible. However, there is no easy way to test whether such an

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1/ The problem with conducting our estimation on data sampled more finely than monthly is that goods prices, which enter the Euler equation, are only sampled monthly.

assumption is warranted. In Section VI, we investigate theoretically the implications for the spread when agents believe that the two-tier market is temporary.

Finally, the predictions about the spread were generated by invoking purchasing power parity (A3). We decided to introduce PPP into the estimates of the Euler equation to check how well this assumption held up for Belgian data. Table 4 reports the results. Unless otherwise indicated, the U.S. consumer price index was used for the foreign price variable.

Specification (1) in Table 4 reports the results using annual data. The discount factor is precisely and plausibly estimated, with $\hat{\rho} = 0.9890$ and the standard error at 0.0076. The chi-square statistic for three degrees of freedom is 5.8407, indicating the probability of not rejecting the null is 0.20241. When the sample is truncated somewhat (specification (2)), the results are even better. The discount factor is still precisely and plausibly estimated and the probability of nonrejection rises to 0.30721. We conclude that the PPP assumption is not unreasonable for the annual data.

Next we investigated the realism of the PPP assumption using quarterly data. Specifications (3)-(11) report the results. The PPP assumption turns out to be quite unrealistic when the sample period runs through 1988 IV. Specification (3) shows that the discount factor is precisely and plausibly estimated, but a $\chi^2(5)$ of 19.9990 indicates only a 0.0043 probability that the null cannot be rejected. Believing that PPP may have been more reasonable over the Bretton Woods period of fixed exchange rates, we chose to cut the sample off at 1971 IV. Our prior was confirmed. Specification (4) shows that the chi square statistic is now much lower. The probability of nonrejection has increased to 0.2155. Specifications (5)-(10) show what happens when the sample period is extended beyond the Bretton Woods era. The chi square statistic increases and the probability of nonrejection declines.

To make sure that the rising chi-squares were due to the breakdown of PPP and not to increased sample size, the Euler equation was reestimated with more recent observations but a sample size no different from that in specification (4), which was based on observations during the Bretton Woods era. In specification (11) the chi square statistic again jumps up to $\chi^2(5) = 12.65809$ and the probability of nonrejection falls to 0.0540. We conclude that the quarterly data does not support the assumption of PPP over the entire observation period.

Finally we reestimated the Euler equation under the assumption of PPP using monthly data. Much to our surprise, we could not reject the null. In specification (12), the chi square statistic for five degrees of freedom was 9.19642. The probability of nonrejection was 0.1373.

Since we are not entirely comfortable with the PPP assumption, we decided to pursue a different route. Suppose that instead of a single composite consumption good there are many categories of goods. If we assume that the period utility function is additively separable in these categories, then the agent's problem becomes:

$$\text{Max} \quad E_t \sum_{j=0}^{\infty} (V^1(c^1_{t+j}) \quad + \quad \sum_{i=2}^{n} V^i(c^i_{t+j}))\rho^j$$

subject to

$$P^1_{t+j}c^1_{t+j} + \sum_{i=2}^{n} P^i_{t+j}c^i_{t+j} + X_{t+j}B^*_{t+j} =$$

$$P_{t+j}y_{t+j} + S_{t+j}i^*_{t+j-1}B^*_{t+j-1} + X_{t+j}\; B^*_{t+j-1}$$

where a superscript indicates the goods category and $V^i(c^i_t)$ is period utility derived from good i.

The first order condition relating time t to time t+1 is

$$V^1(c^1_t)\frac{X_t}{P^1_t} = \rho E_t V^1(C^1_{t+1})\left[\frac{S_{t+1}i^*_t + X_{t+1}}{P^1_{t+1}}\right] \tag{9}$$

Now if the marginal utility of consuming an additional unit of category 1 goods is constant (risk neutrality) and if commodity arbitrage holds for category 1 goods, so that $P^1_t = S_tP^{*1}_t$, then equation (9) can be manipulated into yielding an expression for the spread that is identical to equation (6) except that now the foreign price term is the foreign price of category 1 goods. Again we find that the spread should depend only on foreign variables.

