Bond Spreads, Exchange Rate Movements and Risks

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February 2002

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** We would like to thank seminar participants at a Global Development Network workshop in Prague, and a workshop on Liquidity of Financial Markets at Central European University, for their suggestions and comments. The financial support of a GDN Research Competition grant is gratefully acknowledged. All the remaining errors are ours.

Abstract

This paper looks at the uncovered interest parity condition and the forward premium puzzle from a bond market perspective. Interest parity is rewritten as a bond pricing equation, with domestic interest rates being determined by foreign rates, exchange rate risk, and further fundamental risk factors (default risk and "liquidity" in general).

This enables a detailed look into the working and the failure of interest parity: whether it is due to the transmission coefficient, the exchange rate risk coefficient or extra risk terms. Moreover, this flexible framework also establishes a practical link between domestic interest rates and exchange rate movements, giving policymakers some guideline about the influence of interest rate decisions on exchange rate behavior.

Using quarterly interest and exchange rate data, we find evidence for a too low transmission coefficient and a role for extra risks; but the coefficient of the exchange rate risk has the right sign and order of magnitude: it is almost one for developing countries, and around 0.5 for developed economies.

Keywords: forward premium puzzle, bond spreads, exchange rate risk, market liquidity, interest rate transmission, rational expectations.

1. Introduction

The behavior of the nominal exchange rate is not only a controversial research topic in international finance, but it is also a central issue for open economy policymakers. Researchers usually try to connect exchange rate movements to national price levels, interest rates or the balance of payments. Policymakers are more interested in understanding whether and how they can influence exchange rates, in order to pursue their disinflation or stabilization policies.

Theory would very strongly suggest a close link between nominal interest rate differentials and exchange rate movements: building on a no risky arbitrage argument, the interest differential should equal the expected exchange rate movement. This link is referred to as the uncovered interest parity condition. Despite its convincingly-looking derivation, there is an embarrassing lack of supportive empirical evidence.[1]

The general negative finding can be briefly summarized as follows. Neglecting approximation errors, or working purely in log terms, the interest parity condition says that

$$e_{t+1}^{e} - e_t = i_t - i_t^*.$$

Since exchange rate expectations cannot be perfectly observed (there exist some surveys about market expectations, but they show substantial heterogeneity), one can proceed by defining the difference of the expected future exchange rate and its realization as a prediction error. If investors have rational expectations, then this prediction error should be orthogonal to any information available at time t. In particular, the time t interest differential is also orthogonal to this error term ϵ_t, so the "regression"

$$e_{t+1} - e_t = (i_t - i_t^*) + \epsilon_t = \alpha + \beta(i_t - i_t^*) + \epsilon_t$$

is a valid specification: its error term should be orthogonal to the right hand side variables.

The standard test is then to regress the realized exchange rate movement to the interest differential; or, using covered interest parity, to the forward premium. These tests usually reject the hypothesis of $\beta = 1$, moreover, the point

1. See, for example, Obstfeld and Rogoff (1996), or Isard (1995) as surveys.

estimates are often negative.[2] This so called forward premium puzzle is interpreted that we cannot have rational and risk-neutral investors. There is, however, some current evidence that developing countries match the theoretical prediction of the interest parity hypothesis much more closely than do developed economies.

Our paper tries to shift the focus of the analysis away from the prediction error approach, by recognizing that the interest parity condition is a relation between three different markets: domestic bond markets, foreign bond markets and the foreign exchange market (actually, for two comparably important currencies, one could consider even two separate foreign exchange markets). Taking a small country perspective, the foreign market for our currencies is negligible relative to our domestic foreign exchange market, and we can also assume that the behavior of the foreign (reference) bond market is exogenous for our perspective.

