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Disinflation and the Recession-Now-Versus-Recession-Later Hypothesis: Evidence from Uruguay

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Abstract

Both analytical models and casual empiricism suggest that the timing of the recessionary costs associated with inflation stabilization in chronic inflation countries may depend on the nominal anchor which is used. Under money-based stabilization, the recession occurs at the beginning of the program, while under exchange rate-based stabilization the recession occurs later in the program. This paper provides a first attempt to formally test this hypothesis using a vector-autoregression model for Uruguay. The impulse response of output to different stabilization policies is broadly consistent with the "recession-now-versus-recession-later" hypothesis. The evidence also suggests, however, that the effectiveness of a monetary anchor in reducing inflation is hindered by the high degree of dollarization of the Uruguayan economy.

JEL Classification Numbers:
E3, E5, C3

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Summary

Casual empiricism suggests that the timing of the recessionary costs associated with an inflation stabilization program depends on the nominal anchor used. While under money-based stabilization the recession occurs in the early stages of the program, under exchange rate-based stabilization the recession appears to take place in the late stages of the program. The choice of a nominal anchor would thus entail a choice between recession now (money anchor) or recession later (exchange rate anchor).

This paper offers empirical evidence on the "recession-now-versus-recession-later" hypothesis for the case of Uruguay, a chronic inflation country. Formally, the paper estimates a vector-autoregression model (VAR), which includes the rate of depreciation, the rate of monetary growth, inflation and output, and controls for Argentina's influence on the Uruguayan economy. This VAR model is used to simulate the output response to both a money-based and an exchange rate-based stabilization. Technically--and departing from standard practice--the model is subjected to a series of innovations of the policy variable to ensure that it follows a predetermined path.

The impulse responses for output indicate that a money-based stabilization results in an initial contraction, while a (temporary) exchange rate-based stabilization leads to an initial expansion followed by a later contraction. The econometric evidence is thus broadly consistent with the recession-now-versus-recession-later hypothesis. Furthermore, the evidence suggests that the high degree of dollarization of the Uruguayan economy may hinder severely the effectiveness of a monetary anchor.

I. Introduction

In an open economy, the nominal anchor in a disinflation program may be either the exchange rate (exchange rate-based stabilization) or a monetary aggregate (money-based stabilization). In traditional open-economy models, disinflation is expected to cause an initial recession regardless of the nominal anchor which is used (see, for instance, Fischer (1986) and Chadha, Masson and Meredith (1992)). Therefore, the choice between the two nominal anchors is usually based on a comparison of the "sacrifice ratio" (i.e., the cumulative output loss per percentage point reduction in inflation) needed to achieve disinflation. By examining the sacrifice ratio under different parameter configurations, Fischer (1986) concludes that the exchange rate should be the preferred nominal anchor.

The exchange rate-based programs of the late 1970's (the so-called "Tablitas") in Argentina, Chile, and Uruguay challenged the conventional notion that disinflation is always and everywhere contractionary. In effect, an important expansion in real economic activity characterized the first years of these programs. The recessionary costs traditionally associated with disinflation appeared only later in these programs. Inspired by the Argentine Tablita, Rodriguez (1982) first formalized the pattern of an initial boom and a later recession in an exchange rate-based stabilization in the context of a reduced-form, adaptive-expectations model. The Southern-Cone programs thus raise the intriguing possibility that choosing between the exchange rate and the money supply as the nominal anchor in a disinflation program may imply choosing the timing of the accompanying contraction. Under money-based stabilization, the costs would be paid up front (recession now), whereas under exchange rate-based stabilization, the costs would be paid later (recession later).

The heterodox programs of the mid-1980's in Argentina, Brazil, Israel, and Mexico brought to the forefront once again the issue of the real effects of disinflation in chronic inflation countries. A similar pattern of an initial boom followed by a later recession was observed even in successful programs such as that of Israel. In fact, Kiguel and Liviatan (1992) and Végh (1992) have argued that this boom-recession pattern has characterized most exchange rate-based stabilizations in chronic inflation countries since the 1960's. In the meantime, Calvo and Végh (1990) revisited the main issues from an analytical point of view, and rationalized the recession-now-versus-recession-later hypothesis in terms of a perfect-foresight, optimizing model. 1/

If true, the recession-now-versus-recession-later hypothesis should have major implications for stabilization policy in chronic inflation countries, since it would imply that policymakers may have the ability to choose when to bear the costs of disinflation. Thus, policymakers could opt for one nominal anchor over the other depending on, say, political-economy or external considerations. Lame-duck governments,

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1/ See Uribe (1994) for a welfare analysis of money- versus exchange rate-based stabilization.

for example, would prefer exchange rate-based stabilization, while a new administration might prefer money-based stabilization so as to bear the costs of disinflation while it still enjoys high popular support.

Despite its importance, there has been little, if any, econometric work aimed at corroborating or disproving this hypothesis. The existing empirical evidence consists of anecdotal evidence or, at best, an organized presentation of the relevant data (see Calvo and Végh, 1994a). Although such stylized facts are certainly suggestive of underlying "true" phenomena, they are subject to some obvious shortcomings. First, it is not clear whether expansions or recessions are really such since there is no formal distinction between trends and cycles. Second, no attention is paid to the time-series properties of the different variables. Third, major stabilization programs are often accompanied by important structural reforms (i.e., trade and financial liberalization, and public-sector reform) which tend to obscure the purely monetary effects. Fourth, exogenous shocks--such as the rise in world real interest rates in the early 1980's or the Intifada in Israel--also make it difficult to ascertain the extent to which the observed real effects are due to the stabilization.

The purpose of this paper is to provide econometric evidence on the recession-now-versus-recession-later hypothesis for Uruguay. The choice of Uruguay was motivated by the fact that it constitutes a textbook example of a chronic inflation country. Uruguay has been suffering from high--relative to industrial countries--and persistent inflation since the early 1940's (Figure 1). The inflationary history of Uruguay begins in 1939--when the adoption of the "real bills doctrine" paved the way for a period of credit-propelled inflation--worsens in the early 1960's fueled by increasing fiscal deficits; and continues up to the present with inflation still above 40 percent a year. Repeated attempts to get rid of chronic inflation have met with only temporary success, and inflation has normally come back with a vengeance (see Figure 1). 1/ Thus, given its history of chronic inflation and repeated anti-inflation efforts, Uruguay appears to constitute an almost ideal testing ground for the real effects of disinflation in chronic inflation countries. 2/

The guiding principle behind our econometric exercise is to perform a controlled, model-free experiment of disinflationary policy under alternative nominal anchors, aimed at isolating the "true" real effects. Formally, we first estimate a standard vector-autoregression (VAR) model in the tradition of Sims (1980) which includes four variables: the rates of exchange rate depreciation, money growth, and inflation, and cyclical

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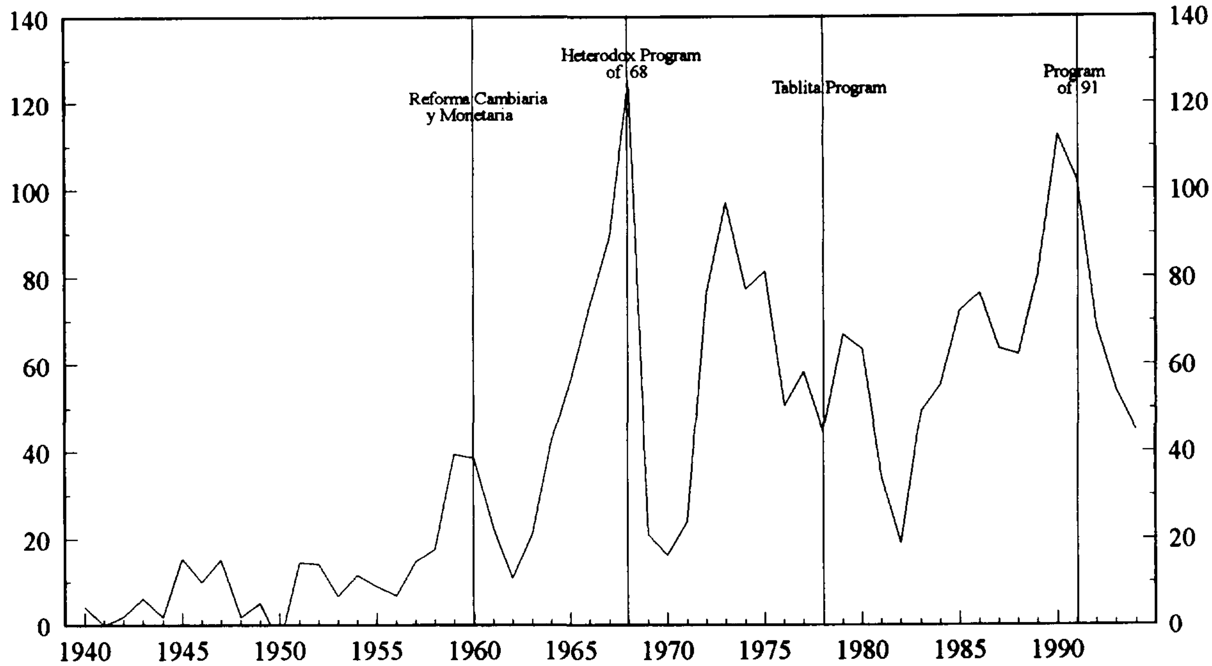
1/ See, among others, Academia Nacional de Economía (1984), Blejer and Gil-Díaz (1986), Díaz (1984), Finch (1979), Hanson and de Melo (1985), Patrón (1986), Talvi (1994), Végh (1992) and Viana (1990).