V. The Evidence

In this section we investigate empirically whether the model captures characteristics of the Belgian spread. Recall the model's basic prediction: the spread will be influenced only by foreign factors.

We examine the determinants of the Belgian spread by regressing the spread on a set of commonly suggested Belgian policy and nonpolicy variables as well as on the foreign variables suggested by our model. The regression is based on quarterly data since some variables are not available on a more frequent basis. The estimation period runs from 1963 I to 1988 I. Before estimating, we made stationary transformations of the explanatory variables by putting them in one-plus-growth-rate form. The idea was to have relatively stationary processes explaining a relatively stationary spread. Table 5 reports the results.

Specification (1) in Table 5 shows the regression of the spread on a constant, one plus the growth rate of real Belgian government spending, one plus the growth rate of real Belgian output, the U.S. interest rate, one plus the U.S. inflation rate, and one plus the rate of growth of the Belgian money supply. The regression gives support to the model. None of the Belgian variables is significant, whereas the U.S. interest rate is significant and has the expected sign. An increase in the U.S. interest rate leads to an increase in the spread. 1/

Since we were concerned that the regression might be capturing a few big changes in the U.S. interest rate in the 1980s, we decided to rerun the regression with observations running only to 1972 I. Equation (2) indicates that the U.S. interest rate is still a significant explanatory variable.

Several aspects of the regressions deserve additional comment. First, the U.S. interest rate and U.S. price term are added separately since there is no reason to believe that they are driven by the same time-series process. Second, we settled on using the U.S. wholesale price

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1/ The U.S. was chosen as the foreign country because the U.S. T-bill rate was significant and had the expected sign in the Table 5 regressions. As mentioned earlier, we also tried German, U.K., and French variables in place of the U.S. variables but we found no significant effects of these variables on the spread.

index in the regressions instead of a U.S. price for a more finely disaggregated category of traded goods since the IFS tape does not provide the latter and our belief was that commodity arbitrage might hold up better for the WPI than for the CPI. Perhaps the U.S. price term might have been significant had we used a better proxy. Third, Belgian industrial production rather than Belgian GNP was used as an explanatory variable since quarterly GNP figures were not available on the IFS tape. Finally, Belgian money rather than Belgian domestic credit was used as an independent variable because there is reason to think that domestic credit was not an exogenous variable during the sample period. The Belgian monetary authority may have been sterilizing reserve movements during the sample period.

VI. Extensions

Inter-Market Leakages

It is widely acknowledged that it is virtually impossible to maintain complete separation of the two exchange markets depending on the source or use of the foreign exchange. Nevertheless, because of analytical complexities, the number of studies that incorporate leakages has been quite small. 1/ The purpose of this extension is to investigate the effects of intermarket leakages on the simplicity of our results.

With leakages, the agent's budget constraint needs to be modified to:

1/ See Bhandari and Decaluwe (1987) and Gros (1988).

$$P_{t+i}c_{t+i} + \left[\theta X_{t+i} + (1-\theta)S_{t+i}\right]B^*_{t+i} =$$

$$P_{t+i}y_{t+i} + \left[\lambda X_{t+i} + (1-\lambda)S_{t+i}\right]i^*_{t+i-1}B^*_{t+i-1} +$$

$$\left[\alpha X_{t+i} + (1-\alpha)S_{t+i}\right]B^*_{t+i-1}$$

where θ is the share of foreign securities purchased at the capital account rate, λ is the share of interest proceeds on foreign-currency denominated security holdings repatriated at the capital account rate and α is the share of foreign-currency denominated securities sold at the capital account rate. Our no leakage analysis assumed $\theta = 1$, $\lambda = 0$, and $\alpha = 1$. Retaining our other assumptions, the first-order condition is now:

$$\frac{\left[\theta X_t + (1 - \theta)S_t\right]}{P_t} =$$

$$\rho E_t\left\{\frac{[\lambda X_{t+1} + (1-\lambda)S_{t+1}]i^*_t + [\alpha X_{t+1} + (1-\alpha)S_{t+1}]}{P_{t+1}}\right\} \tag{10}$$

We retain the condition $P_t = S_tP^*_t$. Equation (10) is now a first order nonlinear stochastic difference equation in X_t/S_t, with only foreign variables forcing the equilibrium. (Unless $\lambda = 0$, an explicit solution requires solving a stochastic nonlinear difference equation, which we avoid.) Therefore, for constant θ, λ, and α the ratio X_t/S_t will depend only on foreign variables but possibly in a complicated way.