We are still left with two markets, and the interest parity condition implies a link between their functioning: for given exchange rate expectations and bond rates, interest parity can be applied to determine the current level of the nominal exchange rate. Turning it upside down, given expected exchange rate movements (i.e., the difference between expected future and realized current exchange rates), the difference between the benchmark (foreign) bond rate and domestic bond yields should be given by the exchange rate risk (expected appreciation or depreciation).

The uncovered interest parity condition then not only assumes rational expectations about future exchange rates and risk-neutrality, but it also implicitly postulates that there is no other source of risk (like default risk), and markets are "perfectly liquid" all the time (there are no periods either in the bond or the foreign exchange market when current market conditions, transitory nonflat supply and demand patterns substantially influence bond or currency prices).

On top of allowing a potential default risk term coming from the bond market, it is instructive to replace the prediction error specification of the interest

2. The classical reference here is Fama (1984). Froot and Thaler (1990) document that the average estimate in 75 publications of this coefficient is -0.88, and estimates are rarely positive.

parity condition to an asset pricing framework of the local bond market. One then writes

$$i_t = \alpha + \beta i_t^* + \lambda(e_{t+1}^e - e_t) + \phi_t + \epsilon_t. \tag{1}$$

Here ϕ_t can capture any further risk component, or illiquid market conditions (to be fully careful, it can also reflect the illiquidity or risks of the foreign exchange market, and not only the bond market), and ϵ_t is a pricing error (noise).

For $\phi = \alpha = 0$ and $\beta = \lambda = 1$, we are back to the interest parity condition, and ϵ_t is the same as the original prediction error. This framework, however, will allow a deeper look into the potential causes of the failure of interest parity: for example, maybe there is a less than one to one transmission of foreign bond rates to domestic, meaning $\beta < 1$.[3] Then the traditional UIP test would artificially impose the restriction of $\beta = 1$, the error term would contain $(1 - \beta)i^*$, and it would be correlated with the right hand side variable. Depending on the sign of the correlation, we would get an upward or downward bias in the estimated β.

As a particular example, the finding of $\beta < 1$ might explain the finding that interest parity is more problematic for negative interest differentials:[4] omitting the extra term ϕ, rewrite (1) as

$$e_{t+1}^e - e_t = -\frac{\alpha}{\lambda} + \frac{1}{\lambda}(i_t - i_t^*) + \left(\frac{1-\beta}{\lambda} i_t^* - \frac{\epsilon_t}{\lambda}\right). \tag{2}$$

The correlation of the right hand side variable and the error term is then $corr\left(i_t - i_t^*, \frac{1-\beta}{\lambda} i_t^*\right)$. Under $\beta < 1$, its sign is the same as $cov(i_t - i_t^*, i_t^*) = cov(i_t, i_t^*) - var(i_t^*)$. Unless there is a strong positive comovement of i_t and i_t^*, this term is negative. Such a negative correlation implies that the OLS estimates of $\frac{1}{\lambda}$ will be biased towards zero, which is exactly the forward premium puzzle. Now if $i_t - i_t^*$ is negative, the ("conditional") covariance term $cov(i_t, i_t^*)$ is likely to be negative, but at least it is more negative than for the positive differential subsample. This means that the OLS bias will be larger in the negative subsample than in the positive subsample.

3. Benczur (2001) also finds a less than full transmission of US interest rates to sovereign dollarbond rates; though in that case, it can be mostly attributed to measurement issues.
4. See, for example, Bansal and Dahlquist (2000).

The bond pricing formalization (1) can be thus rewritten as a "flexible" version of the prediction error approach:

$$e_{t+1} - e_t = e^e_{t+1} - e_t + \eta_t = -\frac{\alpha}{\lambda} + \frac{1}{\lambda} i_t - \frac{\beta}{\lambda} i^*_t - \frac{1}{\lambda}\phi_t + \left(\eta_t - \frac{1}{\lambda}\epsilon_t\right), \qquad (3)$$

where η_t is the standard prediction error of the future exchange rate. One advantage of this specification is that all right hand side variables are observable, while in (1), we face the standard problem of the latent expected exchange rate variable. As explained in more details later on, this difficulty can actually be overcome by using the realized exchange rate movement in (1) and instrumenting with any time t information (basically because it corrects for the measurement error problem caused by the prediction error $e_{t+1} - e^e_{t+1}$).

