WORKING PAPER (DRAFT)

THE UIP AND TIME VARYING RISK PREMIUM: AN APPLICATION TO THE JAMAICAN BOND MARKET

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November 2003

Abstract

The UIP is one of the essential assumptions of macroeconomic theory, yet the empirical evidence in support of this condition is weak. This paper tests the UIP condition for Jamaica and finds that the persistence in the deviation is significant, particularly since 1996. This is taken as an indication of the presence of a time varying risk premium in the interest differential, in addition to currency risk. The paper shows that this risk premium is associated with the degree of fiscal dominance as measured by the relative asset supply. The policy implication of the results is that in addition to minimizing currency risk, lowering interest rates will require reducing the supply of Government debt.

JEL Classification: E40, F31, G15
Keywords: interest rate, interest parity, exchange rate,

[1] The paper has benefited from discussions with Dr. Wayne Robinson, Mr. Courtney Allen and Mr. Neil Mitchell. The views expressed are those of the author and do not necessarily reflect those of the Bank of Jamaica

CONTENTS

I. Introduction

Jamaican dollar denominated securities have traditionally traded at relatively high spreads over comparable US dollar securities. More importantly this interest premium tends to be sticky downwards and is often subject to sharp reversals. The interest rate parity theory posits that this spread is due purely to expected depreciation in the Jamaica dollar. Mitchell (2000) however, questions the validity of the interest parity, in particular, the uncovered parity (UIP) hypothesis, for Jamaica. Numerous studies on other countries also fail to find any significant empirical support that the UIP holds.

The failure of UIP implies that changes in the exchange rate explain only a portion of the interest differential. Most explanations for the failure of UIP posit the existence of a time-varying risk premium and/or expectational errors, or "peso" problems. The risk premium generally arises due to macroeconomic, political or social uncertainties. More recent contributions cite the relative supply of assets as a source of the deviation from interest parity. The peso problem refers to the possibility that market expectations reflect the risk of 'large' events that do not actually occur over the sample period. This can lead to biases in the slope estimates of expectation hypothesis in samples that are two short to accurately reflect the small probability of large events. In other words, rational investors may appear to make systematic expectational errors over short samples[2]. Other factors identified include transaction costs, intervention costs, intervention in the foreign exchange market and capital that does not flow across borders.

This paper analyzes the relative importance of the components of the differential between interest rates on Jamaican and foreign securities and thereby advances an explanation as to why the differential declines very slowly. In, particular, extending the work of Mitchell (2000), it examines the factors that drive the risk premium on Jamaican assets. The analysis is limited to domestic currency sovereign debt securities, which have risen significantly over the past three years and constitute most of the trade on the domestic capital market. Unlike previous empirical studies on the deviations from UIP, which

[2] The implications for the unbiased hypothesis are discussed in Obstfeld (1989) and Krasker (1980) provides empirical estimates for Mexico.

traditionally employ parametric joint tests on the coefficient of the UIP equation, this paper tests for the degree of persistence in the realized deviation from UIP using scalar measures. This approach is similar to that used to study the deviations from purchasing power parity. Another important contribution of the paper is that it tests the hypothesis that the deviation from UIP or the risk premium on Government of Jamaica debt is attributed to the relative supply of, or the share of these instruments in investors' portfolios.

The empirical analysis on persistence supports the results of Mitchell (2000) that the UIP condition does not hold for Jamaican sovereign domestic debt. The paper finds that the deviation from UIP reflects the presence of a risk premia, which may be associated with, *inter alia*, the (excess) supply of Government debt. The implication of these findings is that in addition to reducing the currency risks through a more stable exchange rate, the lowering of domestic interest rates also necessitates a reduction in the relative supply of Government securities.

The rest of the paper is organized as follows. Section I briefly reviews the interest rate parity theory and the main sources of deviation. Section II decomposes the interest differential in Jamaica between risks and other risks and section III presents some conclusions.

II. Interest Rate Parity Theory

The interest rate parity theory provides a link between foreign and domestic interest rates and the spot and forward exchange rates. The Covered Interest Rate Parity (CIP) condition states that the prices from risk-free assets with identical maturity should be equated across countries, after account is taken of currency movements. This identity essentially arises from the arbitrage activities of investors. Profitable deviations from CIP represent riskless arbitrage opportunities and may indicate market inefficiency.

Assuming that the underlying remunerated assets have similar characteristics, mainly in terms of risk, maturity and liquidity[3], perfect capital mobility and low transaction costs, then in equilibrium, arbitrage speculators will ensure that

$$(1+i_t) = (1+i_t^*)(F_{t,t+1}/S_t) \qquad (1)$$

where i_t (i_t^*) is the domestic (foreign) interest rate at time t for a maturity k,
$F_{t,t+k}$ is the forward exchange rate at time t for a maturity date at $t+k$ and
S_t is the spot exchange rate at time t (units of domestic currency against one unit of foreign currency). The more convenient representation is

$$i_t = i_t^* + \frac{F_{t+1} - S_t}{S_t} \qquad (2)$$

where the last term on the right hand side is the forward premium.