Next assume that the leakage parameters depend only on the spread. The basic point remains. Domestic variables do not affect the spread. Of course, domestic variables could matter if they somehow influence the rate of leakage. Our point is not to prove that domestic variables cannot matter. Rather it is to see how much of a two-tier market theory we can build without attaching importance to domestic variables.

The leakages we have considered seem broad enough to encompass most two-tier regimes in practice. For example, a regime in which all interest income is repatriated through the capital account is obtained by setting $\theta = \lambda = \alpha = 1$. This particular regime is of interest because it is often analyzed 1/ and because either it must leak or it must be temporary. The logic of this claim is straightforward. If such a regime were without leaks and agents believed it to be a permanent arrangement, then the agents would realize that they would never be allowed to consume the interest earning on their foreign assets. The agents would not pay a positive amount for assets with a zero return and they would not price capital account foreign exchange.

Regime Temporariness

All exchange rate regimes, indeed all government policies, are expected by agents living under the regime to be abandoned some day when circumstances dictate that government attention be otherwise directed. Let us suppose that agents living under a two-tier market anticipate the possible future demise of the regime. Suppose further, for concreteness, that they anticipate that if the two-tier regime is abandoned the government will adopt a uniform float. The expected return to holding foreign-denominated assets becomes a probability-weighted average of the two-tier market expected return and the uniform float expected return.

1/ See Dornbusch (1986) and Frenkel and Razin (1986).

The important point is that the return now contains the time-varying probability of regime demise. This probability can depend on any domestic or foreign aspects of the state. Only if the probability of a regime switch does not depend on the domestic state will domestic variables be unimportant in explaining the spread. Treating seriously the transitory nature of two-tier regimes established in the 1980s will require taking a stand on the determinants of such probabilities.

Concluding Remarks

Most of the two-tier market literature is built around models in which domestic policy can exert a powerful influence on the spread between the current account exchange rate and the capital account exchange rate. However, if optimizing agents are risk neutral (or if government policy does not much influence the consumption stream), domestic policy has no significant influence on the spread. Our work with Belgian data suggests that a risk neutral specification for Belgian residents acting in the two-tier market is hard to reject. We further find some supporting evidence for risk neutrality when we examine the implication of risk neutrality, namely that domestic variables should not influence the spread.

We are aware of the assertion (Gros (1988)) that realignments of the Belgian current account franc within the European Monetary System have had an impact on the Belgian spread. An alternative explanation, consistent with our work, is that these realignments were correlated with changes in the U.S. interest rate, and it was really the latter that influenced the spread.

We also offer a word of caution. The Belgian experience does not necessarily carry over to other countries, particularly developing countries, that impose two-tier exchange markets. We have no evidence on the appropriate utility function for agents operating in these countries. Moreover, factors such as regime temporariness, the inflation tax and controlled access to one or both foreign exchange markets may be important in explaining the spread in these other two-tier exchange markets.

Table 1. GMM Estimation of Euler Equations

$$1 = E_t\left\{\rho\left[U'(c_{t+1})/U'(c_t)\right]\left[\frac{X_{t+1} + i^*_t S_{t+1}}{X_t}\right]\left[\frac{P_t}{P_{t+1}}\right]\right\}$$

Utility function $U(c_t) = c_t$

Instruments: $\left\{1, \dfrac{X_t + i^*_{t-1}S_t}{X_{t-1}}, \dfrac{P_{t-1}}{P_t}\right\}$

