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**ENDOGENOUS CREDIBILITY  
AND STABILIZATION PROGRAMS:  
EVIDENCE FROM THE DOMINICAN REPUBLIC**

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# **CREDIBILIDAD ENDOGENA Y ACUERDOS DE ESTABILIZACIÓN: EVIDENCIA PARA EL CASO DE LA REPUBLICA DOMINICANA\***

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## **Síntesis**

El trabajo analiza el impacto de los desajustes de política y las reformas estructurales sobre la credibilidad y el éxito de un acuerdo de estabilización en controlar la inercia inflacionaria. El acuerdo adoptado por la República Dominicana en el 1991 es empleado para verificar la hipótesis en cuestión, empleando técnicas econométricas de tipo recursivo. Los resultados de la investigación indican que una implementación errada de las políticas fiscal y monetaria deterioran la credibilidad, mientras que reformas estructurales, cuando son percibidas positivamente, mejoran la credibilidad contribuyendo a la estabilidad macroeconómica.

**Clasificación JEL:** E5; F3.

**Palabras clave:** inercia inflacionaria, credibilidad, programa de estabilización, FMI, modelos recursivos.

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**Abstract**

This paper analyzes the impact of policy misalignments and structural reform policies on credibility and the long-term success of a stabilization program (SP) to reduce inflationary inertia. A controlled-signal state-space model is used to test this hypothesis for the Dominican Republic, a country that introduced an SP in the early 1990s. The results indicate that fiscal and monetary malpractice will deteriorate credibility whereas structural reform policies, when perceived as beneficial, will enhance credibility contributing to economic stability.

**JEL classification:** E5; F41

**Keywords:** Inflationary inertia, credibility, stabilization programs, IMF state-space models.

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## 1. Introduction

It is argued that the long term thrive of any stabilization program (SP) depends crucially on maintaining a high degree of credibility over the executed policies. In an appealing article, Agénor and Taylor (1992) developed a two-step approach, using a proxy of a credibility variable, to test for credibility effects, by means of the Kalman filter, during the *cruzado* stabilization plan implemented in Brazil. The approach suggests, as predicted by theory, that inertial inflation is significantly dependent on credibility, and guidance is given to the development of improved techniques for measuring credibility when analyzing stabilization programs.

Subsequently, Edwards (1998) uses a rational wage-setting model for the Chile and Mexico stabilization plans, isolating the credibility component inherent in inertial inflation, and tests, without means of external proxies, the impact that changes in credibility have over inflation and exchange rate dynamics. Both analyses, although extremely helpful in verifying the empirical relevance of credibility over inertia, offer no references as to what fundamentals influence credibility after a program is implemented.

Recent research on credibility using panel data for the European Exchange Rate system (see Knot *et al.*, 1998) has shown that expected inflation resulting from monetary misalignments, and budget deficits resulting from fiscal misalignments, are direct determinants of credibility. This paper extends Edwards (1998) approach alongside Agénor and Taylor (1992), by endogenising credibility under these assumptions, testing how government behavior and reforms might influence *ex-post* credibility, and, as a consequence, the long term failure or success of a stabilization program. A controlled-signal state-space model (see Koopman, et. al., 1999) is applied to the Dominican Republic (DR).

The relevance of the present investigation unfolds from two important issues. Firstly, the contrasting scenarios characterizing the DR after implementing a successful SP in the early 1990s.<sup>1</sup> If the factors that affect credibility can be isolated, the model could be efficiently used to evaluate policy in general and structural reform policies in particular. The second issue relies on providing additional reference on the use of these techniques in the study of credibility dynamics, especially in the context of emerging market economies.