Suppose that the extra risk term ϕ_t is simply a (default) risk premium, which has to be deducted from i_t to get the (also latent) "riskless rate" i^s_t. The true specification should then contain i^s_t as the right hand side interest rate. So when one uses i_t but does not allow for a term ϕ_t, it also leads to a downward bias of $\frac{1}{\lambda}$. Since ϕ_t might also be correlated with i^*_t, or there may be some risk factors entering not just through the domestic interest rate, the overall sign of the bias is unclear.

One can also rewrite the bond pricing specification into a foreign exchange rate determination equation:

$$e_t = e_{t+1} + \frac{\alpha}{\lambda} - \frac{1}{\lambda} i_t + \frac{\beta}{\lambda} i^*_t + \frac{1}{\lambda}\phi_t - \left(\eta_t - \frac{1}{\lambda}\epsilon_t\right). \qquad (4)$$

This equation, just like (1) with the realized future exchange rate, is subject to a classical measurement error problem: e_{t+1} is correlated with ϵ_t, the prediction error. One remedy is to simply move this term to the left hand side (which is identical to realizing that there is a restriction of its coefficient being one). A potentially more flexible solution would be to allow its coefficient to be unconstrained, and again instrument with extra time t information (not perfectly correlated with i_t, i^*_t and ϕ_t). Practically, this coefficient was almost exactly one in any of our specifications, so it seems to be safe to work with the constrained model. In that case, the foreign exchange rate determination equation is really just the prediction error specification multiplied by minus one; so apart from a potentially more causal interpretation, there is no advantage in using (4).

The general advantage of our flexible approach is that it can distinguish whether the rejection is due to the wrong sign (or small magnitude) of the exchange rate coefficient λ, the less or more than one transmission coefficient β, or an extra risk term ϕ (captured by certain fundamentals, like inflation, default history of a country etc.). Any deviation from interest parity can thus be given a causal interpretation: for example, if we found $\beta < 1$ and $\lambda \approx 1$, it can be interpreted that domestic bond prices "correctly" reflect exchange rate risk, but it would not be on top of the entire value of foreign bond rates.

This changes the manifestation and interpretation of the forward premium puzzle: instead of risk premia coming necessarily from incorrect exchange rate expectations, one would also look for causes of a less than full transmission of foreign bond rates ($\beta \neq 1$), the presence of extra fundamental influences ($\phi \neq 0$), or a less (or more) than full incorporation of the exchange rate risk ($\lambda \neq 1$).[5] The extra risk component interpretation is often incorporated into estimations and explanations of the interest parity condition, but without any further decomposition.

Of course, some of these causes might be related to incorrect exchange rate expectations. Even if all three effects can be traced to expectations, we have still "decomposed" the prediction bias.

Moreover, from a policy point, our more flexible estimation framework definitely leads to a better understanding of how interest rates influence exchange rate movements: For fixed foreign interest rates, it is in fact the unconstrained value of $\frac{1}{\lambda}$, the coefficient of i_t in (2) or (4), that determines the impact of domestic interest rates, and not the value estimated using the $\beta = 1$ constraint.

Using quarterly data on 3-month interest rates and exchange rates of developed and also developing countries, relative to the US dollar, we find strong evidence for a less than one in one transmission. In fact, most of our results show an insignificant coefficient of the US interest rate. The coefficient of the exchange rate risk is positive in all cases. For developed countries, especially

5. The forward premium puzzle means too low, or even negative estimates of $\frac{1}{\lambda}$. A positive but less than one values actually means an overreaction of bond rates to exchange rate risk; while a negative value means that exchange rate risk enters bond prices with the wrong sign.

for developed countries with floating exchange rate regimes, however, it is significantly below one; while for developing countries, the 95% confidence interval often contains one, and it is never far away. This is significantly at odds with the forward premium puzzle; but a similar difference between developed and developing countries was also found by Bansal and Dahlquist (2000).