1. Data Set: IFS annual data (1955-87); 33 observations

$\hat{\rho} = 0.99868$; S.E. = 0.01130; PROB = 1.00000

$\chi^2(2) = 3.17861$; PROB = 0.32433

Instruments: $\left\{1, \dfrac{X_t + i^*_{t-1}S_t}{X_{t-1}}, \dfrac{P_{t-1}}{P_t}, (G_t/P_t)/(G_{t-1}/P_{t-1})\right\}$

2. Data Set: IFS annual data (1955-87); 33 observations

$\hat{\rho} = 1.00721$; S.E. = 0.01061; PROB = 1.00000

$\chi^2(3) = 8.12933$; PROB = 0.10584

3. Data Set: IFS annual data (1955-82); 28 observations

$\hat{\rho} = 0.99832$; S.E. = 0.00885; PROB = 1.00000

$\chi^2(3) = 6.60373$; PROB = 0.16616

Table 2. GMM Estimation of Euler Equations

$$1 = E_t \left\{ \rho \left[U'(c_{t+1})/U'(c_t) \right] \left[\frac{X_{t+1} + i_t^* S_{t+1}}{X_t} \right] \left[\frac{P_t}{P_{t+1}} \right] \right\}$$

Utility function $U(c_t) = c_t$

Instruments: $\left\{ 1, \ \frac{X_t}{P_t}, \ \frac{S_t}{P_t}, \ \frac{S_t i_{t-1}^*}{P_t}, \ \frac{X_{t-1}}{P_{t-1}}, \ \frac{S_{t-1}}{P_{t-1}}, \ \frac{S_{t-1} i_{t-2}^*}{P_{t-1}} \right\}$

1. Data Set: IFS quarterly data (1957I - 1988IV); 128 observations

$\hat{\rho} = 0.99716$; S.E. = 0.00222; PROB = 1.00000

$\chi^2(6) = 8.49887$; PROB = 0.1825

Table 3. GMM Estimation of Euler Equations

$$1 = E_t\left\{\rho\left[U'(c_{t+1})/U'(c_t)\right]\left[\frac{X_{t+1} + i^*_t S_{t+1}}{X_t}\right]\left[\frac{P_t}{P_{t+1}}\right]\right\}$$

Utility function $U(c_t) = c_t$

$$\left(1, \frac{X_t}{P_t}, \frac{S_t}{P_t}, \frac{S_t i^*_{t-1}}{P_t}, \frac{X_{t-1}}{P_{t-1}}, \frac{S_{t-1}}{P_{t-1}}, \frac{S_{t-1} i^*_{t-2}}{P_{t-1}}\right)$$

1. Data Set: IFS monthly data (January 1964-April 1988)

288 observations

$\hat{\rho} = 1.00079$ SE = 0.00123 PROB = 1.00000

$\chi^2(6) = 9.73778$ PROB = 0.1477

2. Data Set: IFS monthly data (January 1964-December 1979)

174 observations

$\hat{\rho} = 1.00101$ SE = 0.00164 PROB 1.00000

$\chi^2(6) = 2.65561$ PROB = 0.1034

Table 4. GMM Estimation of Euler Equations

$$1 = E_t\left\{\rho\left[U'(c_{t+1})/U'(c_t)\right]\left[\frac{X_{t+1} + i^*_t S_{t+1}}{X_t}\right]\left[\frac{S_t P^*_t}{S_{t+1} P^*_{t+1}}\right]\right\}$$

Utility function $U(c_t) = c_t$

Instruments: $\left(1\ ,\ \frac{X_t + i^*_{t-1} S_t}{X_{t-1}}\ ,\ S_{t-1}P^*_{t-1}/S_t P^*_t\ ,\right.$

$\left.(G_t/S_t P^*_t)/(G_{t-1}/S_{t-1}P^*_{t-1})\right)$

1. Data Set: IFS annual data (1955-87); 33 observations

$\hat{\rho} = 0.98908$ SE = 0.00769 PROB = 1.00000

$\chi^2(3) = 5.84072$ PROB = 0.20241

2. Data Set: IFS annual data (1955-82); 28 observations

$\hat{\rho} = 0.99159$ SE = 0.00594 PROB = 1.00000

$\chi^2(3) = 2.79300$ PROB = 0.30721

Instruments: $\left(1\ ,\ \frac{X_t}{S_t P^*_t}\ ,\ \frac{1}{P^*_t}\ ,\ \frac{i^*_{t-1}}{P^*_t}\ ,\ \frac{X_{t-1}}{S_{t-1}P^*_{t-1}}\ ,\ \frac{i^*_{t-2}}{P^*_{t-1}}\right)$

