E C O N O M I C S B U L L E T I N

PPP, RANDOM WALKS, AND UIP AFTER INTEREST RATE LIBERALISATION IN A SMALL DEVELOPING ECONOMY

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Abstract

This paper investigates the impact of interest rate liberalisation on exchange rate expectations in the Dominican Republic (DR). The research employs a nested purchasing power parity, random walk, and uncovered interest parity specification that facilitates the recovery of the fundamentals behind the exchange rate expectations formation mechanism. The findings reveal that the most significant driver of exchange rate expectations is the interest rate differential between the DR and its main trading partner −the United States. These results are of relevance for the design and implementation of financial reforms and exchange rate policy alike, and in anticipating abrupt exchange rate movements.

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1. Introduction

During the 1980s many developing countries, especially Latin American ones, experienced severe economic crises. This prompted widespread economic reform in the region, mostly undertaken in the late 1980s and early 1990s (see Cardoso and Helwege, 1995). An interesting example of these developments is the Dominican Republic (DR), a country that experienced some of the highest rates of GDP growth in the region during the 1990s. This success is partly attributed to the reforms put in place at the beginning of the last decade. Amongst these reforms, which are well documented by Young (2001), the liberalisation of interest rates was thought of as a remarkable progress[1].

In principle, these policies are expected to contribute to the deepening of the financial sector, and ultimately to the stability and growth of the reforming economies. However, in reality a prevalence of high interest rates has been documented. For example, Brock and Rojas Suárez (2000) investigate the impact of the lifting of interest rate ceilings and other financial liberalisation policies in selected Latin American countries during the 1990s. They find that throughout the region high interest rates have lingered as common factors *after* the reforms. Amongst the reasons the authors attribute to that upshot are high operating costs and non-performing loans.

In the light of these developments, how does interest rate liberalisation affect the behaviour of the exchange rate market? Overall, this matter is of interest due to the role of exchange and interest rates in policymaking and on more wide ranging policy reforms in emerging and developing economies (e.g. Calvo and Reinhart, 2002)[2]. In thinking about this phenomenon the reader should recall that there is a natural link between the interest rate differential and the exchange rate via the uncovered interest parity (UIP) hypothesis (see Flood and Rose, 2002).

This paper deals with this question for the DR by modelling the goods and capital markets using a nested purchasing power parity (PPP), random walk (RW), and uncovered interest parity (UIP) specification. The RW component of the analysis assumes that a portion n of the population form expectations in an autoregressive fashion. Notably, this methodology facilitates the calculation of the expected exchange rate based on standard macroeconomic fundamentals.

2. The model

In its relative version, the PPP hypothesis is defined as

$$e_t = \phi_o + \phi_1\left(p_t - p_t^*\right) + \mu_t \,, \tag{1}$$

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[1] After 1995, a series of financial reforms were undertaken. In particular, the banking system was allowed to lend in US currency. After that the internal free flow of capital between US and DR currency has dollarized the system from about 10% in 1996 to almost 45% in 2002.

[2] The DR has historically had a multiple exchange rate system composed of the official, the banking system, and the parallel/'black' markets. Although the parallel market is in part regulated, it is not, and has never been, completely so.

where e_t is the exchange rate between the domestic and foreign currency, p_t is the domestic price level, p_t^* is the foreign price level, and μ_t is a trade shock with zero mean and finite variance[3].

Equation (1) is generally viewed as a long run mechanism in the goods market that guaranties equilibrium between supply and demand among trading partners. The empirical evidence on the validity of this hypothesis is gargantuan. Sarno and Taylor (2002) provide a recent survey of the field.

In the capital market, the UIP implies that the interest rate differential between two countries should equal the expected change in the nominal 'spot' exchange rate. In its simplest form, the UIP is defined as

$$i_t - i_t^* = E_t e_{t+1} - e_t + \rho_t , \qquad (2)$$

where i_t and i_t^* are the nominal interest rates in the domestic and foreign country, respectively; E_t is an expectations operator conditional on all past available information; and ρ_t is a random term usually interpreted in the literature as a risk premium (see, for example, Svensson, 1992). Under rational expectations, deviations from PPP and UIP will determine exchange rate expectations, thereby providing a link between the goods and capital markets (e.g., Juselius, 1995).