For the developing sample, the inflation differential seems to be an important extra determinant, with a coefficient of 0.1. Such an extra fundamental effect, and in particular the role of inflation, also matches the finding of Bansal and Dahlquist (2000). There is some evidence that a dummy for a large exchange rate depreciation in the previous period, and the instability of the exchange rate regime (captured by the number of past regime changes) also plays a role. For developed countries, there is mixed evidence about the role and importance of the inflation differential.

The paper is organized the following way. The next section summarizes our empirical specification, the econometric methodology, and its relationship to other approaches. Section 3. briefly describes the data source and the choice of variables. Results are presented and discussed in section 4., while the last section concludes and points to further research questions.

2. The empirical approach

2.1. UNCOVERED INTEREST PARITY AND BOND MARKETS

Uncovered interest parity is usually tested with the following specification:

$$e_{t+1} - e_t = \alpha + \beta(i_t - i_t^*) + \eta_t. \tag{5}$$

It is obtained by equalizing the expected returns of investment through domestic and foreign bonds, and then adding a prediction error term, $\eta_t = e_{t+1} - e_{t+1}^e$.

This argument builds on a link between current bond and current foreign exchange markets, but the final form is in fact not related closely to any of these markets: the realized exchange rate movement is not the direct equilibrium outcome of any of these markets. To allow for a direct market pricing interpretation, and also a more flexible empirical specification, we propose to consider

$$i_t = \alpha + \beta i_t^* + \lambda_{exch}(e_{t+1}^e - e_t) + \lambda_{risks} phi_t + \epsilon_t. \tag{6}$$

Here domestic bond rates are determined by a constant, the foreign (benchmark) interest rate, expected exchange rate movement (exchange rate risk), some additional risk or market condition ("liquidity") elements, and a pricing error term.

This can be transformed back into a flexible form of the prediction error approach:

$$e_{t+1} - e_t = -\frac{\alpha}{\lambda_{exch}} + \frac{1}{\lambda_{exch}} i_t - \frac{\beta}{\lambda_{exch}} i_t^* - \frac{\lambda_{risks}}{\lambda_{exch}} \phi_t + \left(\eta_t - \frac{1}{\lambda_{exch}} \epsilon_t \right), \tag{7}$$

or into an equation determining the current value of the nominal exchange rate as

$$e_t = \delta e_{t+1} + \frac{\alpha}{\lambda_{exch}} - \frac{1}{\lambda_{exch}} i_t + \frac{\beta}{\lambda_{exch}} i_t^* + \frac{\lambda_{risks}}{\lambda_{exch}} \phi_t - \left(\eta_t - \frac{1}{\lambda_{exch}} \epsilon_t \right). \tag{8}$$

Our experiments showed that the estimated value of δ was always very close to one, so adopting the constraint $\delta = 1$ seems acceptable. In that case, there is no other difference between (7) and (8) than a sign change and its interpretation. For these reasons, we will report results for specifications (6) and (7). The coefficient of i_t^* will be referred to as the transmission coefficient (having mostly a bond market causality in mind). The number λ_{exch} is the coefficient of exchange rate risk (bond market approach) or the domestic interest rate (foreign exchange market approach); and it is the key parameter of interest. Finally, λ_{risks} is the parameter of risks, which, together with the particular choice of ϕ variables, corresponds to certain extra effects (additional risks, like default risk; or market illiquidity). Apart from finding what fundamentals are the best candidates for ϕ, we will not be able to clearly associate any of these to particular risk types. Their presence, however, can be still interpreted as an additional influence of fundamentals.