## 2. A state space model of inflationary inertia and credibility

There are numerous ways of formally modeling inflationary inertia (see, Arkerlof and Yellen, 1985, and Bruno, 1991). Edwards (1998) approaches the problem using a model that allows wages to be set rationally, and letting inertia emerge from the feedback rules used by the monetary authorities. It is assumed that the economy produces two goods: tradable and non-tradable. Tradable prices are related to international prices under the law of one price, while non-tradable are assumed to be determined by domestic conditions of supply and demand. Defining inflation as an average of these prices gives

$$\pi_t = \delta_t + \pi_t^* + \lambda z_t + \phi_t, \quad (1)$$

where  $\pi_t$  is the domestic inflation rate,  $\pi_t^*$  is the foreign inflation rate,  $\delta_t$  is the devaluation of the nominal exchange rate,  $z_t$  is a measure of monetary misalignments and  $\phi_t$  is a supply shock with mean zero and finite variance.

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<sup>1</sup> After a historical inflation high of eighty percent in 1990, the DR engaged in a structural reform process aimed at controlling inflation and devaluation by a stabilization program designed over a managed floating exchange rate target methodology. The new reform was based on restrictive fiscal and monetary policies, a radical tariff reform in order to have a compatible structure with the *Caribbean Commercial Trade Agreement*, and a complete privatization of the state-owned companies in order to rule out inefficiencies and bring about foreign investment. Fiscal and monetary policies were conducted in order to maintain internal balance and to control the exchange rate according to a predetermined target. The Central Bank intervened in the foreign exchange market by selling foreign currency in order to discourage devaluation expectations. The reforms were successful in reducing inflation inertia (see Young *et al.*, 1999).

Additionally, it is assumed that the monetary authorities adjust the nominal exchange rate according to international price differentials, and minimize a loss function in the misalignment of the inflation rate and the real devaluation rate.<sup>2</sup> In this framework, the optimal nominal devaluation rule is given by

$$\delta_t = \theta(1 - \mu)(\pi_{t-1} - \pi_{t-1}^*) + (1 - \mu)\varepsilon_t, \quad (2)$$

where  $\mu \in (0, 1)$  measures the authorities preferences between inflation and exchange rate targets.<sup>3</sup>  $\theta > 0$  is an inertial response, and  $\varepsilon_t$  is an identical and independently distributed random term representing expectations about future changes in the equilibrium exchange rate.

Under a crawling peg regime, in which the authorities pay little attention to domestic inflation (i.e.,  $\mu = 0$ ), the devaluation rule is given by

$$\delta_t = \theta(\pi_{t-1} - \pi_{t-1}^*) + \varepsilon_t, \quad (3)$$

and inflation becomes

$$\pi_t = \theta(\pi_{t-1} - \pi_{t-1}^*) + \pi_t^* + \lambda z_t + \phi_t. \quad (4)$$

Note that domestic inflation will converge to foreign inflation as long as  $z_t = 0$  and  $\theta < 1$ .<sup>4</sup> The introduction of an SP, on the other hand, is interpreted as a change in the authority's preferences going from exchange rate targeting towards inflation targeting (i.e.,  $\mu = 1$ ). Under this policy, the optimal path for

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<sup>2</sup> The real devaluation rate is defined as  $s_t = \delta_t + \theta(\pi_{t-1} - \pi_{t-1}^*)$ , where, without loss of generality, price differentials are assumed to have a lag of one period effect over the real exchange rate. The empirical results (see Table 3) are consistent with this lag structure.

<sup>3</sup> Assuming that the loss function is given by  $L_t = \mu(\pi_t - \pi_t^*)^2 + (1 - \mu)(s_t - \varepsilon_t)^2$ , where  $s_t$  is the percentage change of the real exchange rate, the introduction of a stabilization program could be interpreted as a change in the authorities preferences in terms of policy targets (i.e., changes in  $\mu$  going from a value close to zero to a value close to one).