Table 4 (continued). GMM Estimation of Euler Equations

---

3. Data Set: IFS quarterly data (1957I - 1988IV); 128 observations

$\hat{\rho}$ = 0.99177 SE = 0.00122 PROB = 1.00000

$\chi^2(5)$ = 19.99904 PROB = 0.0043

---

4. Data Set: IFS quarterly data (1957I - 1971IV); 60 observations

$\hat{\rho}$ = 0.99186 SE = 0.00094 PROB = 1.00000

$\chi^2(5)$ = 3.58324 PROB = 0.2155

---

5. Data Set: IFS quarterly data (1957I -1975IV)); 76 observations

$\hat{\rho}$ = 0.99233 SE = 0.00122 PROB = 1.00000

$\chi^2(5)$ = 10.95835 PROB = 0.0882

---

6. Data Set: IFS quarterly data (1957I - 1977IV); 84 observations

$\hat{\rho}$ = 0.99272 SE = 0.00122 PROB = 1.00000

$\chi^2(5)$ = 10.87873 PROB = 0.0901

---

7. Data Set: IFS quarterly data (1957I - 1979IV); 92 observations

$\hat{\rho}$ = 0.99265 SE = 0.00122 PROB = 1.00000

$\chi^2(5)$ = 12.73587 PROB = 0.0528

---

8. Data Set: IFS quarterly data (1957I - 1981IV); 100 observations

$\hat{\rho}$ = 0.99257 SE = 0.00124 PROB = 1.00000

$\chi^2(5)$ = 13.10370 PROB = 0.0472

Table 4 (continued). GMM Estimation of Euler Equations

---

9. Data Set: IFS quarterly data (1957I - 1983IV); 108 observations

$\hat{\rho}$ = 0.99266 SE = 0.00128 PROB = 1.00000

$\chi^2(5)$ = 14.80963 PROB = 0.0273

---

10. Data Set: IFS quarterly data (1957I - 1985IV); 116 observations

$\hat{\rho}$ = 0.99233 SE = 0.00126 PROB = 1.00000

$\chi^2(5)$ = 17.48027 PROB = 0.0108

---

11. Data Set: IFS quarterly data (1973I - 1988IV); 60 observations

$\hat{\rho}$ = 0.98555 SE = 0.00206 PROB = 1.00000

$\chi^2(5)$ = 12.65809 PROB = 0.0540

---

12. Data Set: IFS monthly data (June 1964-87); 270 observations

$\hat{\rho}$ = 0.99749 SE = PROB = 1.00000

$\chi^2(5)$ = 9.19642 PROB = 0.1373

Table 5. Regressions of the Spread

1. Estimation period 1963 II - 1988 I; 99 observations, DW = 1.982, R^2 = 0.1304

Constant	$\frac{G_t}{P_t}/\frac{G_{t-1}}{P_{t-1}}$,	$\frac{Y_t}{P_t}/\frac{Y_{t-1}}{P_{t-1}}$,	i^*,	P^*_t/P^*_{t-1},	M_t/M_{t-1}
0.123824 + 01**	0.652163-02	0.501735-01	0.349131**	-0.254646	-0.453579-01
(7.14363)	(0.834018)	(0.812183)	(3.14029)	(-1.57265)	(-1.54900)