2.2. THE ECONOMETRIC METHODOLOGY

We will adopt the method of Benczur (2001), described there in full details. The method is similar to practices for testing rational expectations (e.g. Mishkin

(1983), Attfield, Demery and Duck (1985), and in particular, Wickens (1982)). We want to estimate a structural equation determining domestic bond rates, of the form

$$i = \alpha + \beta i^* + \lambda_{exch} E[\Delta e|Z] + \lambda_{risks}\phi + \varepsilon_1.$$

Here Z contains information (fundamentals) available at the time of pricing, ϕ is a collection of fundamentals and certain events, capturing certain extra risks or liquidity conditions crisis indicator. The variable i^* is the benchmark rate; while Δe is the exchange rate movement between period t and $t+1$ (exchange rate risk). The conditional expectation is unobserved, but one can use data on realized exchange rate movements. Instead of specifying a prediction equation, put the realizations directly into the pricing equation. This poses an identification problem: since the actual realizations are correlated with the prediction errors, d and l are not orthogonal to the error terms. The solution is to recognize that any information available at the time of pricing (Z) can serve as valid instruments.

It is crucial to have sufficiently long time series of exchange rate data, since one basically needs to predict exchange rate movements. At least, the instruments must be able to sufficiently eliminate the measurement error caused by the prediction error. Our full sample consists of more than 2000 quarterly observations from 43 countries, between 1971 and 1995; which hopefully reduces the risk of peso problems.

As for the foreign exchange market specification (7) or (8), one does not run into the problem of the prediction error, since the realized exchange rate movement is moved to the left hand side. The inclusion of further fundamentals on the right hand side, however, may still be necessary, because of the extra risk factors. One way to test for their presence is to include some on the right hand side and see whether the coefficients are significant. Another is more similar to the instrumental variables approach of estimating (6): testing the orthogonality of the residuals to any time t variables, which is the same as the overidentification test.

The overidentification test here receives a central role: it checks whether no fundamentals (predictors) have any effect above their influence through predicted exchange rate movements. A rejection indicates that the perceived prediction error is not orthogonal to all predictors: either there are additional (risk) factors in the bond pricing equation, or predictions are not fully rational.

Unfortunately, these two alternative causes will be observationally equivalent. Unless one has a strong case for having included all potential extra risks and in the right way, it is impossible to tell apart the assumption of wrong expectations or extra fundamental effects.

Moreover, even the transmission coefficient can be reinterpreted as a special kind of biased exchange rate prediction. In a minimalist interpretation, our results would decompose the prediction bias into a transmission coefficient, an exchange rate coefficient and extra fundamental effects. Such results are useful for forecasting or modeling exchange rate behavior, moreover, they highlight where to start looking for causes of the bias.

3. Data sources

We need three different kinds of data: interest rates, nominal exchange rates and economic indicators (fundamentals). Ideally, one would like to use even monthly data, but the limited availability of such high frequency data led us to adopt a quarterly frequency instead.

Interest rates for a reference currency (the 3-month T-bill rate for the US), and some domestic short-term interest rates (bond rate if available, otherwise some commercial bank rate) for countries are obtained from the IFS. It also provides many observations for dollar exchange rates. Interest rates and exchange rate movements are transformed into logs. For comparability, every variable was annualized, meaning that quarterly log exchange movements were multiplied by four, while interest rates were kept at their annual level.

Country fundamentals are from World Development Indicators and World Debt Tables. The basic set of fundamentals we use are the fourth (quarterly) lags[6] of the following standard variables: reserves to imports, and exports to

6. In some cases, fundamentals were available only at the annual frequency, and the quarterly values were replaced by the (potentially rescaled) annual values. To ensure complete predeterminacy of these variables, one needs to take at least 4 quarterly lags.

