RBEE Revista Brasileira de Economia de Empresas
Brazilian Journal of Business Economics
Vol. 3 - nº 1 Janeiro - Abril 2003 p. 23-32

EXCHANGE MARKET PRESSURE IN THE DOMINICAN REPUBLIC

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Abstract: *This paper applies the Girton and Roper monetary model of exchange market pressure to the case of the Dominican Republic's official exchange rate market. Remarkably, the results indicate a negative relationship between the growth of domestic output and exchange market pressure; i.e. output growth generates an appreciation of the domestic currency, an accumulation of foreign exchange reserves, or a combination of both. In contrast, higher rates of growth of the money multiplier increase exchange market pressure in the Dominican Republic, which implies a depreciation of the domestic currency, a loss of foreign exchange reserves, or a mixture of the two.*

JEL classification: *E5; F41.*

Keywords: *exchange market pressure, monetary policy, the Dominican Republic.*

Introduction

The objective of this paper is to apply the Girton-Roper (G-R) (1977) monetary model of exchange market pressure (EMP) to the Dominican Republic's (DR) official exchange rate market. This exercise is of interest mainly due to the fact that the DR's exchange rate system and monetary policy have characteristics that provide a somehow natural experiment that can be systematically investigated through that model. And, crucially, key policy lessons could be derived from this inquiry.

In this context, several institutional facts about the DR should be highlighted. The Central Bank of the Dominican Republic (CBDR) was founded, and the Dominican Peso (DR$) first introduced, in 1947. As stipulated in the CBDR's 'Organic Law', the Governor of the institution is appointed by the constitutionally elected President of the country, and can be removed at any moment[2] . Additionally, the Secretary of Finance and the Secretary of Industry and Commerce are members *ex-officio* of the Monetary Board. Seven additional members complete the Board, and they are also appointed by the President.

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2 See http://www.bancentral.gov.do/ for further details on the structure of the CBDR.

A further interesting aspect to note is that monetary policy in the DR has been virtually the same for over three decades. Instruments such as foreign exchange market interventions (e.g. SARNO and TAYLOR, 2001) have been amongst the key elements in the CBDR's policy toolkit during most of its history. However, from the beginning of the 1990s the CBDR has increasingly implemented 'less direct' instruments such as open market operations, chiefly by issuing short-term papers called *CBDR's Certificates of Participation*.

The use of that type of instrument has not, however, significantly diminished the active implementation of the more traditional ones highlighted above. More likely, they have complemented each other. Nonetheless, given the financial underdevelopment of the DR, the oligopolistic structure of its commercial banking system, and the (probably) limited credibility of the monetary authorities with the general public, the effectiveness of the *Certificates of Participation*, or of any other comparable instrument, is likely to be limited, at least under the prevalent institutional setting.

Another critical point to note in relation to monetary policy making in the DR is how the exchange rate market has been organised. The DR has for a long time had a 'multiple' exchange rate regime. At present, the system is composed of the official, banking system, and extra-banking system (parallel) exchange rate markets. The banking system and extra-banking system (parallel) rates are expected to be determined by market forces. In contrast, the official rate was fixed until January 1985, and became more flexible after that point in time. Crucially, post-1985 the official foreign exchange rate can be broadly characterised as a crawling peg (See REINHART and ROGOFF, 2002).

Henceforth, the DR's official exchange rate market seems to provide a potentially fruitful base for the application of the G-R model. Particularly, the paper attempts to answer the question: How has the pressure on foreign exchange reserves and the exchange rate, in the presence of an excess domestic money supply over money demand in the context of a managed float exchange rate regime, being dealt with in the Dominican Republic?

It is worth mentioning that previous studies have implemented the G-R model. For instance, Connolly and Silveira (1979) applied it to Brazil, while Modeste (1981) did so to analyse EMP in Argentina. Additionally, Kim (1985) and Mah (1998) studied Korea; Thornton (1995) investigated Costa Rica; and Bahmani-Oskooee and Shiva (1998) the case of Iran.