2/ This is in contrast to countries such as Argentina and Brazil, where extreme inflation variability in the second half of the 1980's makes problematic the application of standard econometric techniques over a prolonged period of time.

Figure 1. Uruguay: Inflation Rate, 1940-94 [1]

(Percent Change)



Source: IMF, International Finacial Statistics.

[1] Vertical bars indicate the beginning of the main stabilization programs.

output. We then compute the impulse responses of the different variables to permanent and temporary changes in the rate of devaluation (exchange rate-based stabilization) and the rate of monetary growth (money-based stabilization). Technically--and departing from standard practice--we subject the model to a series of innovations to the policy variable to ensure that it follows a predetermined path, along which the rate of growth of the policy variable is temporarily or permanently lower.

The impulse responses for output indicate that a money-based stabilization (MBS) leads to an initial contraction, while an exchange rate-based stabilization (EBS) results in an initial expansion. When the reduction in the rate of devaluation is permanent, output remains above its full-employment level throughout the program. When the exchange rate-based stabilization is temporary, however, the initial expansion is followed by a later contraction. In all cases, the output effects are found to be "significant," using confidence bands constructed along the lines of Blanchard and Quah (1989). Therefore, the results are consistent with the recession-now-versus-recession-later hypothesis in the sense that a money-based stabilization causes an initial recession, while a (temporary) exchange rate-based stabilization causes an initial expansion followed by a later contraction.

While a money-based disinflation leads to an initial recession and a gradual fall in inflation regardless of the monetary aggregate which is used in the estimation (M1, M2, or M3), the speed of disinflation critically depends on the choice of the monetary aggregate. The key difference between the various monetary aggregates is that M3 (as defined for the purposes of this paper) includes foreign-currency deposits of resident sectors other than the central government. 1/ The impulse responses show that inflation falls considerably more slowly over time when M1 or M2 is used, instead of M3 (or the exchange rate), suggesting that the monetary aggregates that policymakers can effectively control (i.e., M1 and M2) lose much of their effectiveness in a highly dollarized economy. Thus, our findings provide empirical support for the idea that a high degree of dollarization would favor the exchange rate as the nominal anchor (see, for instance, Calvo and Végh (1992)).

The paper proceeds as follows. Section II presents the estimation of the VAR model for Uruguay. Section III discusses the impulse responses, the robustness of the results, and the role of Argentina. Section IV provides a discussion of several econometric issues that are relevant for the estimation and interpretation of the empirical results. Section V interprets the results in light of theoretical models. Section VI contains

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1/ As is well documented (see Rodriguez (1991) and Savastano (1992)), Uruguay is a highly dollarized economy, with foreign currency deposits of residents comprising roughly 69 percent of M3 at the end of 1993. If M3 is defined as including foreign-currency deposits of non-residents, the corresponding ratio as of end of 1993 rises to 80 percent.

concluding remarks. Econometric material not essential for the discussion is relegated to an Appendix.

II. A Vector-Autoregression Model for Uruguay

This section estimates a vector-autoregression (VAR) model for Uruguay. The model consists of four endogenous variables, an exogenous variable, and seasonal dummies. The VAR model can be expressed as 1/

$$C(L)x_t = \mu_t \qquad (1)$$

where C(L) is a 4 by 4 lag polynomial matrix of order p, defined as $C(L)=I-C_1L-C_2L^2-\ldots-C_pL^p$. The four endogenous variables (x_t) in the VAR model are cyclical output, the rate of inflation, the rate of exchange rate depreciation, and money growth. The cyclical output of Uruguay is measured as the deviation of GDP from a broken linear trend. 2/ The rates of inflation, exchange rate depreciation, and money growth are defined as the percentage change of consumer prices, the official exchange rate (in units of domestic currency per dollar), and M3, respectively. 3/ The reduced form innovation (u_t) has zero mean and covariance matrix Ω.

The exogenous variable in the model is Argentina's cyclical output, defined as the deviation of real GDP from a linear trend. Argentina is not only the most important trading partner of Uruguay, but also plays an important role in directly affecting aggregate demand and prices, given its physical proximity and much larger economic size. Hence, taking into account the effect of Argentina's aggregate demand on Uruguay's output is

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1/ For notational simplicity, the deterministic components (i.e., the exogenous variable and seasonal dummies) in equation (1) have been suppressed. The (quarterly) seasonal dummies were defined in the standard way.

2/ Blanchard and Quah (1989) also use a broken linear trend in their model of the United States. In the case of Uruguay, the break in the trend occurs after the abandonment of the "tablita" in the fourth quarter of 1982.

3/ Quarterly data from 1978:Q2 to 1990:Q4 were used (see the Appendix for data sources). M3 includes foreign currency deposits of resident sectors other than the central government. Section III discusses how the results change when M1 and M2 are used.

important in order to isolate the output effects of inflation stabilization. 1/

1. Time-series properties

Before proceeding to estimate the VAR model, the time-series properties of the different variables need to be examined to ensure efficient estimation. Standard unit root tests were used to determine the time-series properties of the different variables. These unit root tests suggest that all four endogenous variables, and the exogenous variable in the VAR model are stationary (see Table A1 in the Appendix). Specifically, the augmented Dickey-Fuller test supports this conclusion for all but two variables: inflation and the exchange rate depreciation. The Phillips-Perron test, however, suggests that all variables are stationary. Since the Phillips-Perron test was designed to deal with more general error structures and is more robust to heteroskedastic errors, we conclude that all variables in the VAR model are stationary.

2. Lag length

To estimate the model we need to specify the number of lags (i.e., the order of the lag polynomial matrix C(L), p) that are to be included. A number of criteria are available to determine the number of lags in a VAR model. Lutkepohl (1985) examines 12 tests and finds--using Monte Carlo simulations--that the Schwarz test and the Hannan-Quinn test choose correctly the order of the lag polynomial matrix more often than the other tests. Both of these tests compare the benefits of additional information obtained when p increases to the cost measured in terms of smaller degrees of freedom. The results from these tests suggest that the appropriate lag length is one (i.e., p=1, see Table A1 in the Appendix). 2/

1/ Argentina's output is roughly 20 times that of Uruguay. There are two alternative ways of capturing Argentina's impact. The first is to add a fifth equation to the VAR. In this case, no a priori information is added about the effect of Uruguay on Argentina. The second is to constrain the fifth equation so that the impact of Uruguay on Argentina is zero. This adds the a priori information that Uruguay's economy is unlikely to have an impact on Argentina. Although these alternatives are conceptually different, the results are very similar. The Appendix contains the results when alternative exogenous variables--the bilateral real exchange rate and the bilateral terms of trade--are used instead of Argentina's cyclical output.

2/ Recently Koreisha and Pukkla (1993) caution that both the Hannan-Quinn and the Scharz tests tend to underestimate the number of lags when the size of the VAR model increases. In particular, they suggest that Lutkepohl's results hold when the VAR model is small, i.e. for three endogenous variables. However, since our model has four endogenous variables, this problem is probably not important in this study.