GDP, external debt to GDP, and current account balance to GDP (positive if in surplus), GDP growth (in percentage), and GDP per capita (in 1000 USD), an indicator of total past repayment troubles (arrears, relief and rescheduling agreements since 1970), and an indicator of being in arrears in the last year, the annual inflation differential (relative to the US), and a "currency crisis" dummy (at least 50% increase in the exchange rate, i.e., a large devaluation, in the given year, abandoning a pegged exchange rate regime for a float, or moving from managed to free float).

Unfortunately, there are many observations missing, but there is still a complete dataset for 2139 observations, from which 1519 is for developing countries. Altogether, there are 43 countries in the unbalanced panel, corresponding to years 1971 to 1996. As the approach is essentially a pooled cross-section, we do not worry about how balanced a panel our data would be.

4. Results

4.1. DEVELOPED COUNTRIES

Table 1 presents the results for the flexible prediction error approach (foreign exchange market). Columns 1 and 4 correspond to the entire developed sample, 2 and 3 is the floating subsample, while 3 and 6 contains only non-floating countries.

First of all, our data reproduces the forward premium puzzle: when regressing the change in the log exchange rate on the log interest differential for the floating sample, the result is low and insignificant (though not negative). The original Fama (1984) result was obtained for G7 currencies, mostly floating, so it is indeed column 2 that should reproduce the forward premium puzzle.

Columns 1 and 3 show much less of a puzzle: the coefficients are much closer to one. The fit measures and the exogeneity tests, however, suggest that columns 1 and 3 are misspecified, while column 2 shows extremely low fit.

By including the US rate separately on the right hand side, we would get a major improvement in fit. Columns 4-6 also add the inflation differential term, which further improves the fit, and leads to an acceptance of the exogeneity test. The floating sample shows a clearly negative spread coefficient, while the non-floater leads to a coefficient of nearly one. In this specification, the inflation term seems to be important in the pooled and the floating samples. As we shall see, however, this result might be altered when considering the alternative approach, pointing to further potential specification errors.[7]

Table 2 presents the results for the bond market approach. We see clearly that the transmission coefficient is significantly below one, but the exchange rate component is positive and at least marginally significant, though it is quite far away from one. Using the inflation differential as an additional instrument would lead to an estimated exchange rate risk coefficient of 0.5 for the pooled and the non-floater samples. Again, we get the marked difference of floating versus non-floating regime currencies with respect to the forward premium puzzle.

The overidentification result for columns 3 and 6 is hard to interpret: with adding a right hand side variable, overidentification is no longer accepted. It might be caused by the low power of the test, but it is not fully clear still.

Before proceeding to the developing sample, let me relate the numbers of the two approaches to each other. Neglecting the risk term for simplicity, we see that if

$$i = \alpha + \beta i^* + \lambda(e_{t+1} - e_t),$$

then

$$e_{t+1} - e_t = -\frac{\alpha}{\lambda} + \frac{1}{\lambda}(i - i^*) + \frac{1-\beta}{\lambda} i^*.$$

A too low exchange rate coefficient in the bond equation is thus equivalent to a too high spread coefficient in the prediction error specification. As λ approaches zero, however, $\frac{1}{\lambda}$ approaches infinity, and then it should become actually negative. This means that if both λ and $\frac{1}{\lambda}$ has low estimates, then the true value is likely to be negative. It again implies that interest parity is most heavily violated in the floating sample, where both estimates are low (or even negative in one case).

If λ is positive, then a low β implies a high $\frac{1-\beta}{\lambda}$, which is roughly in line with what we see in columns 4 and 6 of both tables.

7. Such errors may be hard to notice here, because the exogeneity test might have relatively low power.

4.2. DEVELOPING COUNTRIES

We have just discussed that though the two approaches differ in many details (in particular, the role of inflation and the overidentification test), their broad conclusions about and implications for the interest parity hypothesis are reasonably similar. Based on this argument, for the developing country sample, we concentrate only on the bond market approach. The results are contained in Table 3.