<sup>4</sup> Note that the speed of convergence will depend on the value of  $\theta$ . If a situation of full backward adjustment exists (i.e.,  $\theta \geq 1$ ), inflation will have a unit root, no anchor will be possible, and there will be no room for stabilization efforts.

the nominal exchange rate is given by

$$\delta_t = 0, \quad (5)$$

and inflation becomes

$$\pi_t = \pi_t^* + \lambda z_t + \phi_t. \quad (6)$$

The transition between these two policies will depend on the credibility placed by agents on the newly implemented policies. If agents, doubting that the new policies will be maintained, attribute a value  $q_t \in (0,1)$  to the probability that the stabilisation regime will be abandoned, implies a nested model of the form

$$\pi_t = q\theta(\pi_{t-1} - \pi_{t-1}^*) + \pi_t^* + \lambda z_t + \phi_t, \quad (7)$$

where  $q\theta$  measures the degree of inflationary inertia in the economy. If agents have full credibility (i.e.,  $q = 0$ ), inertia will disappear. If, however, agents lack credibility (i.e.,  $q = 1$ ), and  $\theta \geq 1$ , (7) will have a unit root and inflation becomes explosive.

Following Knot *et al.* (1998), it is assumed that credibility deteriorates with monetary expansions ( $\Delta m_t$ ) and with positive changes in the budget deficit ( $\Delta x_t$ ), whereas it is unambiguously affected by structural reform policies. Using Agénor and Taylor (1992), and Koopman's *et al.* (1999) insights, these aggregate economic variables and reform dummies are included as controls in the state equation. In this setup, the state-space representation of equation (7) becomes

$$\begin{aligned} \pi_t - \pi_t^* &= \theta q_t (\pi_{t-1} - \pi_{t-1}^*) + \lambda z_t + \phi_t, \\ \theta q_{t+1} - \theta q_t &= \zeta_0 + \zeta_1 (\Delta m_t + \Delta x_t) + \Pi_t \Gamma + v_t, \end{aligned} \quad (8)$$

where  $\Gamma$  is a coefficient matrix, and  $\Pi t$  is a vector of structural reform dummies. The  $\zeta_1$  coefficient should be positive provided that any monetary misalignment and increases in the government deficit should signal political instability that could compromise the stabilization program.<sup>5</sup> On the other hand, the  $\Gamma$  matrix could have a positive definite sub-matrix for reforms if they imply possible regime changes, and a negative definite sub-matrix if they imply extensions of the stabilization program.

### 3. Empirical results

Equation (8) and an error feedback (EF) equation on real money balances were estimated for the DR. Data for real GDP ( $Y$ ), real M1 ( $M$ ), real government deficit ( $X$ ), changes in CPI ( $\pi$ ), foreign inflation ( $\pi^*$ ) approximated by the quarterly percentage changes of the United States (US) CPI, and the DR\$/US\$ exchange rate ( $E$ ) were used. The data is quarterly and seasonally adjusted for the period between the first quarter of 1985 and the fourth quarter of 1995. The sources of the data are the Central Bank of the DR and the IMF International Financial Statistics (see appendix for further details).

The estimation of the model can be summarized as follows. Firstly, a money demand equation was estimated using Bårdsen's (1989) EF transformation. The endogenous variable was the log of real M1 ( $m$ ), and the forcing variables were the log of real GDP ( $y$ ), and the log of the exchange rate ( $e$ ).<sup>6</sup> Secondly, the state-space model, equation (8), was estimated using the residuals ( $z$ ) from the EF model as a measure of monetary misalignments.<sup>7</sup>

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<sup>5</sup> Equation (8) takes provision for the possibility that monetary and fiscal policies, especially in emerging market economies, are correlated (see footnote 12).

<sup>6</sup> The devaluation of the exchange rate was used as a proxy of the cost of holding money considering that in many developing economies, devaluation expectations influence the decision of holding real money balances (see Agenor and Khan, 1996). The cointegration property of the EF structure was verified using an ADF unit root test (see Table 1).

<sup>7</sup> The residuals from an alternative money demand specifications using Carruth and Sánchez-Fung (2000) was tested and found consistent with the above specification.

Finally, the forecasted measure of credibility supplied by the state equation was regressed simultaneously against the growth rate of real M1 ( $\Delta m$ ), the growth rate of the real government deficit ( $\Delta x$ ), and to structural reform dummies ( $\Gamma$ ). Table 2 and 3 summarize the results.