If the domestic interest rate is above the foreign interest rate, the difference should be exactly compensated by a positive forward premium, i.e. the forward exchange rate would be depreciated relative to the spot exchange rate. If the market is efficient, so that the forward rate is an unbiased predictor of the spot rate, then equation two implies that the exchange rate will follow a martingale if the interest differential is zero or negligible.

Further, if the market is efficient then we have a stronger representation of interest rate parity theory- the uncovered interest rate parity (UIP)

[3] Perfect substitutability of assets

$$i_t = i_t^* + \frac{ES_{t+1} - S_t}{S_t} \quad (3)$$

Uncovered interest parity (UIP) is a fundamental parity condition that applies to financial markets in an open economy when domestic and foreign assets are perfect substitutes. It is the equality of expected returns on otherwise comparable financial assets denominated in two currencies, without any cover against exchange risk. Based on arbitrage considerations, UIP implies that the interest rate differential between two countries has to equal the expected change in the exchange rate.

The standard test of UIP is to regress ex post exchange rate changes on lagged interest differential and investigate the joint hypothesis a=0 and ß= 1 in equation (4). Alternatively, a constant risk premium a is allowed and only the hypothesis that ß equals unity is tested.

$$s_{t+1} - s_t = a + b\,(i_t - i_t^*) + e_{t+1} \quad (4)$$

where s_t is the log of the exchange rate. Since expected exchange rate changes are unobservable, (4) is a joint test of the UIP hypothesis $E_t \Delta s_{t+1} = i_t - i_t^*$ and the rational expectation hypothesis $s_{t+1} = E_t[s_{t+1}] + e_{t+1}$, where e_{t+1} is white noise. If $[a, b] \neq [0,1]$ in (4), UIP does not hold or the exchange rate expectations are systematically erroneous.

Most of the empirical work on the determination of interest rate differentials has rejected the uncovered interest parity (UIP) relation. The bulk of the evidence indicates not just that exchange rate changes fail to move one-for-one with interest rate differentials, but rather that these changes are substantial and in the opposite direction to that implied by UIP. Although Flood and Rose (2002) find that there is some improvement post 1990, there is still a significant degree of heterogeneity in the UIP relation across countries.

McCallum (1994) and Meredith and Chinn (1998) have argued that for relatively short horizons, failure of UIP results from risk-premium shocks in the face of endogenous monetary policy. They found that a positive risk premium shock, for example, leads to the combination of an immediate exchange rate depreciation and an increase in short-term interest rates, the latter in the face of higher prospective inflation and activity. When the risk premium subsequently unwinds, the exchange rate is likely to appreciate from its initial depreciated level, so that higher short-term interest rates are associated with expectations of future exchange rate appreciation rather than depreciation. In the medium to long term, in contrast, exchange rate movements are driven by macroeconomic 'fundamentals', leading to a relation between interest rates and exchange rates that should be more consistent with UIP.

There has developed a substantial literature on the causes of less than perfect movement of capital across borders, i.e., of deviations from interest-rate parity. Of course, there are a number of different interest parities, corresponding to pairs of varying types and maturities of interest-bearing instruments. This is one explanation of observed deviations based on any particular series of rates.[4] Kenen's theoretical work suggests a reason for such deviations: Because individuals face rising interest rates as they increase their borrowings of funds, the marginal interest-rate-parity relevant to actual lenders and borrowers may differ from the rates recorded in statistical series, and thus interest rate parity may not exist as an observed (average as distinct from marginal) phenomenon.

However, such statistical problems do not sufficiently explain the deviations from interest-rate parity. The early writers on the topic attributed deviations from interest parity to speculation or to market imperfections and limitations on the availability of arbitrage funds.[5] As recent writers have shown, however, speculation (or trade imbalances) can lead to deviations from interest parity only when coupled with limited arbitrage funds. The failure to consider transaction costs invalidates the argument that one of the important implications of the modern portfolio theory for the theory of forward exchange "is that foreign assets covered against exchange risk tend to be added to domestic portfolios in a continuous, smooth fashion, and that there exist no critical

[4] For discussion of the choice among different interest rates and of the maturity structure of forward-exchange rates, see (H.G. Grubel, "Forward Exchange, Speculation and the International Flow of Capital". Stanford: Stanford University Press, 1966, chaps. 8, 13)
[5] See, for instance J.M. Keynes (1923), "A Tract on Monetary Reform," London: Macmillan

interest-rate differentials at which large amounts are suddenly shifted from one group of assets to another"[6].