The rest of the paper is organised in the following fashion. Section 2 outlines the intuition behind the G-R model. In section 3 the model is applied to the particular case of the DR's official exchange rate using static and dynamic econometric specifications. Section 4 concludes.

The Girton-Roper monetary model

Let us briefly outline the components of the Girton-Roper (1977) EMP model[3]:

$$M^D = kPY \tag{1}$$

[3] Following Connolly and Silveira (1979), it is assumed that the fact that the DR is a price taker, and that it cannot influence foreign monetary conditions, it allows the implementation of the model without considering problems such as monetary dependence, treated in G-R's original investigation.

$$M^S = M\left(R + D\right) \tag{2}$$

$$M^D = M^S \tag{3}$$

$$E = \frac{P}{P^*} \tag{4}$$

The first component of the model stands for the Cambridge demand for nominal balances equation. In (1) k is the inverse of the velocity of circulation of money, Y is real income, and P is the domestic price level. Equation (2) describes the money supply process as the product of the sum of net foreign assets and domestic credit (the monetary base) by the money multiplier (M). In equation (3) the money market equilibrium is imposed, while equation (4) represents the purchasing parity power condition. In (4) E is the nominal exchange rate, while P^* denotes the foreign price level.

Substituting (1) and (2) into (3) yields

$$kPY = M\left(R + D\right) \tag{5}$$

Further substituting (4) into (5) produces

$$kEP^*Y = M\left(R + D\right) \tag{6}$$

Obtaining percentage changes from (6), and assuming k as a constant

$$e + p^* + y = m + r + d \tag{7}$$

Rearranging (7) produces

$$e - r = -p^* - y + m + d \tag{8}$$

In (8) p^*, e, y, and m represent the percent changes in P^*, E, Y, and M, respectively[4]. The empirical analyses that follow assume that $r = \mathrm{D}R / (R + D)$, and $d = \mathrm{D}D / (R + D)$. Note that equation (8) corresponds to G-R's EMP. Such equation states that, for instance, an increase in the rate of growth of domestic credit, for a given rate of growth of the money multiplier, world prices, and real income, will give rise to (i) an exhaustion of foreign reserves with no alteration in the exchange rate, (ii) a depreciation of the exchange rate, or (iii) a mixture of both.

[4] Note that in the present framework an increase (reduction) in e represents a depreciation (appreciation) of the DR$.

Empirical analyses

Data

The empirical assessment of the G-R model for the Dominican Republic employs annual data ranging from 1985 to 2000[5]. [Further details on the data set are provided in the data appendix.] Since the results obtained from the application of time series econometric techniques crucially depend on the order of integration of the variables under analysis, standard stationarity tests (Dickey and Fuller, 1979) were applied as the first step of the empirical analyses. All the variables were found to be stationary, i.e. integrated of order zero [$I(0)$]. These results are gathered in Table 1's panel A. Henceforth, the outcome of the analyses that will be carried out below should not suffer from spurious regression problems.

Static econometric estimations

The EMP equation to be estimated empirically can be written down as follows

$$e_t - r_t = \beta_0 + \beta_1 p_t^* + \beta_2 y_t + \beta_3 m_t + \beta_4 d_t + \xi_t \tag{9}$$

In (9) $\beta_1, \beta_2 \prec 0$, $\beta_3, \beta_4 \succ 0$, and ξ_t is expected to be a well-behaved disturbance term[6].

Several versions of equation (9) are tested. The results are gathered in Table 1's panel B, which also includes a battery of diagnostic tests. Table 1's first column, labelled Model 1, presents coefficients that are roughly in line with the predictions of the G-R model. Notably, the domestic output and money multiplier growth variables carry negative and positive signs, respectively, and are statistically well determined. In contrast, the coefficients on the foreign price and domestic credit growth measures are not statistically significant. Additionally, the array of diagnostic statistics exhibited at the bottom of Table 1 are complied with.

Economically, Model 1 reveals that, for example, for every 10% increase in the rate of growth of the money multiplier the Dominican peso will depreciate by approximately 6%, the economy will lose reserves in such a magnitude, or a combination of the two. Likewise, for every 1% increase in the rate of growth of the Dominican economy (a) its reserves would increase by 3.53% (-r = -3.53 $\times$ 0.01), (b) the official exchange rate would appreciate by that amount (e = -3.53%), or (c) a combination of both (e - r = -3.53%).