3. Estimation

Since the VAR model contains stationary variables, efficient estimation is obtained with OLS estimates (see Campbell and Perron, 1991). Two sets of estimates are considered. 1/ The first set corresponds to the standard (unconstrained) estimates, while the second set is obtained by imposing fairly standard restrictions in theoretical macroeconomic models. In particular, the constraints imposed are: (i) long-run neutrality of nominal variables--namely, inflation, exchange rate depreciation, and money growth--and, (ii) long-run linear homogeneity of nominal variables. 2/ These restrictions are imposed in the estimation by setting the sum of the coefficients of nominal variables equal to zero in the output equation, and equal to one in the other equations (see Table 1). Note that these sets of estimates are very similar, and results using either set of estimates are virtually identical; the two main differences are that the rates of growth of nominal variables decline one for one with the decline in the nominal anchor, and that cyclical output returns to full employment in the long-run. Further note that these constraints are not rejected by the data, and are thus used to calculate the results provided in this paper.

VAR estimates are essentially dynamic reduced-form estimates and are difficult to interpret directly. Nonetheless, it is worthwhile pointing out two interesting features of the VAR estimates. First, estimates for the output equation suggest that, on impact, an exchange rate-based stabilization is expansionary, while a money-based stabilization is contractionary. Second, Uruguay's business cycle is significantly influenced by Argentina. However, looking at the coefficients of the VAR model can be misleading because variables move together (i.e., within the quarter) and these contemporaneous movements can alter these features. 3/ We thus turn to impulse responses for a complete picture of the dynamics of the economy.

III. Impulse Responses

The impulse responses calculated in this paper to characterize the dynamic responses of the economy to a stabilization program--while using standard VAR identification based on a contemporaneous ordering (see Sims (1980))--depart from standard practice by presenting the responses to a series of shocks. A typical inflation stabilization program consists in setting a lower growth rate of the nominal anchor--the exchange rate or a monetary aggregate--so that inflation eventually converges to this lower rate. Therefore, computing impulse responses to a single shock to a nominal

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1/ The coefficients of the seasonal dummies (not reported) are statistically significant.

2/ These long-run constrained estimates are in the spirit of the long-run restrictions used by Shapiro and Watson (1988).

3/ This is unlikely in our application, however, because contemporaneous correlations in our VAR model are small (see Table A1 in the Appendix).

Table 1. VAR Estimates, Constrained and Unconstrained, 62 Observations from 1975:Q3-90:Q4

(Standard Errors in Parenthesis) 1/

	Cyclical Output		Inflation		Exchange Rate of Depreciation		Money Growth	
	Unconstrained	Constrained	Unconstrained	Constrained	Unconstrained	Constrained	Unconstrained	Constrained
Coefficient of determination (R^2)	0.63	0.63	0.61	0.61	0.04	0.01	0.12	0.12
Adjusted R^2	0.61	0.61	0.58	0.59	0.02	0.01	0.06	0.07
Sum of squared errors	0.0599	0.0600	0.0488	0.0488	0.8657	0.9096	0.2057	0.2070
Standard error of estimate	0.0324	0.0322	0.0292	0.0290	0.1232	0.1263	0.0601	0.0597
Durbin Watson	2.00	2.01	2.65	2.66	1.98	1.96	2.37	2.35
Lagged Regressors								
Cyclical output	0.524**	0.529**	-0.031	0.043	-0.943**	-0.841**	-0.035	-0.051
	(0.104)	(0.102)	(0.100)	(0.092)	(0.397)	(0.407)	(0.193)	(0.190)
Inflation	-0.008	0.005	0.649**	0.655**	0.616**	0.877**	0.654**	0.611**
	(0.072)	(0.060)	(0.065)	(0.054)	(0.273)	(0.233)	(0.133)	(0.111)
Exchange rate depreciation	-0.104**	-0.100**	0.173**	0.175**	-0.091	-0.017	-0.109	-0.121**
	(0.038)	(0.036)	(0.034)	(0.032)	(0.144)	(0.140)	(0.070)	(0.067)
Money growth	0.100	0.095	0.173**	0.170**	0.242	0.140	0.493**	0.509**
	(0.070)	(0.068)	(0.064)	(0.062)	(0.268)	(0.266)	(0.131)	(0.127)
Argentine output	0.275**	0.274**	-0.031	-0.032	-0.078	-0.108	-0.075	-0.070
	(0.111)	(0.110)	(0.100)	(0.099)	(0.423)	(0.430)	(0.206)	(0.205)
Homogeneity Tests								
Sum of the coefficients of nominal variables	-0.012	0.000	0.995	1.000	0.767	1.000	1.038	1.000
F(1,57) 2/		0.113		0.027		3.113*		0.352
Significance level		0.739		0.871		0.083		0.555
Chi(4) 3/	6.041							
Significance level	0.196							

1/ Significance at 5 percent and 10 percent is denoted by (**) and (*) respectively.
2/ In the output equation, test refers to long-run neutrality of nominal variables; in the other equations the test refers to price homogeneity of degree one.
3/ Tests the joint hypothesis of the long-run neutrality and price homogeneity in the full VAR system.

anchor would not capture the dynamics of a stabilization program, since the nominal anchor would not follow a predetermined path. 1/

Technically, the series of shocks used to capture the impact of a stabilization program are computed as follows. The H-step innovation path used for the computation of the impulse response functions is constructed iteratively from H-1 impulse responses. The system is first shocked so as to obtain the desired reduction in the policy variable in period 0; this provides the first shock. This first impulse response function generates a period 1 response, which is used to calculate the second shock. The second shock is obtained as the difference between the period 1 response of the nominal anchor, and its predetermined path. Next a new impulse response function is calculated using these two shocks that guarantee that the nominal anchor is on the predetermined path in periods 0 and 1. The third shock is obtained as the difference between the period 2 response of the nominal anchor and its predetermined path, and so on. This procedure ensures that the policy variable follows a predetermined path, along which it increases at a lower rate. Note that each of these innovations are obtained such that they correspond to standard VAR analysis, i.e. they are orthogonalized using a Choleski lower factor.

The effects of different stabilization policies (i.e., temporary versus permanent and gradual versus shock) are characterized using four alternative predetermined paths for the nominal anchors: (i) permanent stabilization (a once and for all reduction in the rate of growth of the nominal anchor); (ii) temporary stabilization with gradual reversal (the rate of growth of the nominal anchor falls in period 0 and then gradually reverts over 10 quarters to its initial value; (iii) temporary stabilization with abrupt reversal (the rate of growth of the nominal anchors falls in period 0, stays at that lower level for 10 quarters, and then returns abruptly to its initial level); and (iv) gradual permanent stabilization (the rate of growth of the nominal anchor is gradually reduced to a lower level over a 10-quarter period. The ordering used for the impulse responses for exchange rate-based stabilization was exchange rate, money, prices, and output; for money-based stabilization, the ordering reverses money and the exchange rate. Such orderings are consistent with the spirit of the stabilization programs analyzed since they treat the policy variable as the most exogenous. 2/

1/ See, for instance, Leiderman (1993, Chapter 8) for an application of the standard procedure to disinflation in Argentina, Chile, and Israel.

2/ Confidence bands for the output responses are provided as a measure of the precision of the estimated impulse responses. Following Blanchard and Quah (1989), we calculate--based on 1000 bootstrap replications--the square root of the mean square deviation from the point estimate in each direction. Thus, the bands need not be symmetric and will contain, by construction, the point estimate.

1. Exchange rate-based stabilization

Consider first a reduction of 30 percentage points in the rate of exchange rate depreciation. 1/ The first exercise (see Figure 2 Panel A) assumes that the reduction is permanent. Output expands for around one year and then falls gradually towards its full-employment level. Inflation is quite persistent taking roughly two years to fall by 25 percentage points. The output response--provided in Table A2 in the appendix--remains essentially unchanged when a permanent, but gradual, reduction in the devaluation rate (in the spirit of the Southern-Cone Tablitas) is considered. The only difference is that, as one might have expected, the initial boom develops more gradually and lasts longer.

To illustrate a temporary exchange rate-based stabilization, the second exercise assumes that the rate of devaluation falls initially by 30 percentage points, and then gradually returns to its initial level over a period of 10 quarters (see Figure 2, Panel B). As in the previous case, there is an initial output expansion. Output reaches a peak after roughly four quarters, and then begins to decrease. After two years, the economy falls into recession as output falls below its full-employment level. Inflation falls by roughly 15 percentage points before beginning to increase. If one takes the difference between inflation and the exchange rate depreciation as a measure of real exchange rate appreciation, the exercise suggests that the initial expansion is accompanied by a sustained real exchange rate appreciation, while the later contraction is accompanied by real depreciation.