Equation (9) is the demand for money and its steady state transformation. It is consistent with Friedman's (1956) quantity theory version as the coefficient on real output is not statistically different from unity [ $\chi^2 = 11.87$ ,  $p < 0.01$ ]. The impact of the exchange rate devaluation is negative and about 0.8.<sup>8</sup> In addition, relevant statistics and diagnostics are also acceptable. Equations (10) and (11), on the other hand, is the state-space model with both the signal and state equations. The signal equation indicates that monetary misalignments, as measured by the residuals of the money demand EF equation, are a significant driver of the inflation gap. The impact, with a two quarter lag effect, is high and about two thirds of a percentage point for every point that money supply exceeds demand. The lagged dependent variable, which has the coefficient that measures inflation inertia, is also significant and consistent with Edwards (1998). The SP was announced in the fourth quarter of 1990, signed in August of 1991, and fully implemented with a fiscal reform in February of 1992. The results suggest that the announcement of a stabilization program is not a sufficient condition to reduce inertial inflation, although it reduces inflation itself. This appears to be the case, since inflation dropped when the IMF program and its implications, with a direct control over monetary aggregates, were announced in 1991 (see Figure 1), while the recursive coefficient on lagged inflation only dropped when the fiscal reform was actually implemented in 1992 (see Figure 2).<sup>9</sup>

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<sup>8</sup> If the devaluation rate is capturing the cost of holding money as well as a measure of country risk, and if agents are risk adverse, then it is plausible to believe that the relationship is negative and significantly high.

<sup>9</sup> The F-statistic ( $F = 40.64$  with  $p < 0.01$ ) and the LR-statistic ( $LR = 40.2030$  with  $p < 0.01$ ) of a

The endogenous state (credibility) equation on the other hand, which in deviation form measures the probability that agents attribute to the abandonment of the stabilization program,<sup>10</sup> shows some additional interesting results.<sup>11</sup> It provides evidence that monetary and fiscal misalignments have a highly significant adverse impact over credibility.<sup>12</sup> Increases in government deficit are usually associated with financial instability and signal the possible abandonment of the SP. On the other hand, and due to the interdependence between fiscal and monetary policy in the DR, accelerated supply of money is either associated with fiscal imbalances or to inflation.

Finally, structural reform dummies for the post-electoral period of 1990 were also tested. A dummy trying to capture a fiscal reform aimed at balancing the budget in compliance with the IMF macroeconomic guidelines was included for the second quarter of 1993.<sup>13</sup> The dummy had a significant negative sign, indicating that the reform was perceived as beneficial to economic stability. As a matter of fact, the initial policies and several announcements in favor of commitment by the government, added support to the stabilization efforts that started in early 1991 (see Young, et. al, 1999).<sup>14</sup> In this regard, a dummy for the second quarter of 1993 was included to capture an extension of the program signed in July of that year. The dummy was also significant and with the expected negative effect. In general, the results and

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Chow break point test, confirms a structural break that started in the third quarter of 1990.

<sup>10</sup> This is the case under the assumption that  $\theta$  remains fairly constant through the sample period.

<sup>11</sup> As a note, higher values of  $q$  imply higher probabilities of abandoning the program and vice versa.

<sup>12</sup> Given that monetary policy in the DR is highly depended on fiscal objectives, and in order to avoid autocorrelation problems, a combined measure of the growth of real M1 and the growth of the real deficit was used instead. A lag of one period on the real deficit provided a better model in terms of its information criteria.

<sup>13</sup> A tax reform, approved in 1992, modified the income tax from specific to *ad valorem*. On the expenditure side, food subsidies and capital outlays were removed. These modifications shifted the deficit from a 1% of total GDP to an average 3% surplus in 1993.

<sup>14</sup> The newly elected government embraced a communication policy of transparently informing agents about their macroeconomic objectives, which according to the results, was credible and successful. Nolan and Schaling (1996) showed that if agents are certain about the social planners' target preferences, inflation expectations are likely to be lower.

theoretical assumptions appeared to be in accordance with the Dominican reality.