Of the reasons for deviations from interest rate parity is the issue of repatriation of funds prior to maturity. Foreign assets become less liquid due to the possible need for repatriating funds prior to maturity, this is important in the sense that liquidity loss may act as a deterrent to international short-term capital flow. Stoll (1967) assumes a continuous forward exchange market, one in which the markets for exchange of all relevant maturities are fully developed. He noted that if repatriations must take place at points for which forward exchange can be obtained only at an extra premium, the arbitrager would suffer a loss. Thus the possibility of repatriation prior to maturity remains a source of additional risk on foreign assets.

The relative importance of the various factors, which have been discussed - non-monetary returns, default risk, transaction costs, and premature repatriation – remains a difficult empirical question. The question of distinguishing empirically among the various factors, which contribute to the upward slope of the arbitrage schedule, is not an easy one. As Moore has argued: "In the real world yield differentials among assets arise most importantly from differences in risk, maturity, and costs of intermediation and information. Moreover, not all participants act rationally in the above sense (of expected-utility-maximizing portfolio choice), while aversion to and evaluation of risk differs. Consequently in practice it becomes extremely difficult to determine empirically the extent to which observed return differentials are attributable to market imperfection and risk respectively. Nevertheless, the explanations themselves are complementary rather than competitive within the context of a generalized portfolio-balance approach to international movements. The failure of interest-rate parity to occur need not imply disequilibrium or market imperfection.

[6] H.G. Grubel, 1966, "Forward Exchange, Speculation and the International Flow of Capital", Stanford: Stanford University Press, pg.

A number of empirical tests have attributed the deviation from interest parity to the presence of a time varying risk premium[7]. Theoretically, the ex post deviation from UIP in (4), e_{t+1}, can be divided into a risk premium rp_{t+1} and a forecast error v_{t+1}:

$$e_{t+1} = rp_{t+1} + v_{t+1} \tag{5}$$

As shown by Fama (1984), a small (below 0.5) or negative OLS estimate of ß in (4) implies that the variance of the risk premium exceeds the variance of the expected exchange rate change, indicating that the deviations in UIP is primarily as a result of risk premium:

$$Var(rp_{t+1}) > Var(E_t \Delta s_{t+1}) \tag{6}$$

For instance, the typical finding that ß equals '–3' in (4) requires that the variance of the risk premium is at least four times as large as the variance of the expected rate changes (see Meredith, 2000). This is puzzling because it is difficult to generate risk premia of the required magnitude. Numerous unsuccessful attempts to model a large and variable exchange rate risk premium have been made. Hodrick (1989) provides a survey of this literature.[8] Hodrick and Srivastava (1986) show that the relation in equation (6) can be derived from the general equilibrium model of Lucas (1982). If nominal exchange rate changes are completely unpredictable, as Meese and Rogoff (1983) and others claim, the right hand side of (6) is zero and an infinitely small variance of the risk premium is sufficient to satisfy the inequality in (6).

An important branch of the literature focuses on defining the risk premium. This is largely inspired by Dornbusch (1986) portfolio balance model. Dornbusch showed that if agents are risk averse then the interest differential is comprised of three components, the degree of risk aversion, currency variability and the relative asset supply. The interest differential is positively related to these factors. Earlier empirical investigations on the

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[7] See for example Browne (1986).

[8] A possible exception is De Santis and Gerard (1997, 1998), who were able to predict a non-trivial portion of the excess returns in foreign exchange markets using GARCH-models. Other studies have however failed to detect significant exchange rate risk premia in similar models based on time-varying second moments (Giovannini and Jorion, 1989, Alexius and Sellin, 1999)

relevance of relative asset supplies in explaining risk premia have found weak evidence for developing countries.[9] However, Werner (1996) found that the share of Government bonds do explain the deviations from UIP in Mexico. Bratsiotis and Robinson (2002) provides similar evidence with privately issued bonds for Korea.

III. UIP and Risk Premium in Jamaica

This section tests for the existence of a risk premium and the main factor explaining this premium. It first examines the realized deviations from UIP. Any persistence in the deviations can be considered as evidence for the presence of a risk premium. Follow on this it then tests a portfolio balance model of the interest differential, wherein the risk premium is shown to depend on the relative asset supply.