Column 1 uses the basic set of instruments, leading to an insignificantly negative transmission coefficient, and a good-looking exchange rate risk coefficient of 0.5. Overidentification is accepted. The next columns try to check how robust these results are to using more instruments. The specific choice of the extra instruments were determined by experimentation.

In particular, column 2 uses the inflation differential as an extra instrument: it modifies the point estimates slightly, but more importantly, it leads to a rejection of overidentification. A similar result applies to the choice of the crisis indicator (not reported in the table).

Including these variables also on the right hand side (column 3 and 4) again changes the point estimates a bit (smaller exchange rate risk coefficients), overidentification is restored, and both terms get a large and significant coefficient.

Keeping these variables on the right hand side and further increasing the set of instruments (with 18 additional instruments, basically any relevant country fundamental which is available in IFS and would not drastically reduce the data set), overidentification is again rejected (column 5), though the point estimates stay mostly similar. As column 6 shows, the rejection was mostly due to Africa: by excluding African countries from the sample, we get a zero transmission coefficient, a nice and large (near one) exchange rate coefficient, and three influential extra risk terms, the third being a count variable of exchange rate regime changes in the past.

What emerges from the developing country results as a robust finding is the surprisingly low interest rate coefficient (low transmission of US rates) and the large and significant exchange rate risk coefficient. For the developed sample, the transmission coefficient was larger, but there the exchange rate parameter was much smaller.

In summary, the interest parity condition fails for different reasons in the two samples: for developing countries, the problem is that domestic interest rates do not follow US rates closely, but they do reflect expected interest rate movements, while for developed countries, they follow US rates more closely, and "err" more on the other margin.

5. Conclusion and further directions

The paper presented an alternative angle at the uncovered interest parity condition (or, the forward premium puzzle). Instead of using the standard

$$e_{t+1} - e_t = (i_t - i_t^*) + \epsilon_t = \alpha + \beta(i_t - i_t^*) + \epsilon_t$$

"prediction error" specification, we estimated

$$i_t = \alpha + \beta i_t^* + \lambda_{exch}(e_{t+1}^e - e_t) + \lambda_{risks} phi_t + \epsilon_t.$$

This can be interpreted as a bond pricing equation, but it can be rewritten as a flexible form of the prediction error approach, or as a foreign exchange market asset price equation.

Replacing the latent expectation term with its realized value, and correcting for the measurement problem implied by the prediction error, we found evidence for a too low transmission coefficient and a role for extra risks.

For developed economies, inflation differential proved to be such an extra effect, while for developing economies, the strongest candidates were the inflation differential, an exchange rate regime volatility measure, and an indicator for a currency crisis last period.

On the other hand, the coefficient of the exchange rate risk has the right sign and order of magnitude: it is almost one for developing countries, and between $0.2 - 0.5$ for developed economies.

Based on these findings, the failure of the interest parity condition seems to be mostly caused by the too low transmission coefficient, additional risk, and much less by an inappropriate influence of the exchange rate risk (or the domestic interest rate). This implies that it would be crucial to get a clear understanding of the transmission of US interest rates to other countries.

Another research agenda is to identify these extra risks more: how much are they related to default risk, or market liquidity? A potential way to analyze this issue is to compare bonds issued by the same country but in different currencies, since the default risk component should be largely common in the two.

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Table 1: Forex approach: developed economies[a]

		(1)	(2)	(3)	(4)	(5)	(6)
		LHS variable: realized exchange rate movement					
spread		0.53	0.23	0.86	0.35	-0.4	1.16
		(2.48)*	(0.93)	(2.26)*	(1.26)	(1.19)	(2.52)*
US rate					1.22	0.73	1.67
					(3.36)*	(1.62)	(2.98)*
inflation differential					1.86	3.10	-0.0
					(2.56)*	(3.92)*	(0.00)
F stat.	deg. of fr.	F(1,618)	F(1,299)	F(1,317)	F(3,608)	F(3,292)	F(3,312)
F stat.	value	6.20	0.87	5.11	10.09	7.71	5.19
F stat.	p value	0.01	0.35	0.01	0.00	0.00	0.00
R^2		0.009	0.002	0.01	0.04	0.07	0.04
p value of exog. test[b]		0.00	0.20	0.03	0.51	0.66	0.53
Number of obs.		620	301	319	612	296	316

a All estimations are OLS. T statistics are in parentheses. * denotes significance at the 95% level.