#### **4. Concluding remarks**

This paper has analyzed, using a controlled-signal state-space model, the effects of macroeconomic policy misalignments and structural reform policies over credibility and its importance in sustaining a stabilization program. The results suggest that the high degree of correlation between policy conduct and credibility could account as an instrument for controlling inflation, and should be taken into consideration when evaluating policy and/or reform programs. For the specific case of the DR, it was found that credibility deteriorates with monetary expansions and government deficits. Also, the results indicate that structural reforms, when perceived as favorable, will have beneficial effects over inflation inertia. In general, if governments incur in policy malpractice, strong negative effects over credibility, inertia, and economic stability will arise.

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**Appendix**

The source of the DR GDP, CPI, the exchange rate, M1, and central government deficit is the Central Bank of the Dominican Republic (*Boletín Mensual del Banco Central*, various volumes). The US CPI is taken from the International Monetary Fund's (*International Financial Statistics*, various volumes). Small caps in the text denote logs. Real variables were indexed to the first quarter of 1986. The nomenclature is as follows:

- E* (RD\$/US\$) unofficial ('black') market exchange ('sell') rate. Quarterly data based on monthly averages. Monthly observations based on a five-day weekly average.
- P* CPI of the DR, (1986=100).
- P\** CPI of US, (1986=100).
- M* Real notes and coins outstanding of DR. Quarterly frequency. Deflated to the third quarter of 1986.
- Y* Real GDP of DR. Quarterly frequency. Deflated to the third quarter of 1986.
- X* Real central government deficit of DR. Quarterly frequency. Deflated to the third quarter of 1986.

**Table 1****Augmented Dickey Fuller (ADF) test for unit root**

Variable	ADF(1) test statistics (constant included)
$(m-p)$	0.25
$\Delta(m-p)$	-2.77*
$y$	-1.01
$\Delta y$	-4.40**
$e$	-1.90
$\Delta e$	-2.55
$\Delta^2 e$	-5.16**

*Note:* \* and \*\* denote significance at the 5% and 1% levels respectively. Critical values based on MacKinnon (1991) response surface. The results indicate that  $m$ , and  $y$  are I(1), while  $e$  is I(2).

**Table 2**  
**ADL on real money balances (1985:1-1995:4)<sup>†</sup>**

(9) $\Delta m_t = \alpha_1 \Delta(m-p)_{t-1} + \zeta_{10} \Delta y_t + \zeta_{11} \Delta y_{t-1} + \alpha_2 m_{t-2} + \zeta_{12} y_{t-2} + \zeta_{22} \dot{e}_{t-2}$ $m = \theta_1 y + \theta_2 \dot{e}$				
Parameters	Coefficients	S.E	N	LL
$\alpha_1$	0.46	0.15	42	53.05
$\alpha_2$	-0.21	0.07		
$\zeta_{10}$	0.15	0.05		
$\zeta_{11}$	0.08	0.05		
$\zeta_{12}$	0.21	0.07	ADF	PP
$\zeta_{22}$	-0.37	0.15	-4.25**	-5.29**
$\theta_1$	1.03	0.07*		
$\theta_2$	-0.78	0.04*		

† Estimated using IV OLS. Instruments based on lagged endogenous and exogenous variables from SS model (see Table 3).

\* Estimated using  $\text{var}(\hat{\theta}_j) \cong \left( \frac{1}{-\hat{\alpha}_j} \right)^2 \text{var}(\hat{\zeta}_{m_j}) + \left( \frac{\hat{\zeta}_{m_j}}{\hat{\alpha}_j} \right)^2 \text{var}(\hat{\alpha}_j) + 2 \left( \frac{1}{-\hat{\alpha}_j} \right) \left( \frac{\hat{\zeta}_{m_j}}{\hat{\alpha}_j} \right) \text{cov}(\hat{\alpha}_j, \hat{\zeta}_{m_j})$

\*\* Significant at the 1% level under the standard critical surface.