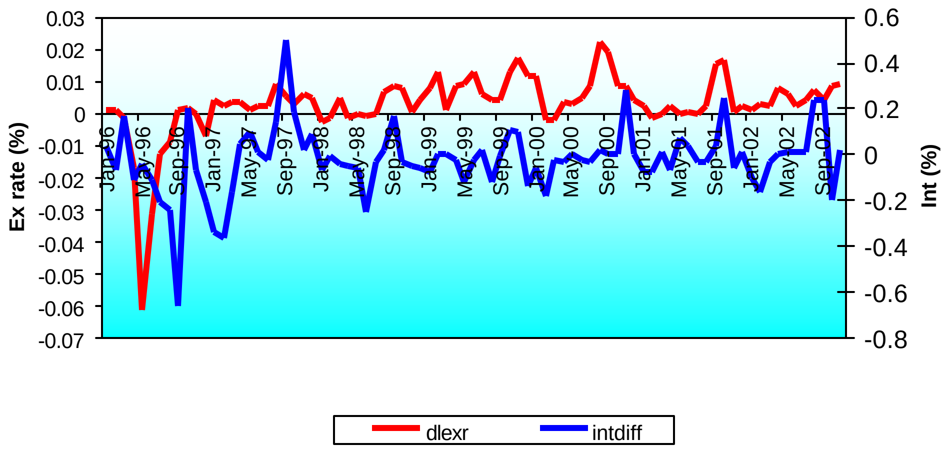
III.I Deviations From UIP

The analysis focuses on the differential between the 6-month Jamaican treasury bill rate[10] and that of the US. Apart from the availability of data, this treasury bill rate was used as it generally influences rates on Government debt and private rates. Figure 1 shows the trends in the interest rate differential and exchange rate changes at a one month lag. In general, there is a positive correlation between the interest rate differential and changes in the exchange rate. But this relation, in most cases, is the similar to that implied by UIP. More importantly the graph indicates significant deviations from interest parity.

[9] See Fremkel (1983).

[10] Fluctuations in this rate are sometimes influenced by sharp swings in market liquidity. To account for this the series was smoothed. However, the results of the ensuing analysis were not significantly different and were therefore not reported.

Figure 1. Change in nominal exchange rate (in logarithm) and Interest rate differential



As noted previously, the most recent study for Jamaica, Mitchell (2000), found that the hypothesis does not hold. In particular, his findings indicated that although the coefficients on interest rate differential had the expected positive sign, it was significantly different from one and the constant was significantly different from zero. One of the shortcomings of the methodology used by Mitchell (2000) is that it is difficult to determine whether the statistical results reflect a failure of market efficiency solely or a failure of both market efficiency and interest parity.

To explain this deviation, the paper tests for persistence in the realized deviation from UIP, ω.

$$w_t \approx i_t - i_t^* + s_t - s_{t+1} \tag{7}$$

The rationale is that if UIP holds then any deviation should only be temporary. Thus the presence of some persistence indicates that the deviation may be due to a risk premium as against a purely stochastic factor. As such we analyze the time series properties of the deviations.

The first and most simple test is whether the sample mean of ? $_t$ is statistically different from zero. Second, to see whether ? $_t$ fluctuates around a mean or drifts boundlessly, three popular stationarity tests are applied to ? $_t$: the Augmented Dickey Fuller (ADF), the Z_a test, due to Phillips and Perron (1988) (P-P) and the KPSS. To test directly for persistence we use standard scalar measures, namely the cumulative impulse response (CIR), the spectrum of ? $_t$ at zero frequency (SPEC) and the half-life (HLF) where

$$CIR = \frac{1}{1-b}$$

$$SPEC = \frac{s^2}{(1-b)^2}$$

$$HLF = \frac{-0.693147}{\ln(b)}$$

and

$$w_t = \hat{a} + \hat{b}w_{t-1} + e_t$$

Note that all the measures of persistence depend on the *true* autoregressive coefficient. It is known however, that least square estimates of *b* has a downward bias, particularly in small samples. As such the measures may not give a true picture of persistence. Given this the measures using the exact median-unbiased estimates of *b* proposed by Andrews (1993) are also reported. Specifically, the median-unbiased estimates of *b*, $\hat{b}_u$, is given by

$$\hat{b}_u = \begin{cases} 1 & if\ \hat{b} > m(1) \\ m^{-1}(\hat{b}) & if\ m(-1) < \hat{b} \le m(1) \\ -1 & if\ \hat{b} \le m(-1) \end{cases}$$

where *m(b)* is the median function of $\hat{b}$.

The main problem in (7) is the measurement of the expected exchange rate, which is unobservable. In addition to the assumption that $E_t S_{t+1} = S_{t+1}$, two additional measures were used to proxy expected exchange rates. The first is a univariate approach in which the forecast of the exchange rate is generated using an ARIMA model and a multivariate approach where the exchange rate forecasts are derived from a VAR. The latter is based on the portfolio model of exchange rate determination, where with rational expectations the forward looking solution to the exchange rate is

$$s_t = \frac{1}{1+l} \sum_{j=0}^{\infty} \left(\frac{l}{1+l} \right)^j E_t z_{t+j}$$

where λ is the interest elasticity of money demand and z is a vector of macroeconomic fundamentals. If the fundamental variables are stationary then the above can be represented by the VAR

$$Z_t = B(L) Z_{t-1} + z_t$$

If they are non-stationary then the forecast is generated from the VAR in first differences. From the standard portfolio model of exchange rate determination the fundamental variables include foreign and domestic interest rates and foreign and domestic money supply.