A random walk specification is also nested in the analysis, under the assumption that a portion *n* of the population establishes expectations in an autoregressive fashion. This is the main feature that distinguishes this from previous works, in which only the link between the PPP and UIP was included in the formation of exchange rate expectations.

After manipulation of (1) and (2), the final rational expectations solution is given by

$$E_t e_{t+1} = \omega_0 + \omega_1 \left(i_t - i_t^*\right) + \omega_2 \left(p_t - p_t^*\right) + \omega_3 e_t + \varepsilon_t , \qquad (3)$$

where $-1 \leq \omega_1, \omega_2 \leq 1$, and $\omega_3 = n \geq 0$ are the weights on the UIP, PPP, and RW components, which depend on the underlying structural parameters. ε_t is the combined, trade and risk, random term[4]. The relationship nesting the UIP, PPP, and RW is obtained by plugging (3) into (2), yielding

$$\left(1 - \omega_3\right) e_t - \omega_2 \left(p_t - p_t^*\right) + \left(1 - \omega_1\right)\left(i_t - i_t^*\right) = \xi_t . \qquad (4)$$

Taking into consideration the stochastic properties of the model, it then follows that the parities will have an empirical meaning if and only if $i_t - i_t^*$, $p_t - p_t^*$ and e_t

[3] Hereafter, increases (decreases) in the exchange rate are depreciations (appreciations) of the domestic currency.

[4] These weights, according to Juselius (1995), also account for asymmetric information, aggregation and misspecification in the variables used as proxies of the true model. In addition, the portion of the population that behave in a PPP and UIP framework, and the one behaving in a random walk fashion, will also affect the magnitude of the weights.

follow the same order of integration, and $\xi_t \sim I(0)$, implying that deviations from the underlying equilibrium correction mechanism (ECM) are stationary.

3. Econometric modelling

The empirical analysis employs monthly data on prices and commercial banks' interest rates for the DR and the US, and exchange rate data for the DR covering the period ranging from January 1992 to December 2002 [5]. The data are obtained from the Central Bank of the Dominican Republic, and the Federal Reserve Bank of St Louis' FRED database, for the DR and the US, respectively[6]. Note that in what follows all the variables are expressed in logs.

Before proceeding to the formal econometric exercises the order of integration of the time series at hand is investigated. The application of the standard Augmented Dickey-Fuller (ADF) test reveals that the levels of all the variables mentioned above are integrated of order one and become stationary after being differenced once. Figure 1 displays the clear $I(0)$ pattern of the differenced series.

The analysis proceeds to investigate equation (4) using a linear dynamic specification *à la* Bårdsen (1989) that can be written as

$$\Delta e_t = \sum_{j=0}^{q-1}\left[\delta_{1j}\Delta\left(i_{t-j} - i^*_{t-j}\right) + \delta_{2j}\Delta\left(p_{t-j} - p^*_{t-j}\right) + \delta_{3j}\Delta e_{t-j+1}\right] + (\omega_3 - 1)\mathrm{ECM}_{t-q} + \xi_t \qquad (5)$$

where $\mathrm{ECM}_{t-q} = e_{t-q} + \frac{\omega_2}{(\omega_3 - 1)}\left(p_{t-q} - p^*_{t-q}\right) + \frac{\omega_1}{(\omega_3 - 1)}\left(i_{t-q} - i^*_{t-q}\right) + \frac{\omega_0}{(\omega_3 - 1)}$, and ξ_t is required to be white noise (see also Banerjee et al, 1993). Note that the estimation of equation (5) is undertaken using OLS and instrumental variables (IV) methods.