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[5] It should also be noted that annual data is used in the investigation given that a higher frequency series of the GDP variable is not readily available. Considering the well-known shortcomings of such type of data in developing countries, further manipulations (e.g. extrapolation to higher frequency) could compromise its accuracy, with relatively small gains in terms of the *information* the series contain. Nevertheless, given the fashion in which monetary authorities behave in economies such as the DR (probably with considerable lags, amongst other factors because of the operating constraints they stand up to) studying their behaviour through annual data should help characterise their reactions in a sensible way.

[6] Note that G-R (1977) emphasise that their model has no implication for the sign or significance of the constant term.

These results are plausible, since a higher rate of growth of the economy will very likely generate more foreign exchange, affecting the accumulation of international reserves and the relative value of the domestic currency. Analogously, adverse aggregate conditions would lead to a depletion of foreign exchange reserves and a depreciation of the domestic currency. Also, excess liquidity, said to be generated through an increase in m, will put pressure on the exchange rate and foreign reserves, i.e. increase the EMP.

Importantly, the fact that the foreign price and domestic credit growth variables are not significant in Model 1 does not imply that they are irrelevant, but that in the present context they do not provide significant information *above* that contained in y and m. These results are in harmony with the key economic events that took place during the sample under scrutiny. Particularly, at the end of the 1980s the government substantially financed its expenditures via monetary emissions. In contrast, during the 1990s the DR economy experienced a healthy output growth, which was in part responsible for the macroeconomic stability observed in this period. On this latter developments a recent IMF report states[7] : "A stabilization and structural reform program, initiated in the early 1990s, helped to triple the average annual real GDP growth rate from 2¼ percent a year in the first half of the decade to 7¾ percent a year in the second half. Growth was supported by rising investment, including substantial foreign direct investment in the electricity, telecommunications, free-trade-zone, and tourism sectors".

As pointed out by G-R, the application of their model might be sensitive to the composition of the EMP measure, i.e. it might be the case that one of the components of the EMP measure is bearing most of the tension. In order to test such a hypothesis they propose that an additional explanatory variable should be added to the right hand side of (9). The variable they propound is $Q = \frac{(e-1)}{(r-1)}$, where e and r are defined as above[8]. The predictions are that if most of the pressure of the exchange rate market falls on the exchange rate, Q should be positive and statistically significant. Conversely, if the pressure lies on foreign reserves Q should be negative and statistically significant.

The results of testing for the sensitivity of the composition of the EMP for the DR, Model 2 in Table 1, are somewhat similar to those of Model 1. Notably, Q is not statistically significant. Moreover, the Schwarz information criterion supports Model 1 over Model 2. In the light of these outcomes it is useful to furnish a visual impression of the adequacy of a reduced version of Model 1 (Model 3). [Note that the reduction to Model 3 is endorsed by the SCHWARZ information criterion displayed in Table 1.] To this end, Figure 1 displays the actual and fitted values of EMP, whereas Figure 2 shows Model 3's recursive diagnostic statistics. These latter graphs endorse the goodness of Model 3's econometric fit, and particularly its stability.

It is worth to note that the generation of the recursive graphs implies the estimation of the coefficients of interest over a period ranging from 1 to $M-1$, and subsequently analyzing them for the span comprised between M and T, where T denotes the total number of observations

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7 IMF Public Information Notice (PIN) No. 02/66 on the Dominican Republic, June 26, 2002.

8 It has to be pointed out that G-R's proposed to measure Q by $Q = \left(\frac{e}{r}\right)$. Connolly and Silveira (1979), however, propose the measure presented here, since Q would be discontinuous for values of r that are zero.

considered. Finally, the recursive statistics displayed in Figure 2 are the 1-step ahead, $N \downarrow$ and $N \uparrow$ recursive Chow tests, where N is the number of observations. (See Doornik and Hendry, 2001, for further details on these statistics).