The analysis uses monthly data from 1991, when the capital account and foreign exchange market was liberalized, to 2002. The estimates were computed for the full sample and two sub-samples –1991 to 1995 and 1996 to 2002, to account for the shift in monetary policy.

The results are presented in Tables 1a to 1c. The results indicate that the mean of the UIP deviations is relatively low and statistically significant from zero, with high t-ratios. The analysis of variance (ANOVA), indicates that the mean of the deviations are not significantly different across sub-samples. The data highlights the fact that the variance in the latter sub-sample (1996 to 2002) is small, almost half the variance in the sub-sample 1991 to 1995. This may be indicating the significant shift in monetary policy in the latter period. The results for the test of unit root across samples and methodologies are ambiguous. It is known that the traditional unit root tests do not necessarily detect the presence of long run memory processes.

The measures of persistence are shown in Tables 2a to 2c. There are no established benchmarks with which one can assess the significance of the deviation from UIP. In the Jamaican economy, which is highly open, there are no capital controls, the financial sector has acquired some degree of sophistication over the years and financial markets generally tend to adjust more quickly than goods market and technology has improved significantly in recent years. Given these factors, one would expect that if UIP holds then shocks would dissipate relatively quickly, probably within three to six months. Hence, measures of persistence greater than 6 months are taken as an indication that UIP does not hold.

The half-life for Jamaica for the full sample ranges from 5 months to 8 months. The standard errors are relatively small. The spectrum at zero[11] is relatively large, while the cumulative impulse response (CIR)[12] ranges from eight months to a little over a year. The persistence does not seem to be very significant in the first sample, however the measures increase significantly in the post 1995 period. In particular, the CIR increases to over one year in all cases, while the range for the half-lives increases to 9 to 11 months and the spectrum at zero is above 2.

The adjusted autocorrelation coefficients are higher by 0.02 to 0.04, which are not large in absolute terms but do imply significant difference in the measures of persistence. The median unbiased estimates for the half-life for example ranged from 6 months to 10 months over the full sample, the CIR from 10 months to over a year. More, importantly median unbiased estimates point to a significant increase in persistence in the period 1996 to 2002, relative to the previous five years. The CIR indicates persistence in the deviation from UIP lasting over two years while the half-life is just under two years.

[11] The spectrum at zero is a measure of the low-frequency autocovariances of the series given by $\frac{s^2}{(1-a)^2}$.

[12] The long-run persistence properties of time series are exhibited by their impulse response function (IRF). The CIR is the sum of the IRF over all time horizons. Where in an AR(p) model, CIR = 1/(1-a)

The analysis therefore does support the hypothesis that there are departures from UIP in Jamaica. The deviations from UIP have a non-zero mean which was not constant over the sample. More importantly, there was a significant break down in the UIP relation since 1996. One can therefore conclude that the interest differential, in Jamaica reflects the presence of a risk premium, as well as currency risks. The next section seeks to add some clarity on the source of this premium.

III.II A Model of the Risk Premia

Several authors, including Fama (1984), Korajczk (1987), and Levine (1989), have suggested that deviations from UIP represent either a risk premium or an unexpected change in the real exchange rate. This paper focuses on the risk premium. This idea is formalized in the model below.

The model is a simple portfolio model and is based on Werner (1996) and Bratsiotis and Robinson (2002). The investor holds his real wealth, W in two types of assets, Jamaica dollar sovereign bonds, K_j, offering an interest rate i and a US dollar sovereign K_{us} which has an interest rate i*. The investor faces transactions costs in both market t_j and t_{us}, respectively. The investor's budget constraint is simply

$$\frac{K_j}{P} + \frac{sK_{us}}{P} \equiv W \qquad (8)$$

where s is the J$/US$ foreign exchange rate, and P is the Jamaican price level. The total real return on the investor's portfolio is,

$$R = g\ (i - p - t_j) + (1 - g)(i^* + \Delta s - p - t_{us}) \qquad (9)$$

where $g = \frac{K_j}{WP}$ is the share of the investor's total financial real wealth spent on Jamaican sovereign debt and p denotes inflation and Δs the rate of depreciation.