2. Money-based stabilization

Consider now the economy's response to a reduction in the rate of money growth of 30 percent. The first exercise assumes that the reduction is permanent (see Figure 3, Panel A). The impulse responses suggest that there is a large recession which lasts throughout the program, and inflation takes roughly a year to fall by 25 percentage points. In contrast, the rate of exchange rate depreciation falls roughly one to one with the rate of money growth on impact, but subsequently depreciates at a slower rate. The contraction is thus accompanied by real exchange rate appreciation, as the rate of depreciation remains below the rate of inflation for roughly two years. A similar output pattern--provided in Table A3 in the appendix--is observed when the rate of monetary expansion falls gradually over time. As one would expect, however, the recession develops gradually over time.

The impulse responses for a temporary money-based stabilization suggest that, as in the permanent case, there is an initial recession (Figure 3, Panel B). Output then quickly returns to its long-run full-employment level. Once again, using the difference between depreciation and inflation

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1/ As discussed below, a reduction of 30 percentage points in the rate of growth of the nominal anchor accords well with the historical experience of Uruguay.

as a measure of the evolution of the real exchange rate, the real exchange rate initially appreciates, and then depreciates as the rate of monetary expansion returns to its initial level.

The results discussed above use a monetary aggregate, M3, which includes the (domestic-currency value of) foreign currency deposits of residents. Since such an aggregate would be quite hard for the monetary authorities to control, the exercise has no direct policy relevance but provides an important conceptual benchmark. 1/ The important policy question is what would occur in a money-based stabilization using other monetary aggregates, such as M1 or M2, which in principle can be effectively controlled by the monetary authorities. 2/

The results obtained using these narrow monetary aggregates are qualitatively similar to those using M3; in particular, there is an output contraction and the rate of devaluation falls by more than the rate of inflation in the initial stages (see Figure 4). The magnitude of the output contraction, however, is smaller than before when M3 was used. Furthermore, there is a dramatic difference in the response of inflation. Inflation falls considerably more slowly following the 30 percent reduction in the rate of monetary expansion when either M1 or M2 is used. In fact, it takes inflation roughly 4 quarters to fall by 25 percent when M3 is used, while it takes inflation at least 30 quarters to fall by the same magnitude when either M1 or M2 is used. These results are in line with what one would expect: since either M1 or M2 is a small fraction of the "relevant" money supply (M3)--20.6 percent and 30.6 percent, respectively as of the end of 1993--a reduction in their rate of growth has little impact on inflation. Hence, these results suggest that a high degree of dollarization hinders the effectiveness of a monetary anchor in reducing inflation.

3. Robustness of results

The evidence presented is robust to changes in the ordering used to identify the orthogonal shocks. Reversing the order of money growth and the exchange rate depreciation--the two significantly correlated variables--does not change the qualitative results obtained for the impulse responses (see Appendix Tables A1 and A2). This is due to the fact that the contemporaneous correlations of the reduced form errors (u_t) are very small, and thus the (covariance) correlation matrix is almost diagonal (see Bernanke (1986), and Table A1, Panel C in the Appendix).

The results are also robust to expanding the model. Specifically, adding four endogenous variables--exports, imports, real effective exchange rate, and domestic interest rates--we find that a permanent exchange

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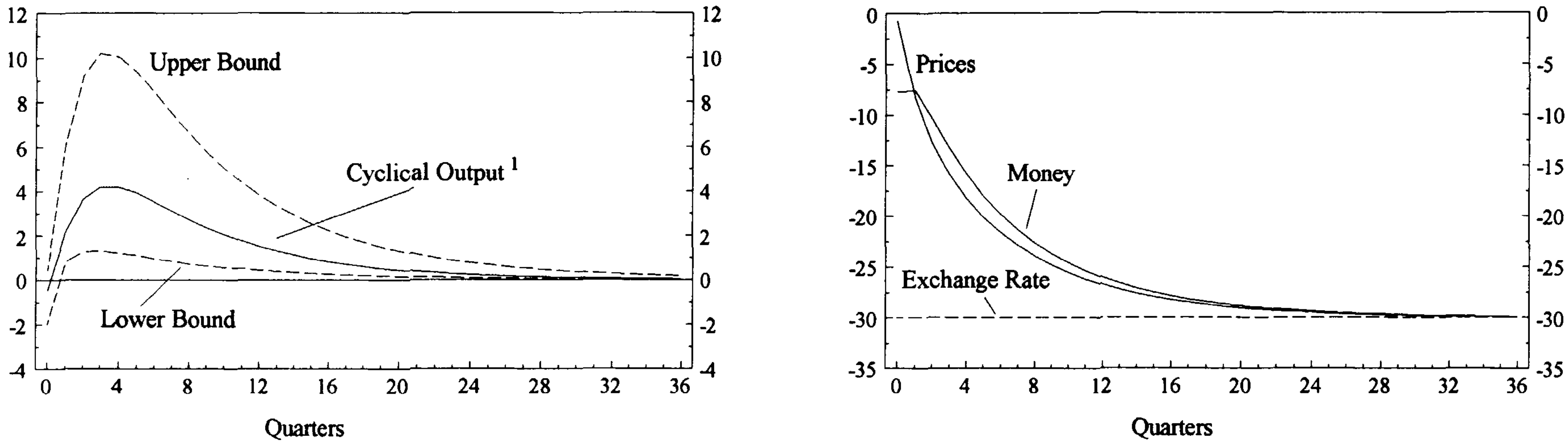
1/ Recall that 69 percent of M3 (or 80 percent if deposits of nonresidents are included) is denominated in dollars as of the end of 1993.

2/ The VAR was re-estimated using, alternatively M1 and M2, and the impulse responses were calculated as discussed before.

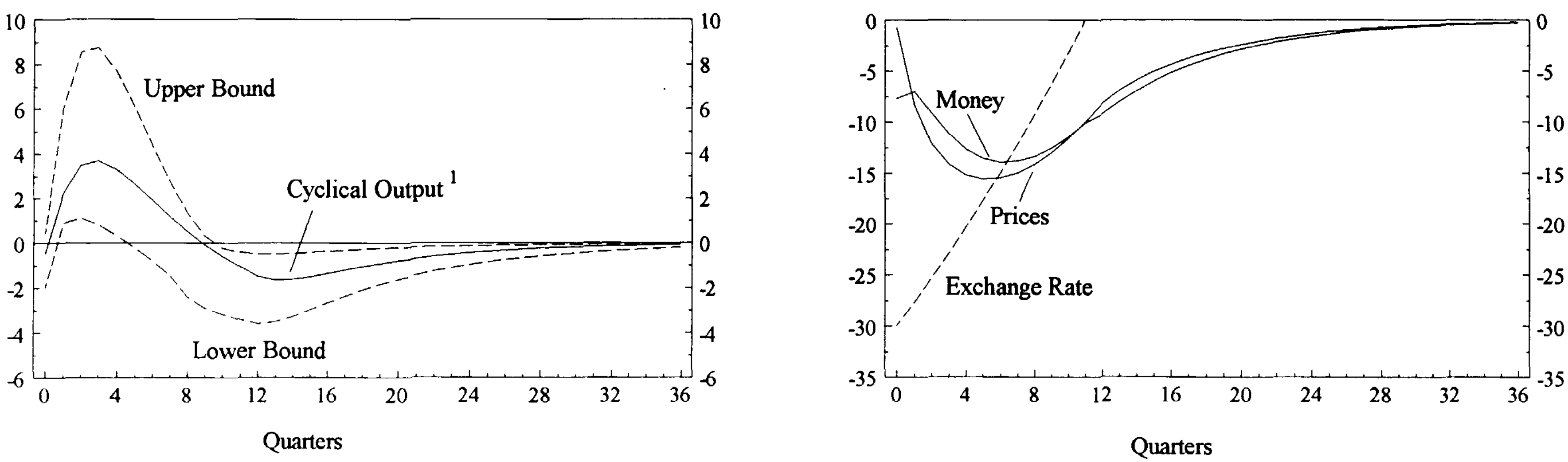
Figure 2. Exchange Rate-Based Stabilization

(Percent change, unless otherwise indicated)