A dynamic specification

As argued by Mah (1998), previous analyses of the G-R model have focused on static specification like (9). Mah finds that for Korea a dynamic specification performs better than a semi-dynamic one. Following this intuition, the present paper proceeds to estimate Model 3 by adding one lag of each of the variables in question, i.e. an autoregressive distributed lag model of order one [$ADL(1,1)$], which seems appropriate for the type of data being examined. (See Hendry, Pagan, and Sargan, 1984.)

The outcome of this empirical exercise is given in Table 1 under Model 4. The solved long run coefficients are displayed. Although the coefficients of interest are quite similar to Model 3's, overall this dynamic specification does not seem to generate additional information above that provided by Model 3, with only the coefficient affecting the contemporaneous value of m being statistically significant. Furthermore, the SCHWARZ information criterion supports Model 3 over Model 4. Henceforth, it can be concluded that, at least in the present context, a dynamic specification does not improve the performance of the EMP model. Nevertheless, the reader should note that the growth rate nature of the model under consideration embodies an *imposed* dynamic structure.

Conclusion

This paper applies the Girton-Roper (1977) model of EMP to the Dominican Republic's official exchange rate market. The results suggest that the Dominican Republic provides a reasonable example of an official exchange market in which EMP has been alleviated by a mixture of exchange depreciation and changes in reserves. Specifically, the key findings indicate a *negative* relationship between the growth of domestic output and exchange market pressure; i.e. output growth generates an appreciation of the domestic currency, an accumulation of foreign exchange reserves, or a combination of both. In contrast, higher rates of growth of the money multiplier *increase* exchange market pressure in the Dominican Republic, which implies a depreciation of the domestic currency, a loss of foreign exchange reserves, or a mixture of the two.

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Data appendix

All the data described below were collected from the International Monetary Fund's *International Financial Statistics* **CD ROM**, with the exception of the exchange rate variable, which was obtained from the Central Bank of the Dominican Republic (CBDR). The corresponding IMF CD ROM codes are displayed in **bold**.

D	Domestic component of the monetary base, obtained by adding currency (**24314A…ZF...**) and reserves (**24320...ZF...**), as in Bahmani-Oskooee and Zhiva (1998).
E	Official exchange rate of Dominican Pesos (DR$) per US Dollars (US$), where an increase in E denotes a depreciation of the domestic currency. The source for this data is the CBDR.
H	Monetary base, obtained by adding D and R .
P^*	United States (US) wholesale price index (WPI) (foreign price level) (**11163...ZF...**). The US WPI is used as a proxy of foreign prices since the US can be considered to be the DR's main trading partner.
R	Net foreign assets (foreign component of the monetary base), calculated as the difference between foreign assets (**24311...ZF...**) and foreign (short-term) liabilities (**24316C...ZF...**).
Y	Real output (GDP), (**24399BVPZF…**).

Table 1

Unit root texts and OLS estimations of the EMP in the Dominican Republic, 1985-2000

Panel A: Unit root test statistics				
$e-r=-4.273^{**}$	$p^{*}=-4.015^{**}$	$y=-3.776^{**}$	$m=-4.886^{**}$	$d=-4.815^{**}$
Panel B: OLS estimations of the EMP in the DR				
Coefficient/ Test statistic	**Model 1**	**Model 2**	**Model 3**	**Model 4**
	The Dependent variable is: $e-r$			
β_0	0.30 (2.57)*	0.27 (1.72)	0.30 (3.79)**	0.26 (1.56)
β_1	0.38 (0.13)	0.13 (0.04)	-	-
β_2	-3.53 (2.29)*	-3.44 (2.10)	-3.57 (2.64)*	-2.52 (0.84)
β_3	0.61 (5.30)**	0.60 (4.90)**	0.63 (9.75)**	0.92 (2.73)*
β_4	-0.07 (0.15)	-0.01 (0.02)	-	-
Q	-	0.02 (0.29)	-	-
Diagnostic statistics				
R^2	0.88	0.88	0.88	0.92
$AR-F$	0.3109 (0.5894)	0.7343 (0.4137)	0.2687 (0.7692)	0.0354 (0.8549)
$ARCH-F$	0.0377 (0.8502)	0.0770 (0.9993)	0.0609 (0.8096)	1.7391 (0.2238)
$HET-F$	3.4372 (0.2449)	NA	0.6046 (0.6046)	NA
$NORM-\chi^2$	2.4696 (0.2909)	2.5966 (0.2730)	2.5163 (0.2842)	1.3842 (0.5005)
$SCHWARZ$	-2.5892	-2.4248	**-2.9331**	-2.8352