2. Estimation period 1963 II - 1972 I; 35 observations, DW 1.887, R^2 = 0.2186

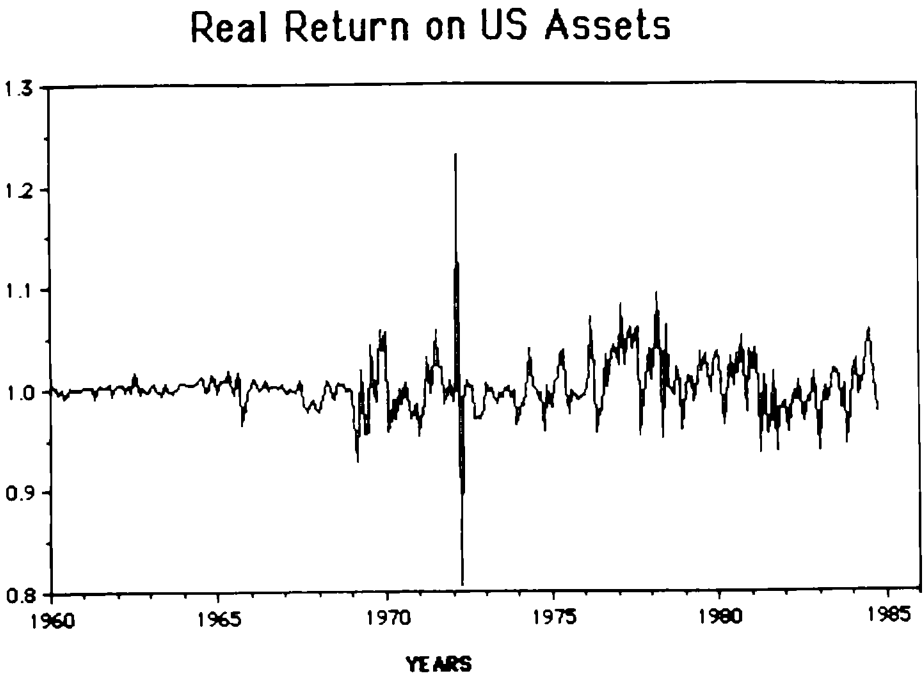
Constant	$\frac{G_t}{P_t}/\frac{G_{t-1}}{P_{t-1}}$,	$\frac{Y_t}{P_t}/\frac{Y_{t-1}}{P_{t-1}}$,	i^*,	P^*_t/P^*_{t-1},	M_t/M_{t-1}
0.678861	-0.361403-02	-0.240131-01	0.60501*	0.30596	0.208706-01
(1.84788)	(-0.203460)	(-0.231851)	(2.63317)	(0.921802)	(0.568288)

Notes: Numbers in parentheses are T-statistics.
The price ratio in the regression is the inverse of the price ratio in the euler equation, so we would expect a negative coefficient in the regression.
Both regressions have been corrected for first order seriel correlation.

Chart 1.