A. Permanent



B. Temporary

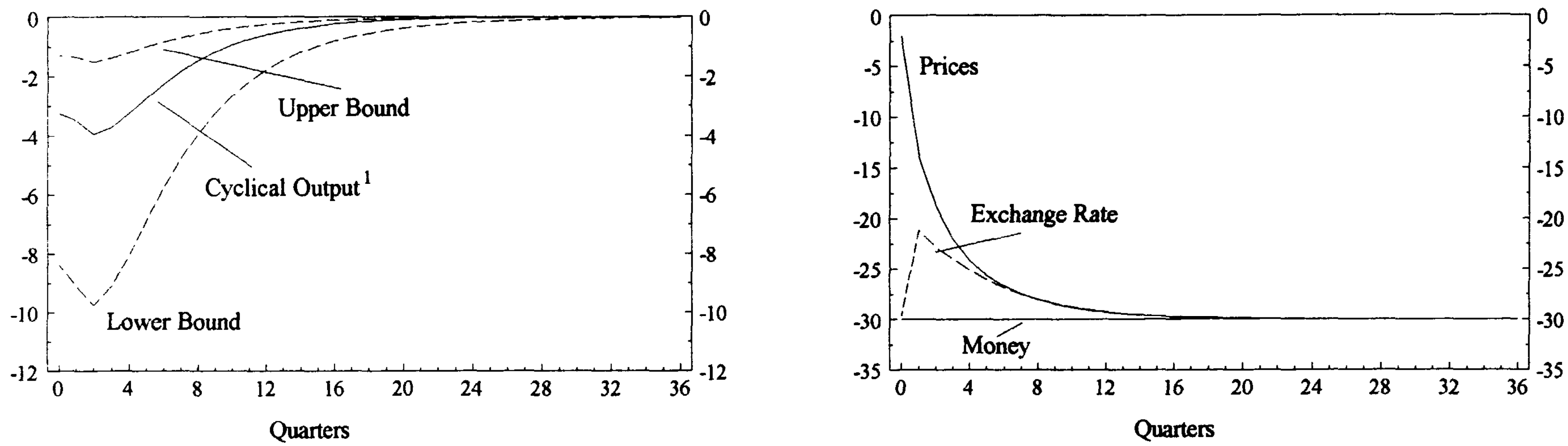


[1] Percent deviation from trend. Upper and lower bounds refer to one standard deviation of the impulse response, calculated using 1000 bootstrap replications.

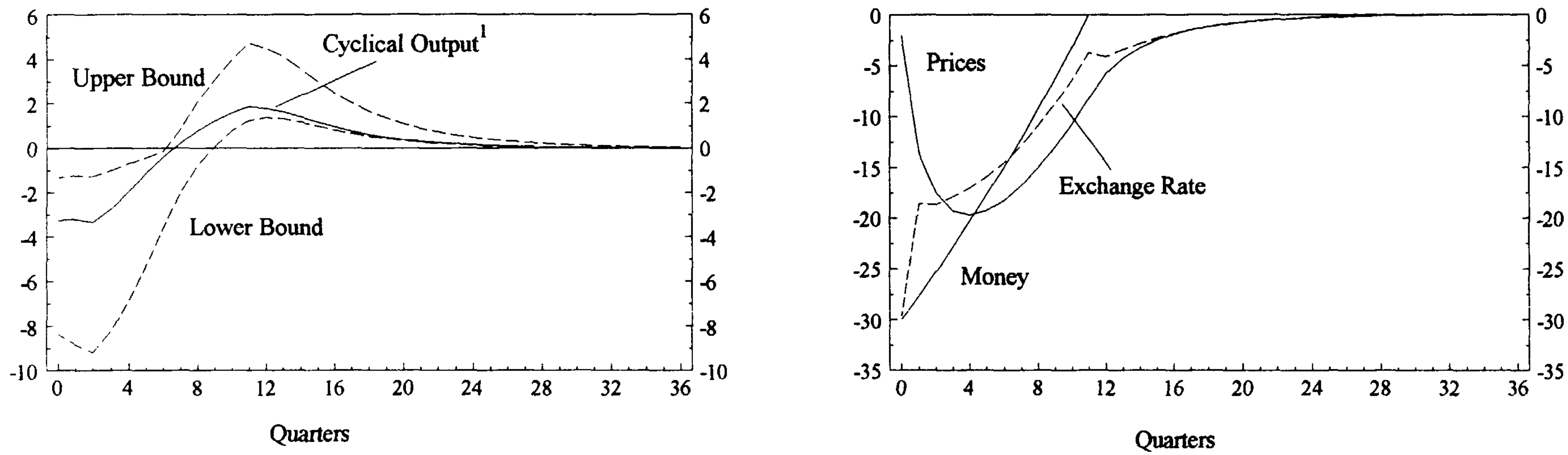
Figure 3. Money-Based Stabilization

(Percent change, unless otherwise indicated)

A. Permanent



B. Temporary

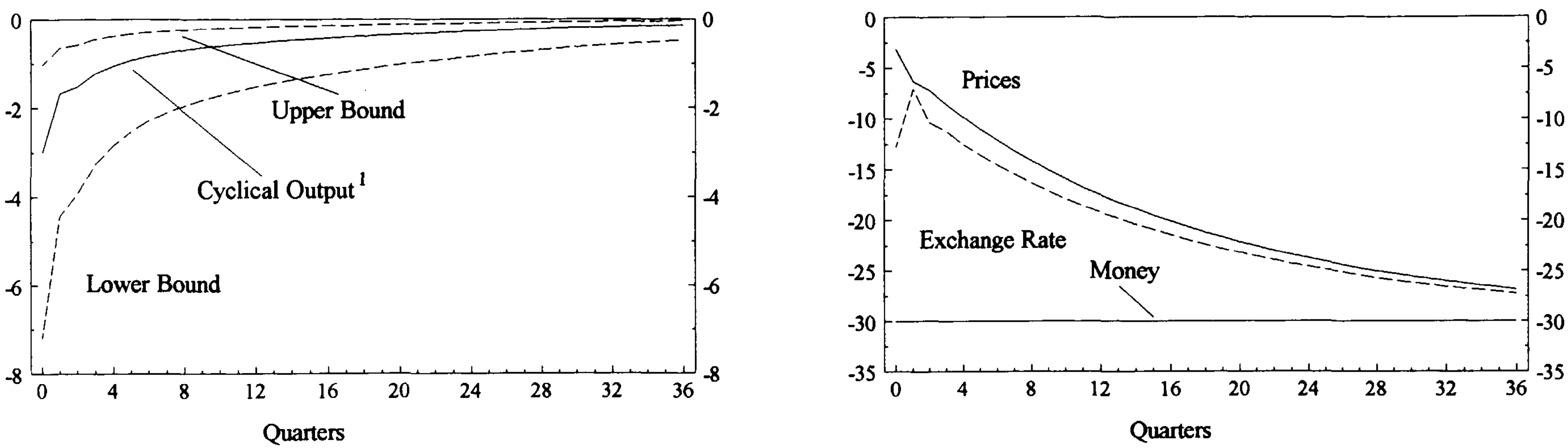


[1] Percent deviation from trend. Upper and lower bounds refer to one standard deviation of the impulse response, calculated using 1000 bootstrap replications.