The final, preferred, reduced empirical model corresponding to equation (5) complies with all the diagnostic tests, and displays economically interpretable coefficients[7]. The normalised ECM consistent with equation (4) is given by

$$-\underset{(0.06)}{0.28^{**}}\left[e_{t-12} - \underset{(0.13)}{0.67^{**}}\left(p - p^*\right)_{t-12} - \underset{(0.04)}{0.09^{**}}\left(r - r^*\right)_{t-12} - \underset{(0.52)}{2.87^{**}}\right] \sim I(0). \qquad (6)$$

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[5] Throughout the paper refers to the parallel 'selling' exchange rate of Dominican Republic Pesos (DR$) per United States Dollars (US$), since the US is by far the DR's main trading partner. Interest rates refer to the commercial lending rate, since UIP is analyzed from a lender's perspective.

[6] The websites of the Central Bank of the Dominican Republic and the Federal Reserve Bank of St. Louis are http://www.bancentral.gov.do/ and http://research.stlouisfed.org/fred/, respectively.

[7] The full set of results is not displayed here for reasons of space, but is available from the authors upon request.

The ECM represented by (6) is statistically significant and indicates that, on average, $\frac{1}{3}$ of any disequilibrium is corrected within one quarter[8]. From equation (6) the underlying parameters of the expected exchange rate, equation (3), can be recovered. Accordingly, exchange rate expectations are determined by

$$E_t e_{t+1} = \underset{(0.17)}{0.81^{**}} + \underset{(0.37)}{1.02^{*}}\left(r_t - r_t^*\right) + \underset{(0.04)}{0.19^{**}}\left(p_t - p_t^*\right) + \underset{(0.15)}{0.72^{**}} e_t \,. \tag{7}$$

Equation (7) implies that deviations from both PPP and UIP are significant drivers of exchange rate expectations. Moreover, the latter is in harmony with Flood and Rose's (2002) analysis of the performance of UIP in crises. Particularly, they conclude that exchange rate depreciation in 23 developed and developing countries generally followed interest rate differentials. Flood and Rose also note that UIP seems to work better in times of crisis, which also seems to be true for the DR.

To illustrate the point, Figure 2 displays the actual and expected exchange rates calculated using the ECM (6). An interesting feature is the convergence of expectations towards the actual exchange rate after the introduction of an IMF stand-by agreement in 1991. Additionally, after 1995, and the substantial reforms introduced in the banking system, an equilibrium correction pattern, consistent with Calvo and Reinhart's (2002) 'fear of floating' argument of interest rate adjustments, emerges.

By the end of 2001, however, several internal and external shocks, including the September 11 attacks and the collapse of one of the DR's mayor commercial banks at the end of 2002, contributed to the widening of the interest rate gap. This also led to a break in expectations and a corresponding drift away from the ECM. Reforms aimed at enhancing capital mobility and full access to foreign currency lending technology contributed to this outcome. Arguably, this has been exacerbated by the fact that the DR's regulation of the banking system is poor, and therefore the economy was not ready for such reforms.

It is worthy to note that the inclusion of random walk agents is also significantly meaningful. If one is willing to assume a pure underling RW process, it then follows from the coefficient of e_t in (7) that about 72% of the agents in the exchange rate market form expectations in this fashion.

In summary, the paper shows that in the DR during the period investigated the most significant driver of aggregate exchange rate expectations is the interest rate differential, followed by the present stance of the exchange rate, and finally by the price differential. These results have consequential implications for financial reforms and exchange rate policy alike.

[8] Hereafter the figures in parenthesis are standard errors, calculated using the formula

$$\mathrm{var}(\omega_i/-\omega_1) = (1/-\omega_1)^2\ \mathrm{var}(\omega_i) + (\omega_i/-\omega_1)^2\ \mathrm{var}(\omega_1) + (1/-\omega_1)(\omega_i/-\omega_1)\,\mathrm{cov}(\omega_i,\omega_1)\,,$$

where var(•) and cov(•,•) are the variance and covariance of the arguments, respectively. * and ** denote significance at the 95% and 99% level respectively.

References

Banerjee, A., J. Dolado, J.W. Galbraith, and D.F. Hendry (1993) *Co-integration, error-correction, and the econometric analysis of non-stationary data*, Oxford University Press: Oxford.

Bårdsen, G. (1989) "The estimation of long-run coefficients from error correction models" *Oxford Bulletin of Economics and Statistics* **54**, 345-350.