b The exogeneity test regresses the residuals on the first annual lag of the following exogenous variables: reserves to imports, exports to GDP, debt to GDP, current account balance to GDP, GDP growth, GDP per capita, past repayment troubles, an arrears dummy, and any additional right hand side variable of the original regression.

Table 2: Bond market approach: developed economies[a]

		LHS variable: domestic bond rate					
		(1)	(2)	(3)	(4)	(5)	(6)
US rate		0.20	0.17	0.34	0.27	0.18	0.42
		(1.26)	(0.83)	(1.74)	(2.12)*	(1.79)	(2.42)*
exchange rate movement		0.33	0.29	0.29	0.23	0.27	0.14
		(3.17)*	(1.85)	(3.21)*	(2.51)*	(1.79)	(2.42)*
inflation differential					1.04	0.82	1.37
					(3.86)*	(1.86)	(7.05)*
F stat.	deg. of fr.	F(2,617)	F(2,298)	F(2,316)	F(3,608)	F(3,292)	F(3,312)
	value	15.15	5.74	14.76	51.91	22.22	42.92
	p value	0.00	0.00	0.00	0.00	0.00	0.00
p value of overid. test[b]		0.26	0.55	0.43[c]	0.21	0.92	0.00
Number of obs.		620	301	319	612	296	316

a All estimations are IV, using the first annual lags of the following exogenous variables: reserves to imports, exports to GDP, debt to GDP, current account balance to GDP, GDP growth, GDP per capita, past repayment troubles, and an arrears dummy. T statistics are in parentheses. * denotes significance at the 95% level.

b The overidentification test regresses the residuals on the instruments and included exogenous right hand side variables.

c Overidentification would be rejected with the inflation differential as an extra instrument. For columns 1 and 2, it would still be accepted.

Table 3: Bond market approach: developing economies[a]

		LHS variable: domestic bond rate					
		(1)	(2)	(3)	(4)	(5)	(6)
US rate		-0.32	-0.39	-0.21	-0.30	-0.17	-0.05
		(1.19)	(1.34)	(1.22)	(1.18)	(0.56)	(0.14)
exchange rate movement		0.51	0.65	0.34	0.47	0.55	0.78
		(5.67)*	(6.90)*	(5.29)*	(5.43)*	(5.76)*	(6.68)*
inflation differential				0.60		0.46	0.45
				(9.87)*		(4.27)*	(3.68)*
past crisis					0.26	0.14	0.15
					(4.13)*	(2.31)*	(1.86)
exchange rate regime						-0.01	-0.02
						(1.62)	(2.18)*
F stat.	deg. of fr.	F(2,1516)	F(2,1448)	F(3,1447)	F(3,1515)	F(5,1196)	F(5,818)
	value	17.01	24.26	77.88	25.34	23.77	23.99
	p value	0.00	0.00	0.00	0.00	0.00	0.00
p value of overid. test[b]		0.62	0.00	0.60	0.71	0.00	0.54
Number of obs.		1519	1451	1451	1519	1202	824[c]

a All estimations are IV, using the first annual lags of the following exogenous variables: reserves to imports, exports to GDP, debt to GDP, current account balance to GDP, GDP growth, GDP per capita, past repayment troubles, and an arrears dummy. Columns 5 and 6 also contain 18 extra instruments. T statistics are in parentheses. * denotes significance at the 95% level.

b The overidentification test regresses the residuals on the instruments and included exogenous right hand side variables.

c Africa is excluded here.