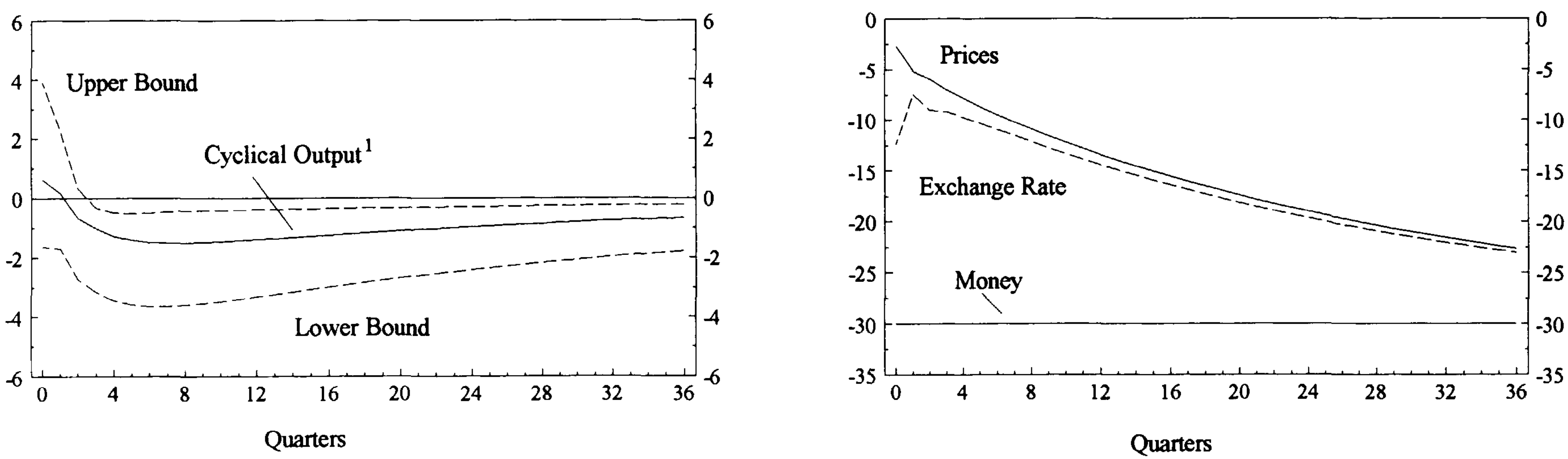
Figure 4. Narrow Monetary Aggregates

(Percent change, unless otherwise indicated)

A. M1



B. M2



[1] Percent deviation from trend. Upper and lower bounds refer to one standard deviation of the impulse response, calculated using 1000 bootstrap replications.

rate-based stabilization is expansionary, while a permanent money-based stabilization is contractionary. However, the main drawback of the evidence from the expanded model is that it is based on far fewer degrees of freedom. As a result, the estimates of this expanded model are less precise, and are not presented in this paper. 1/

4. The role of Argentina

Finally, our results are robust to the variable chosen to control for the effect of Argentina. Empirical studies of the Uruguayan economy point out to two alternative variables linking these countries: the bilateral real exchange rate and the bilateral terms of trade (see, for example, Favaro and Sapelli (1986)). To test the robustness of our results, we re-estimated the VAR model using these variables (see Table A5 in the Appendix) and in turn re-calculate the impulse response functions (see Figures A1 and A4 in the Appendix). By and large, our results suggest that regardless of the variable chosen to control for Argentina, the main qualitative results hold.

IV. Econometric Issues

The impulse responses of output presented in the previous section provide econometric evidence in favor of the recession-now-versus-recession-later hypothesis in chronic inflation countries. Before interpreting the results in terms of existing theoretical models in the next section, it is important to discuss some caveats and econometric issues related to this type of exercise.

1. Underlying economic mechanisms

The simulations presented are based on a reduced-form econometric model (i.e., the VAR model estimated in Section II). Hence, one should compare the econometric evidence to the reduced-form of various theoretical models. The econometric evidence will thus not allow us to differentiate between alternative mechanisms (say, backward- versus forward-looking behavior, or wealth effects versus substitution effects) postulated by various models. It is only to the extent that the reduced form generated by a given theoretical model differs from the econometric evidence that one may be able to cast doubts on the underlying mechanisms.

2. Temporary versus permanent shocks

A great deal of caution should be exercised in interpreting the distinction between permanent and temporary stabilization. The VAR model is a backward-looking econometric model which does not explicitly allow for the effects of future changes in policy on today's behavior. Hence, a given change in a policy variable will have the same effect today regardless of whether the policy will be continued in the future or not. Furthermore, to

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1/ These estimates are available from the authors upon request.

the extent that most policy changes in Uruguay may have been perceived as temporary during the sample period, even the impulse response to a permanent change will be "contaminated" by temporary elements (see below).

3. Cooley and LeRoy's critique

Cooley and LeRoy (1985) argue that standard VAR analysis--impulse response functions--is complicated when the variables in the model are not predetermined during the sample period because the standard Choleski decomposition does not recover the true underlying innovations, but rather a combination of these. Potentially, this could be a problem in this study because the sample used covers periods when the nominal exchange rate was predetermined--when the exchange rate was the nominal anchor--and periods where it was not. Thus, Cooley and LeRoy (1985) would argue that our impulse responses show the economy's adjustment to a shock that might not resemble the impulse response function to a pure stabilization program.

Although this is a drawback of the standard VAR analysis, it is not a particularly serious problem for the impulse responses used in this study because our impulse responses are numerically equivalent to "generalized" impulse responses (GIR, see Pesaran, Potter, and Shin (1994). 1/ As such, they can be re-interpreted as the expected response of the Uruguayan economy, given the historical data, to the paths followed by the nominal anchors. Thus, while the impulse responses above might not show the responses to "pure structural innovations," they do nonetheless provide useful information regarding the expected response to a stabilization program, conditional on the sample data, of Uruguay's output, prices and money/exchange rate.

4. The Lucas critique

Our results could be subject to the Lucas critique since we are essentially performing policy analysis with reduced form estimates, and thus our estimates can change with the policy experiments we perform. Sims (1982) argues that the Lucas critique, although correct in principle, is limited to policy analysis made with "invalid reduced forms." He argues that reduced forms that ignore the effect of expectations can be seriously misleading--as first noted by Kydland and Prescott (1977). Nonetheless, "judicious" use of "valid" reduced forms can produce reasonable policy analysis. In Sims' judgment, "judicious" policy experiments are those experiments not far removed from the historical experience. For example, if Uruguay has stabilized its economy by reducing the rate of devaluation by 30 percentage points, a policy experiment that reduces the rate of devaluation by, say, three times as much is not likely to provide useful

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1/ Pesaran, Potter, and Shin (1994) show that the GIR can be calculated by placing the variable first in the ordering and using the standard Choleski decomposition. Thus, the impulse responses above for the EBS and MBS that place the corresponding anchor first in the ordering are numerically equivalent to GIR.

information about the Uruguayan economy's response to such a stabilization. In other words, using a policy experiment to extrapolate the impact of stabilization well outside the historical experience is unlikely to be useful. On the other hand, simulating policy exercises that fall roughly within the historical experience is likely to provide a useful characterization of the economy's response to such policies, because these policy shifts will be embedded in the estimated reduced forms.

According to Sims (1982), valid reduced forms are those which do not ignore the impact of expectations. He argues that the fact that policy actions occur through expectations does not necessarily imply that the expectation mechanism must be estimated explicitly to produce valid policy analysis. He further suggests that VAR models can provide a valid reduced form from which "reasonable" policy experiments can be performed. 1/

The policy experiments performed with the VAR model for Uruguay are within the historical limits of the experience of Uruguay. 2/ As described in the Appendix, there have been several changes in exchange rate regimes in Uruguay during the last 20 years, which are included in our sample. Specifically, during the "Tablita" stabilization initiated in October 1978, the rate of devaluation was reduced from 50 percent per year in 1978:Q3 to 15 percent per year in 1982:Q1. Thus, the exercise considered above--a 30 percentage point reduction--is within the historical range. Similarly, there were several periods during which the money supply was used as the nominal anchor and its rate of growth was reduced by roughly 30 percent. During the period 1974-77, for instance, money growth (M1) fell from 80 to 46 percent. Similarly, from 1986 to 1989, money growth fellfrom 95 to 60 percent. Given the occurrence of these regimes, it makes sense to compute a money-based stabilization, even though there has not been a major money-based program during this period, with the possible exception of the 1974-77 period (see Hanson and de Melo (1985)).

To provide some empirical support for the conjecture that Lucas critique problems are not likely to be an important issue in Uruguay, we tested for coefficient stability before and after the collapse of the "Tablita," which is the natural place for a structural break to occur, if it does. As discussed in the Appendix, we find no significant evidence of a break in the data based on both system-wide tests and individual equations test.

5. How important are nominal shocks in Uruguay?

The relevance of our findings related to the recession-now-versus-recession-later hypothesis implicitly rests on the presumption that nominal shocks are important in explaining the observed movements of output in

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1/ For a complete discussion of policy analysis and the Lucas critique, see Sims (1982).

2/ The appendix provides a brief description of monetary and exchange rate developments in Uruguay since 1972.

Uruguay, at least during periods of stabilization. The VAR methodology suggests two methods to measure the importance of nominal innovations: the variance decomposition and the historical decomposition.