Brock, P.L., and L. Rojas Suárez (2000) "Understanding the behaviour of bank spreads in Latin America" *Journal of Development Economics* **63**, 113-134.

Calvo, G.A., and C. M. Reinhart (2002) "Fear of floating" *Quarterly Journal of Economics* **117**, 379-408.

Cardoso, E.A., and A. Helwege (1995) *Latin America's economy: diversity, trends, and conflict*, MIT press: Cambridge, UK.

Flood, R.P., and A.K. Rose (2002) "Uncovered interest parity in crisis" *IMF Staff Papers* **49**, 252-266.

Juselius, K. (1995) "Do purchasing power parity and uncovered interest rate parity hold in the long run? An example of likelihood inference in a multivariate time series model" *Journal of Econometrics* **69**, 211-240.

Sarno, L., and M.P. Taylor (2002) "Purchasing power parity and the real exchange rate" *IMF Staff Papers* **49**, 65-105.

Svensson, L.E.O. (1992) "The foreign exchange rate risk premium in a target zone with devaluation risk" *Journal of International Economics* **33**, 21-40.

Young, P., Ed., (2001) *The Dominican Republic: Stabilization, structural reform, and economic growth*, IMF Occasional Paper 206: Washington, D.C.

Figure 1
Annual changes in the logs of the exchange rate,
and price and interest rate differentials (percent per annum)

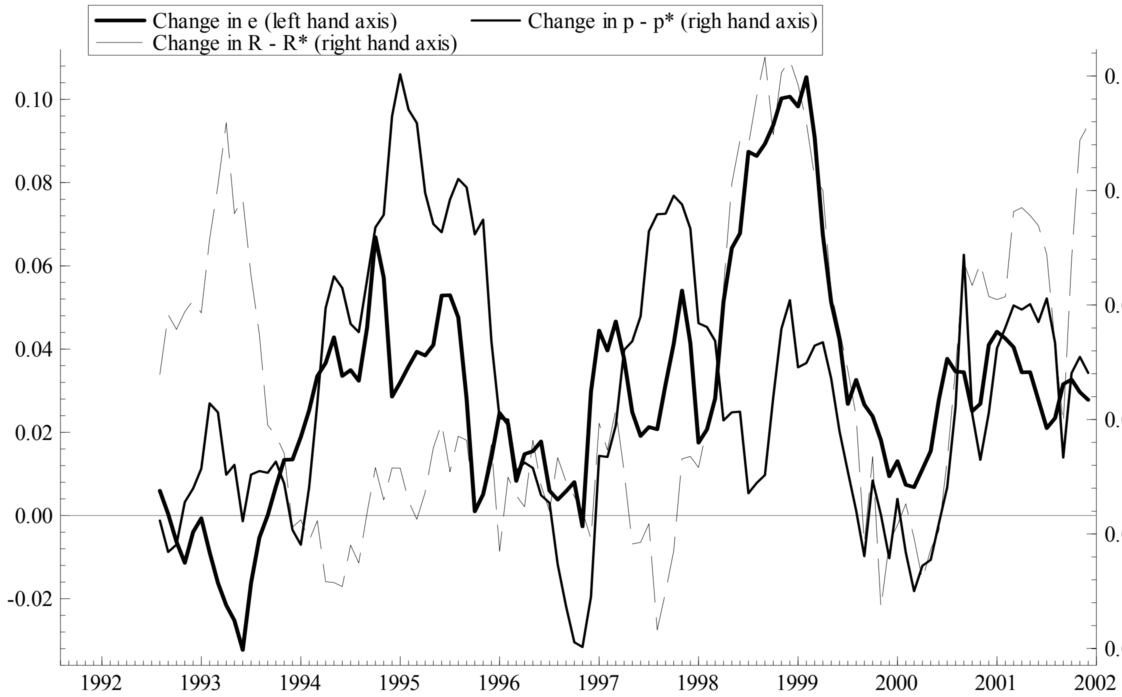

Figure 2
Actual and 'expected' exchange rates (DR$/US$)