The investor maximizes utility based on a simple mean-variance analysis, where utility increases with the unconditional expected real return $E(R)$ on the portfolio but decreases with financial risk measured by the variance of the return, s_R^2

$$U = E(\tilde{R}) - \frac{q}{2} s_{\tilde{R}}^2 \qquad (10)$$

where $q > 0$ is the coefficient of relative risk aversion. From equation (9) the expected real return on the investor's portfolio is

$$E(R) = g(i - t_j) + (1-g)(i^* + E(\Delta s) - t_{us}) - E(p) \qquad (11)$$

and the variance of the portfolio's real return is,

$$s_R^2 = (1-g)^2 s_{\Delta s}^2 + s_p^2 - 2(1-g) s_{p,\Delta s} \qquad (12)$$

where $s_{x,y}$ the covariance of x and y. Maximizing (10) with respect to the share, g, subject to (11) and (12) we obtain

$$\mathrm{i} - \mathrm{i}^* = \mathrm{E}\Delta s + q s_{\Delta \mathrm{e}_{\mathrm{wu}}}^2 g + q(s_{p,\Delta \mathrm{e}_{\mathrm{wu}}} - s_{\Delta \mathrm{e}_{\mathrm{wu}}}^2) + t - t_{us} \qquad (13)$$

Equation (13) is the basic UIP relation augmented by a risk premium and transactions costs. It shows that the interest differential is increasing in the relative share of Jamaican sovereign debt held by investors, γ. If the change in the exchange rate is assumed to be stationary such that its variance is constant, purchasing power parity holds and transactions costs are either constant or negligible[13], then from (13) we obtain the following testable equation

[13] It is reasonable to assume negligible transaction cost given the openness of the Jamaican economy, technology, increasing financial sophistication and integration of the Jamaican financial sector with the international markets.

$$\mathrm{i} - \mathrm{i}^* = b_0 + b_1 \mathrm{E}(\Delta s_t) + b_2 g_t + e_t \tag{14}$$

The paper estimates this equation using Generalized Method of Moments (GMM), with a HAC option. The leads and lags of the right hand side variables and total government debt used as instruments to account for the fact that the share maybe endogenous as the Government takes into account the interest rate when issuing debt. The proxy for financial wealth is the sum of the demand liabilities of banks and near banks plus the total stock of domestic debt outstanding. The security used is the 6-month treasury bill.

The interest differential could also reflect country or default risk and as such a measure of this risk is included and its significance tested. Country risk is proxied by the import cover of the foreign exchange reserves as this represents the country's capacity to import and honor its debt. International creditors such as banks and foreign portfolio investors often monitor the level of foreign exchange reserves available to assess the risk of default on foreign debt. Thus, if the import cover serves as a good proxy for the measure of country risk and has a significant impact on the movement of capital and therefore on the short-term equilibrium exchange rate, the sign of the coefficient of import cover should be positive.

A dynamic version of equation (14) is estimated with an equilibrium correction factor so as to capture the effects of long run disequilibrium shocks and short run exogenous shocks.

$$\begin{aligned}\Delta(\mathrm{i}_t - \mathrm{i}_t^*) = a_0[(\mathrm{i}_{t-1} - \mathrm{i}_{t-1}^*) - b_0 - b_1 \mathrm{E}(\Delta s_{t-1}) - b_2 g_{t-1}] + a(L)\Delta(\mathrm{i}_{t-1} - \mathrm{i}_{t-1}^*) \\ + b(L)\mathrm{E}(\Delta\Delta s_t) + c(L)\Delta g_t + e_t\end{aligned} \tag{15}$$

The model was augmented by the change in the monetary base to capture the effect of changes in liquidity[14]. While it may not be important in the long-run, sharp swings in liquidity characterizes domestic money market from time to time do influence the short term fluctuations in interest rates.

The analysis indicates that most of the deviations occurred in the post 1996 period. As a result, the estimation is done over the period 1996 to 2002, using three different estimates of expected exchange rate, as discussed in section II. The estimation results are given in Tables 4 and 5. The results for equation 14 reveal that the variables have the expected signs and the coefficients on the share of T-bill to wealth and exchange rate changes are significant in all cases. The inclusion of country risk did not add to the explanatory power of the model, as the coefficient on the reserve cover was not significantly different from zero. The regression provided reasonable fits, with the J-statistics suggesting that apart from the constant, the variables should be included in the model. The results point to the importance of the share of government debt in wealth, as well as exchange rate changes, to the interest differential.

The results of the dynamic model are given in Table 5. The coefficients have the expected signs and are significant. It is important to note that the different estimation of expected exchange rate, yielded different results. In particular, the models of expected exchange rate using ARIMA and VAR methodologies yielded the same results. That is, the behaviour of the interest rate differential is influenced by changes in the exchange rate and liquidity. The model of expected exchange rate using the perfect foresight model, however, indicated that in the short run, the behaviour of the interest differential is driven mainly by changes in the exchange rate. Additionally, the relative size of the coefficients indicates that in the long run, the variables essentially have equal influence on the risk premia.

[14] A more appropriate measure would be the current account balance plus overnight deposits. However, time series data in the latter was not available.