	JAN JUL	FEB AUG	MAR SEP	APR OCT	MAY NOV	JUN DEC
1964		1.00382	1.00168	0.99547	0.99984	0.99175
	0.99493	1.00209	0.99976	0.99897	0.99870	1.00034
1965	1.00135	1.00182	1.00237	1.00241	0.99043	1.00147
	1.00433	1.00253	1.00166	1.00523	0.99388	0.99654
1966	1.00328	1.00413	1.00364	0.99847	1.00442	0.99804
	1.01547	1.00699	0.99623	1.00096	0.99889	0.99671
1967	0.99859	1.00678	0.99860	0.99702	0.99241	1.00575
	0.99871	0.99649	0.99465	1.00038	1.00204	1.00491
1968	1.00536	1.00363	1.00336	1.00455	1.00537	1.00619
	1.01256	1.00874	0.99825	0.99904	1.01376	1.00958
1969	0.99616	1.00801	1.00758	1.00823	1.01765	0.99781
	0.99286	1.01648	1.00292	0.96465	0.98015	0.99503
1970	1.00135	1.00953	1.00203	0.99667	1.00217	1.00723
	0.99718	1.00143	1.00156	1.00102	0.99975	1.00275
1971	0.99775	0.99577	0.99917	0.99771	0.99490	1.00722
	1.00101	0.98184	0.97586	0.97987	0.99003	0.98106
1972	0.97583	0.98313	0.99798	1.00810	1.00013	0.99047
	0.98836	1.00515	1.00306	1.00385	0.99704	0.99875
1973	0.99569	0.94700	0.92762	1.01768	0.99480	0.95534
	0.95782	1.04383	0.99491	0.98790	1.05809	1.03665
1974	1.05680	0.95794	0.96916	0.98833	0.96938	0.99886
	0.98515	1.00595	0.99424	0.96963	0.97466	0.98579
1975	0.95257	0.97885	0.98498	1.03115	0.99485	1.00706
	1.05900	1.02220	1.02060	0.98429	0.99397	1.00880
1976	0.98644	1.00605	1.23120	0.80634	0.98583	1.00715
	1.00086	1.00091	0.96995	0.97269	0.96952	0.97808
1977	1.00570	0.99819	0.99990	0.99026	0.98561	0.99623
	0.99057	1.00054	1.00173	0.99039	0.99757	0.96424
1978	0.96789	0.98463	0.98297	1.00955	1.04019	1.00068
	0.99940	0.98927	0.99541	0.95741	1.00122	0.99167
1979	0.98006	1.00674	1.00939	1.03168	1.03678	0.99738
	0.97378	0.99714	0.99357	0.98952	0.98994	0.99318
1980	0.99277	1.01194	1.07191	1.01233	0.95474	0.97940
	0.97954	1.03223	1.00252	1.02204	1.04332	1.03749
1981	1.02186	1.08383	1.02204	1.04326	1.06068	1.03846
	1.05546	1.06091	0.95385	0.98880	1.00647	1.03858
1982	1.00744	1.04825	1.09468	1.01793	0.95189	1.06278
	1.00149	0.99513	0.99407	1.02108	1.00358	0.96037
1983	0.99830	1.01130	1.01031	0.98656	1.00857	1.03430
	1.01610	1.03278	1.01189	0.99635	1.02429	1.03524
1984	1.02564	0.97995	0.96462	1.01032	1.03132	1.00095
	1.03235	1.01492	1.05128	1.02124	0.97680	1.03653
1985	1.01761	1.04028	1.00420	0.93726	1.01304	0.99220
	0.95518	0.96965	1.01705	0.93908	0.97992	0.98315
1986	0.98666	0.95858	0.97915	0.99655	0.99005	1.00705
	0.97659	0.96887	0.99135	0.98614	1.01632	0.98937
1987	0.93855	0.97899	1.00174	0.98693	0.99153	1.01929
	1.01842	1.01103	0.98135	1.00283	0.94500	0.97609
1988	1.01502	1.02895	0.99335	1.00053	1.01506	1.04014
	1.05911	1.03119	0.99413	0.97726		

Figure 1



Real Return on US Assets
1.3
1.2
1.1
1.0
0.9
0.8
1960
1965
1970
1975
1980
1985
YEARS

Appendix

GMM Estimation of Euler Equations

$$1 = E_t \left\{ \rho \left[U'(c_{t+1})/U'(c_t) \right] \left[\frac{X_{t+1} + i_t^* S_{t+1}}{X_t} \right] \left[\frac{P_t}{P_{t+1}} \right] \right\}$$

Utility Function $U(c_t) = \left[1/(1-\alpha)\right] c_t^{1-\alpha}$

Instruments: $\left\{ 1, (c_t/P_t)/(c_{t-1}/P_{t-1}), \right.$

$\left. \frac{S_t i_{t-1}^* + X_t}{X_{t-1}}, \frac{P_{t-1}}{P_t} \right\}$

---

1. Data Set: IFS annual data (1955-1987)

   33 observations

   $\hat{\rho} = 0.81979$ SE = 0.05890 PROB = 1.00000

   $\hat{\alpha} = -6.60102$ SE = 2.41973 PROB = 0.05270

   χ^2 (2) = 5.39248 PROB = 0.18189

---

2. Data Set: IFS annual data (1955-1982)

   28 observations

   $\hat{\rho} = 0.84144$ SE = 0.14527 PROB = 1.00000

   $\hat{\alpha} = -5.39529$ SE = 5.52681 PROB = 0.48367

   χ^2 (2) = 2.35231 PROB = 0.36280

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