The variance decomposition describes at different time horizons the average contribution of each innovation to the observed movements of output throughout the sample period (see Table 2, Panel A). The variance decomposition for Uruguay's output suggests that on average, from 1975-90, nominal shocks explain a relatively small portion of output movements. This result is not totally unexpected because Uruguay is a small open economy that during the sample period has been subjected to many real shocks both of domestic and external origin. Nonetheless, the variance decompositions do not rule out the possibility that nominal shocks were important during specific stabilization programs, such as the Tablita program.

The historical decomposition allows us to measure the contribution of nominal shocks during the Tablita program (1978:Q2-82:Q4) when the exchange rate was used as the nominal anchor. It is also important to isolate Argentina's impact, because Argentina implemented a similar "Tablita" program in December 1978, and the resulting boom contributed to Uruguay's output expansion. The historical decomposition shows the importance of nominal variables during this stabilization, as well as the impact of Argentina (see Table 2, Panel B). 1/ The historical decomposition suggests that, during the initial phase of Uruguay's output expansion (1978-79) and during the recession phase (1982-83), nominal innovations played a central role in explaining Uruguay's output. The evidence also confirms the importance of Argentina, especially during 1980-81, where its effect was larger than the direct effect of nominal innovations.

V. An Economic Interpretation

Having discussed some caveats and econometric issues, let us now turn to the economic interpretation of the results.

1. Money-based stabilization

The recession observed in the impulse response of output to a reduction (either permanent or temporary) in the rate of growth of money (regardless of whether the monetary aggregate is M1, M2, or M3) is consistent with the reduced form of several models. As is well known, for a (permanent) money-based stabilization to be contractionary, some kind of nominal rigidity must be present. Otherwise, the economy would adjust instantaneously to its new

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1/ Consistent with the fact that the exchange rate was the nominal anchor during this period, the historical decompositions were calculated by placing the exchange rate first in the ordering. Also, since Argentina is exogenous, its effect--0.274 times Argentina's cyclical output--can be subtracted from the base projections and is shown separately.

Table 2. Variance and Historical Decompositions of Cyclical Output

A. Variance Decomposition

	Percentage of Cyclical Output Variation due to innovations in: 1/			
Quarters Ahead	Exchange Rate	Money	Prices	Output
1	0.246	2.840	2.497	94.417
2	5.787	6.274	2.321	98.619
4	7.117	8.837	2.050	81.995
8	7.530	9.519	1.982	80.969
16	7.551	9.555	1.979	80.915
32	7.551	9.555	1.979	80.915
	Money	Exchange Rate	Prices	Output
1	2.962	0.124	2.497	94.417
2	2.608	9.452	2.321	85.619
4	3.121	12.834	2.050	81.995
8	3.249	13.800	1.982	80.969
16	3.256	13.850	1.979	80.915
32	3.256	13.850	1.979	80.915

B. Historical Decomposition During the Tablita Program 2/

Year	Actual Cyclical Output	Cyclical Output Explained by: Nominal	Argentina	Other 3/
1978	0.1	0.8	-0.6	-0.1
1979	5.0	2.8	0.7	1.6
1980	6.9	1.7	1.5	3.6
1981	9.0	0.6	1.7	6.7
1982	-3.6	-0.9	-1.3	-1.4
1983	-8.1	-3.3	-1.1	-3.7

1/ Columns indicate the ordering used in the Choleski decomposition.
2/ Annual decomposition obtained as an average of the quarterly decompositions; the ordering used placed exchange rate first, then money, inflation and output.
3/ Consists of the innovation in output, plus the baseline projection of the VAR model excluding the effect of Argentina.

steady-state. Two basic types of rigidities are considered in the literature. First, the price level may be predetermined which, combined with an interest-rate-elastic money demand, implies that a money-based stabilization is contractionary (see, for instance, Dornbusch (1980, Chapter 12), Calvo and Végh (1990)). 1/ Intuitively, the decline in the rate of monetary growth reduces (expected) inflation and hence the nominal interest rate, which increases real money demand. Given that the real money supply is given on impact (since the price level is sticky), the resulting liquidity "crunch" leads to higher real interest rates and a nominal (and real) appreciation. The ensuing recession restores equilibrium in the money market. 2/3/

A second type of rigidity--which does not require of an interest-rate elastic money demand to cause a recession--consists in assuming that the rate of change of some nominal variable (usually nominal wages or inflation) is not fully flexible. Taylor (1980, 1983) and Fischer (1986, 1988) emphasize the rigidities imposed by overlapping wages which are set for several periods according to expected prices. In this case, a reduction in the rate of monetary growth does not affect the path of nominal wages set in the past--based on a high inflation rate--which are still outstanding today. As a result, real wages increase and a recession ensues.

The reduced form of the two types of models just described is thus consistent with the econometric evidence on money-based stabilization for Uruguay. In addition, these models would also be able to generate the inflation persistence that seems to characterize disinflation in Uruguay. If the inflation rate is flexible (as in Calvo and Végh, 1990), then inflation persistence may result from lack of credibility in the program. In the models of Taylor (1980, 1983) and Fischer (1986, 1988), inflation persistence is related to the length of contracts. In sum, the econometric evidence appears to be consistent with models that emphasize nominal rigidities in either the level or the rate of change of prices or wages.

The econometric evidence on money-based stabilization should also be related to the literature on dollarization (see Calvo and Végh (1992) for a review). A key issue in this area is that, for all practical purposes, the "relevant" monetary aggregate (i.e., the one which influences inflation and

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1/ Note that sticky prices by themselves may not be enough to generate a recession--as emphasized by Ball (1994) and Calvo and Végh (1993)--because the inflation rate remains fully flexible. In a cash-in-advance model, for instance, a reduction in the rate of monetary growth would reduce inflation instantaneously with no output costs, even in the presence of sticky prices.

2/ As is well known, this recession could by avoided by increasing the level of the money supply at the same time that its rate of change is reduced. In practice, this is likely to generate credibility problems as the difference between changes in level and slopes becomes blurred.

3/ It should be noted that, at an analytical level, the distinction between permanent and temporary money-based stabilization is not critical, because the recession is unrelated to expectations.

economic activity) comprises the (domestic-currency value) of foreign currency deposits. The evidence presented in the previous section supports this notion in two respects. First, a reduction in either M1 or M2 has little impact on inflation, while a reduction in M3 (which includes foreign currency deposits) has much greater impact. Second, the recession associated with the monetary contraction is larger when M3 is used than when either M1 or M2 is used. Hence, the econometric evidence supports the idea that, in the case of Uruguay, the relevant monetary aggregate is the one which includes foreign currency deposits. From a policy perspective, this implies that targeting a monetary aggregate such as M1 or M2 is likely to be a rather ineffective nominal anchor.

2. Exchange rate-based stabilization

The results discussed in Section III indicate that a permanent reduction in the devaluation rate leads to an initial output boom (Figure 2, Panel A). Output then falls gradually towards its full-employment level. When the reduction in the rate of devaluation is temporary, the initial boom is followed by a later recession (Figure 2, Panel B). Bearing in mind the caveats discussed above, let us interpret these results in terms of theoretical models. For our purposes, it is useful to divide existing explanations into three different categories: (i) backward-looking behavior, (ii) wealth effects, and (iii) lack of credibility (modeled as temporary policy). 1/

a. Backward-looking behavior

Models relevant for exchange rate-based stabilization have incorporated backward-looking elements in different ways: Rodriguez (1982) relies on adaptive expectations; Dornbusch (1982) and Ball (1993) consider rational expectations but assume that the inflation rate is a predetermined variable; and Calvo and Végh (1994b) assume, in the context of an optimizing model, that the rate of change of nominal wages is predetermined. All of these models generate a boom-recession cycle in response to a permanent reduction in the rate of devaluation. 2/ The initial boom responds to lower real interest rates, while the later recession is caused by a sustained real appreciation of the domestic currency. The key force behind both low initial real interest rates and the real exchange rate appreciation is inflation inertia. 3/

1/ See Rebelo and Végh (1995) for a detailed analysis of the different hypotheses.

2/ In Calvo and Végh (1994b), however, the initial boom takes place only if the intertemporal elasticity of substitution exceeds the elasticity of substitution between traded and home goods.

3/ Note that since expectations of future policy do not play much of a role in backward-looking models, similar dynamics should follow if the fall in the rate of devaluation was temporary (and enough time was allowed for the contractionary effects of real exchange rate appreciation to prevail).