In essence, the results suggest that there is evidence in support of the existence of a risk premium that depends on relative asset supplies. The implication of this is that the riskiness of Jamaica dollar assets not only depends on exchange rate volatility but also, the relative size of government debt

V. Conclusion

The analysis shows significant deviation from UIP, particularly since 1996. It is posited that this deviation reflects the presence of a risk premium, which is related to the share of government debt held by investors in their portfolios. This share represents the degree of fiscal dominance. The empirical results indicate that this is a significant component of interest differential in addition to the exchange rate volatility. It is likely that the significant break down in the UIP relation since 1996 is more related to the increased fiscal dominance. This as the stock of debt has increased sharply while the exchange rate has been stable relative to the first half of the 1990's. The policy implication of these results is that a reduction in the supply of government debt, as well as foreign exchange market stability are essential prerequisites to lowering interest rate.

Finally, in this model, the interest differential is derived as a function of relative asset supply and expected exchange rates were modeled using three different methodologies. A possible extension would be to incorporate a model that accounts for inefficiencies in the foreign exchange market. Also, as a robustness check, cross country comparison of the persistence in UIP deviations would assist in providing a benchmark for Jamaica.

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APPENDIX I

Table 1: **Descriptive Statistics**

Table 1a: $E_t S_{t+1} = S_{t+1}$						
	Mean	Variance	T-Ratio	ADF	P-P	KPSS
1991-2002	0.2027	0.0107	1.9616	-3.2329	-3.1554	0.4419
1991-1995	0.2624	0.0108	2.5181	-2.6069	-2.6247	0.2209
1996-2002	0.1756	0.0064	2.2029	-2.7407	-2.4389	0.7590
Prob. Anova F-Statistics for difference in mean = 0.0197						

The 95% critical values of the ADF, P-P and KPSS are –2.8972, -2.8968, and 0.4630.

Table 1b: $E_t S_{t+1} \approx ARIMA$						
	Mean	Variance	T-Ratio	ADF	P-P	KPSS
1991-2002	0.2166	0.0096	2.212	-2.8473	-2.9942	0.6501
1991-1995	0.2343	0.0140	1.9802	-2.5022	-2.4088	0.2878
1996-2002	0.1783	0.0054	2.4308	-2.7664	-2.7665	0.7905
Prob. Anova F-Statistics for difference in mean = 0.0197						

The 95% critical values of the ADF, P-P and KPSS are –2.8972, -2.8968, and 0.4630.

Table 1c: $Es_{t+1} \approx$ VAR						
	Mean	Variance	T-Ratio	ADF	P-P	KPSS
1991-2002	0.2166	0.0094	2.228	-2.2915	-3.0776	0.7321
1991-1995	0.2671	0.01001	2.6524	-2.9505	-2.9245	0.1853
1996-2002	0.1745	0.0050	2.4585	-3.0253	-3.0253	0.7689
Prob. Anova F-Statistics for difference in mean = 0.0197						

The 95% critical values of the ADF, P-P and KPSS are –2.8972, -2.8968, and 0.4630

Table 2: **Persistence**

$$w_t = \hat{a} + \hat{b} w_{t-1} + e_t$$

Table 2a: $E_t s_{t+1} = s_{t+1}$					
	ß	CIR	SPEC	HLF	HLF – 95% Interval
1991-2002	0.9197	12.4559	1.6571	8.2824	8.0798 – 8.4849
1991-1995	0.8864	8.8018	1.0819	5.7474	5.5158 – 5.9790
1996-2002	0.9374	16.0095	1.6291	10.7466	10.5904 – 10.9029
Median –Unbiased Estimates					
1991-2002	0.9300	14.2857	1.4764	9.5513	9.3488 - 9.7539
1991-1995	0.9300	14.2857	1.6883	9.5513	9.3197 - 9.7829
1996-2002	0.9700	33.3333	2.6575	22.7566	22.6003 - 22.9128

Table 2b: $E_t s_{t+1} \approx ARIMA$					
	ß	CIR	SPEC	HLF	HLF – 95% Interval
1991-2002	0.8816	8.4459	0.8209	5.5004	5.3099 – 5.6909
1991-1995	0.7754	4.4518	0.4471	2.7245	2.5276 – 2.9214
1996-2002	0.9276	13.8077	0.9800	9.2199	9.0808 – 9.3590
Median –Unbiased Estimates					
1991-2002	0.9000	10.0000	0.9720	6.5788	6.3883 - 6.7693
1991-1995	0.8000	5.0000	0.5219	3.1062	2.9094 - 3.3031
1996-2002	0.9700	33.3333	2.3659	22.7566	22.6175 - 22.8957