Notes on Table 1. Panel A: ** denotes rejection of the unit root hypothesis at the 1% level according to the augmented Dickey-Fuller (ADF) test statistic. For y and m the Dickey-Fuller test statistic is reported.

Panel B: estimated coefficients' absolute t-values are inside parentheses. **Note** that for Model 4 the *solved* long run coefficients are displayed. The diagnostic statistics are described as follows: coefficient of determination (R^2); residual serial correlation ($AR\ \ F$); autoregressive conditional heteroscedasticity ($ARCH\ \ F$); heteroscedasticity ($HET\ \ F$); and normality ($NORM\ \ ^2$). The null distribution is given by ^{2} or F. Probability values are inside parentheses. NA indicates a test cannot be calculated due to data limitations.

Figure 1 - Actual and fitted EMP (Model 3), 1985-2000

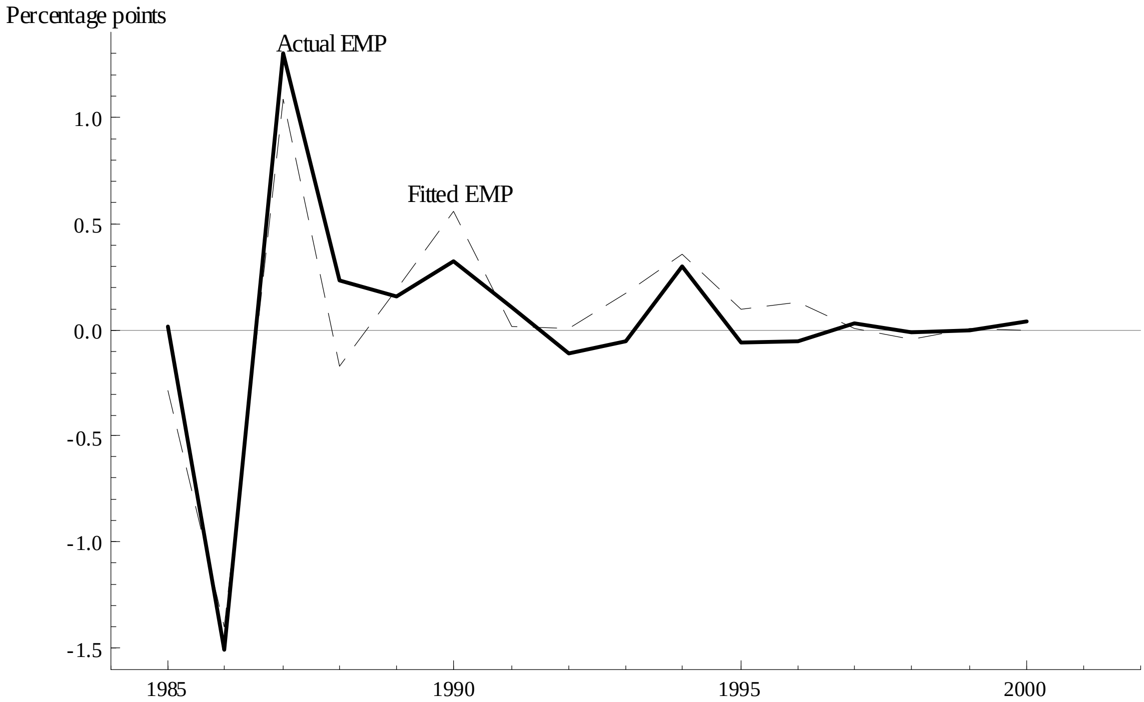

Figure 2 - EMP recursive coefficients and diagnostic statistics (Model 3)