**Table 3****State-space (SS) model on inflation and credibility (1985:1-1995:4) <sup>† †</sup>**

(10) $\hat{\pi}_t - \hat{\pi}_t^* = \theta q_t (\pi_{t-1} - \pi_{t-1}^*) + \lambda z_{t-2}$				
(11) $\Delta \hat{q}_{t+1} = \zeta_0 + \zeta (\Delta m_t + \Delta x_{t-1}) + \Gamma_1 Dum(92:2) + \Gamma_2 Dum(93:2)$				
Parameters	Coefficients	S.E.	N	LL
$\lambda$	0.65	0.18	41	46.81
$\zeta_0$	0.45	0.06		
$\zeta_t$	0.43	0.05	-5.66**	-6.17**
$\Gamma_1$	-0.45	0.16		
$\Gamma_2$	-0.23	0.15		

<sup>††</sup> Estimated using maximum likelihood with diagonal covariance matrix for both signal and state equations.

\*\* Significant at the 1% under the standard critical surface.

*Note:* In order of appearance, N is the number of observations adjusted for end points, LL is the value of the Log Likelihood function, ADF is the Augmented Dickey and Fuller unit root test, and PP is the Phillip and Perron unit root test (see Hamilton (1994) for further details).

Figure 1

Smoothed signal estimate of the DR inflation gap (adjusted sample)

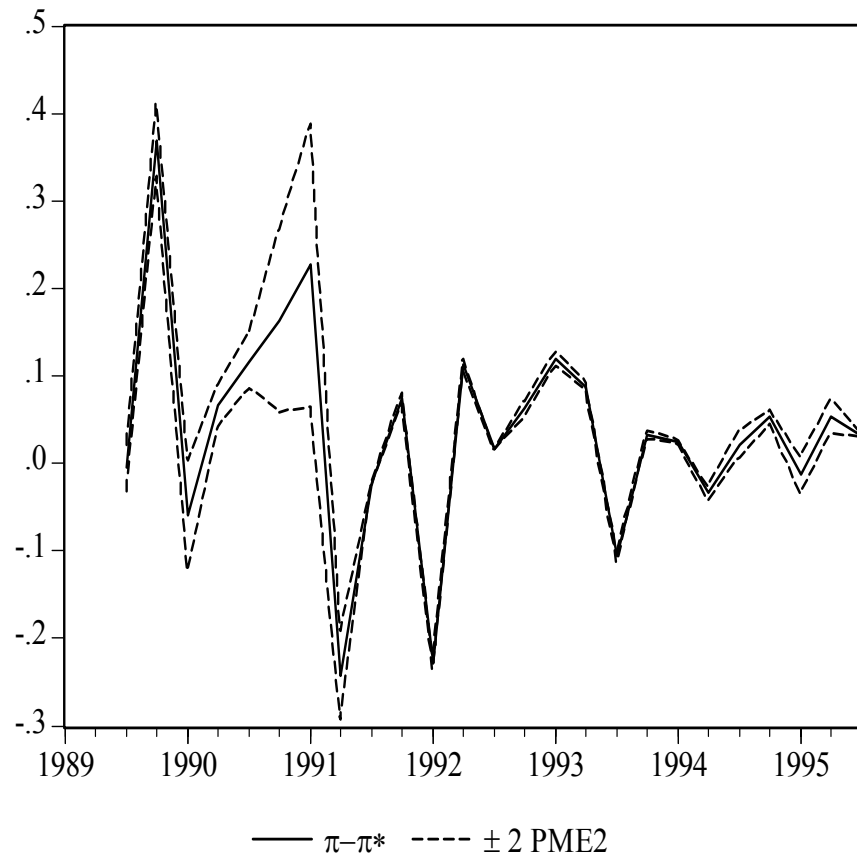


Figure 2

Smoothed state estimate of credibility (adjusted sample)