Table 2c: $Es_{t+1} \approx$ VAR					
	ß	CIR	SPEC	HLF	HLF – 95% Interval
1991-2002	0.9009	10.0989	0.9885	6.6474	6.4556 – 6.8393
1991-1995	0.8256	5.7337	0.5929	3.6167	3.4140 – 3.8194
1996-2002	0.9309	14.4860	1.0628	9.6903	9.5465 – 9.8340
Median –Unbiased Estimates					
1991-2002	0.9300	14.2857	1.3983	9.5513	9.3594 - 9.7432
1991-1995	0.8500	6.6667	0.6894	4.2650	4.0623 - 4.4677
1996-2002	0.9700	33.3333	2.4455	22.7566	22.6128 – 22.9003

Table 4: **Risk Premia – GMM Estimates (1996-2002)**

Table 4a

Dependent Variable: $i - i^*$

Method: Generalized Method of Moments: $E_t S_{t+1} = S_{t+1}$

Instrument List: T-bill/wealth, $E(\Delta s_t)$, $i - i^*$ (-1)

Variable	Coefficient*	Std. Error	t-Statistic	Prob.
C	0.041648	0.009241	4.507007	0.0000
g_t	0.221543	0.303663	2.120091	0.0373
$E(\Delta s_t)$	0.241508	0.349696	2.006915	0.0484
R-squared	0.784808	J-statistic	0.099231	
Adjusted R-squared	0.784083	Prob(J-statistic)		

*Corrected for serial correlation

Table 4b

Dependent Variable: $i - i^*$

Method: Generalized Method of Moments : $E_t S_{t+1} \approx ARIMA$

Instrument List: Tot. Gov. Debt, T-bill/wealth, $E(\Delta s_t)$, $i - i^*$ (-1)

Variable	Coefficient*	Std. Error	t-Statistic	Prob.
C	0.030853	0.008749	3.526433	0.0007
g_t	0.220718	0.386854	2.087955	0.0402
$E(\Delta s_t)$	0.216029	0.433084	1.825455	0.0720
R-squared	0.746660	J-statistic	0.085086	
Adjusted R-squared	0.732965	Prob(J-statistic)		

*Corrected for serial correlation

Table 4c Dependent Variable: $i - i^*$ Method: Generalized Method of Moments : $Es_{t+1} \approx$ VAR Instrument List: Tot. Gov. Debt, T-bill/wealth, $E(\Delta s_t)$, $i - i^*$ (-1)				
Variable	Coefficient*	Std. Error	t-Statistic	Prob.
C	0.00464	0.005396	0.860577	0.3923
g_t	0.08949	0.271328	3.312310	0.0014
$E(\Delta s_t)$	0.15838	0.217299	2.337134	0.0222
R-squared	0.837625	J-statistic	0.152048	
Adjusted R-squared	0.830952	Prob(J-statistic)		

*Corrected for serial correlation

Table 5: **Risk Premia**
GMM Estimates (Error Correction Model)

Table 5a Dependent Variable: $i - i^*$ Method: Generalized Method of Moments: $E_t s_{t+1} = s_{t+1}$ Instrument List: Liquidity, T-bill/wealth, $E(\Delta s_t)$, $i - i^*$ (-1), $e_t(-1)$				
Variable	Coefficient*	Std. Error	t-Statistic	Prob.
C	-0.001152	0.001166	-0.987956	0.3264
$E(\Delta s_t)$	0.266140	0.088307	3.363291	0.0012
$e_t(-1)$	-0.374680	0.058166	-7.188548	0.0000
R-squared	0.206926	Prob(J-statistic)	0.057930	
Adjusted R-squared	0.164058			

*Corrected for serial correlation

Table 5b

Dependent Variable: $i - i^*$

Method: Generalized Method of Moments: $E_t S_{t+1} \approx ARIMA$

Instrument List: Liquidity, T-bill/wealth, $E(\Delta s_t)$, $i - i^*$ (-1), $e_t(-1)$

Variable	Coefficient*	Std. Error	t-Statistic	Prob.
C	-0.001076	0.000902	-1.193466	0.2366
l_{t-3}	-0.050136	0.018089	-2.568968	0.0122
$E(\Delta s_t)$	0.333906	0.122273	2.612889	0.0109
$e_t(-1)$	-0.50368	0.134155	-3.479891	-0.0009

R-squared 0.190541 Prob(J-statistic) 0.064422

Adjusted R-squared 0.135099

*Corrected for serial correlation

Table 5c

Dependent Variable: $i - i^*$

Method: Generalized Method of Moments: $Es_{t+1} \approx$ VAR

Instrument List: Tot. Gov. Debt, T-bill/wealth, $E(\Delta s_t)$, $i - i^*$ (-1)

Variable	Coefficient*	Std. Error	t-Statistic	Prob.
C	-0.000190	0.000955	-0.198513	0.8432
l_{t-3}	-0.038393	0.020737	-1.851434	0.0683
$E(\Delta s_t)$	-0.687480	0.295167	-2.329121	0.0227

R-squared 0.351329 Prob(J-statistic) 0.085895

Adjusted R-squared 0.314784

*Corrected for serial correlation