The econometric evidence presented in Figure 2 is broadly consistent with backward-looking models. In particular, the dynamics associated with a temporary fall in the rate of devaluation exhibit the typical behavior that would be predicted by backward-looking models. 1/ When the reduction in the devaluation rate is temporary, the behavior of inflation illustrated in Figure 2 suggests that the real exchange rate would follow a U-shaped path, appreciating at first and depreciating later. After the initial boom, the economy falls into a recession. 2/

b. Models that rely on wealth effects

Several authors have attributed the initial expansion in economic activity to wealth effects. Wealth effects may arise as a result of lack of Ricardian equivalence (Helpman and Razin (1987)); future reductions in government spending (Drazen and Helpman (1988), Rebelo (1994)); variable labor supply (De Gregorio, Guidotti, and Végh (1993) and Roldos (1993)); capital accumulation (Uribe (1993)) and Roldos (1995)); or, in the particular case of Israel, higher perceived financial wealth (Bruno (1993)).

All of these models are, in principle, consistent with the initial boom caused by a permanent reduction in the devaluation rate illustrated in Figure 2. The econometric evidence, however, indicates that output returns to a long-run equilibrium level--rather than staying at a higher level--as suggested by the failure to reject long-run neutrality. Since models that rely on wealth effects generally predict a permanently higher level of output and consumption, the econometric evidence for Uruguay may be interpreted as casting doubts on the notion that wealth effects may be a major factor behind the real effects of exchange rate-based stabilization. 3/

c. Models that rely on temporary policy

Calvo (1986) and Calvo and Végh (1990, 1993) have argued that lack of credibility--modeled as temporary policy--may account for the boom-recession cycle in exchange rate-based stabilizations. In Calvo and Végh (1993), the anticipation of a future reversal of the policy increases, through

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1/ In this respect, it is instructive to compare the dynamics illustrated in Figure 2 with their theoretical counterparts in Figure 4 of Calvo and Végh (1994b).

2/ It should be noted, however, that when the rate of devaluation is lowered permanently (Figure 2), the econometric evidence does not show the late recession that would be predicted by backward-looking models. Output simply goes back to its unchanged long-run level, without ever falling below it.

3/ It should be noted, however, that the specification of the econometric model may be not be the most adequate to capture the supply effects of disinflation programs. Further macroeconometric work is needed to disentangle demand and supply effects of disinflation programs (see the discussion in Section VI).

intertemporal substitution, today's demand for home goods, thus leading to an output expansion. The excess aggregate demand implies that inflation remains above the rate of devaluation, thus leading to a sustained real exchange rate appreciation, which leads to a contraction of excess aggregate demand. Eventually, the economy falls into a recession, as output falls below its full-employment level.

The predictions of the model are consistent with the impulse response of output to a temporary reduction in the devaluation rate (Figure 2). As suggested above, however, the econometric exercise does not explicitly incorporate expectational considerations and, hence, may not be truly interpreted in terms of the "temporariness" hypothesis. However, to the extent that today's behavior may have actually responded to future expectations of policy, the econometric evidence could be capturing "temporary" elements.

VI. Final Remarks

The real effects of disinflation programs have received a great deal of attention in the theoretical literature. An important idea that emerges from this literature is that the timing of the contractionary costs associated with reducing inflation may depend on what nominal anchor is being used. Specifically, analytical models suggest that, under money-based stabilization, the recession would occur at the beginning of the program (recession now) while, under exchange rate-based stabilization, the recession would occur later in the program following an initial boom (recession later).

In spite of the practical importance of the "recession-now-versus-recession-later" hypothesis, there has been little formal econometric work in this area. This paper provides a first attempt at filling this void by providing econometric evidence on the real effects of disinflation under different nominal anchors for the case of Uruguay. A four-variable vector-autoregression model for Uruguay was estimated, and used to compute the impulse responses to permanent and temporary money-based and exchange rate-based stabilization. The results are generally consistent with the "recession-now-versus-recession-later" hypothesis: money-based stabilization always leads to an initial contraction, while a (temporary) exchange rate-based stabilization provokes an initial boom and a later recession. The results also suggest that the high dollarization of the Uruguayan economy hinders the effectiveness of a monetary anchor in reducing inflation.

Despite some well-known (and other more subtle) limitations of the econometric approach followed in this paper, we feel that having been able to illustrate for the case of Uruguay the contrasting output effects of different nominal anchors should prove a useful first step in an econometric analysis of the effects of disinflation. Further econometric work in this area could proceed along various lines. First, the approach pioneered by Blanchard and Quah (1989) could be used to distinguish between supply effects and aggregate-demand effects of disinflation. The VAR methodology used in this paper does not allow us to separate explicitly demand-side effects from possible supply-side effects of disinflation on labor supply and capital accumulation. By identifying supply-side effects with permanent shocks and aggregate-demand effects with temporary shocks, Blanchard and Quah's (1989) technique could be used to obtain interesting insights into the relative importance of these two effects.

Second, one could conduct similar exercises to those in this paper using a structural model, which would explicitly deal with the Lucas critique type of problems. While we do not feel that for the case of Uruguay taking explicit account of regime changes would give rise to substantial differences for the purposes at hand (see the discussion in Section IV), there is little doubt that in other cases--such as the Israeli July 1985 stabilization--an important regime change took place at the time of the stabilization. In such a case, a structural model may be better suited for a simulation of disinflation programs.

Third, it would be interesting to explicitly incorporate forward-looking elements in an econometric study of output effects of disinflation. As some theoretical models emphasize (see, for instance, Calvo and Végh (1993), the public's expectations regarding the sustainability of a stabilization program are likely to play a key role in the dynamics of stabilization plans. This could be accomplished by using a structural model that would incorporate uncertainty with respect to the program's sustainability, and estimating the "deep structural parameters" using Hansen's (1982)) generalized method of moments.

Supportive Econometric Evidence

1. Data sources and sample

The data series and their source used in this paper are: Uruguay's GDP (Central Bank of Uruguay), consumer prices (line 64, International Financial Statistics (IFS)), nominal exchange rate (line ae, IFS), Argentina's GDP (line 99b.p IFS), M3 (line 34 plus line 35, IFS), and M1 and M2 (Central Bank of Uruguay). The sample period used for the estimations was 1975:Q3 through 1990:Q4.

2. Time-series properties

The augmented Dickey-Fuller test (ADF) and the Phillips-Perron (PP) unit root tests were performed (see Table A1, Panel A). The number of lags included in these tests--four for output, the nominal rate of depreciation, and Argentina's output, two lags for money growth, and one lag for inflation--were determined by testing-down for the highest significant lag. Monte Carlo simulations suggest that testing-down will select the correct number of lags as the number of observations increases (see Campbell and Perron (1991)). Critical values for these tests at 95 percent significance were taken from Guilkey and Schmidt (1989). Since output has a break, the critical value for its unit root test was taken from Perron (1989).

3. VAR lag length

Following Lutkepohl (1985), we have calculated the Hannan-Quinn and Schartz tests for the VAR model (see Table A1, Panel B). The maximum lag-length considered for these tests was 4 because higher lags reduce the degrees of freedom to undesirable small numbers. The results indicate that one lag is appropriate--the cost of additional lags in terms of lost degrees of freedom more than offsets the additional informational content of the additional lag.

4. Contemporaneous correlation matrix

The correlation matrix is important because it provides information on how sensitive are impulse responses to the ordering of variables. The smaller the correlations, the less likely that impulse responses will change substantially by changing the ordering. In the limit, when contemporaneous correlations are zero, the impulse responses are invariant to changes in the ordering (see Bernanke (1986)). For our model, the contemporaneous correlations are small and, in fact, only one is statistically significant, the correlation between money growth and the rate of depreciation (see Table A1, Panel C).

Table A1. Unit Root, Lag Length Tests, and Contemporaneous Correlations

A. Unit Root Tests

	Cyclical Output	Inflation	Exchange Rate Depreciation	Money Growth	Argentine Output
Augmented Dickey-Fuller	-3.48	-3.92	-3.47	-1.75	-3.32
Phillips-Perron	-2.86	-3.92	-8.58	-5.63	-3.28
Critical value for 95 percent significance 1/	-3.39	-3.16	-3.16	-3.28	-3.16

B. Lag Length Tests 2/

	Lags Included			
	1	2	3	4
Hannan-Quinn	-24.10	-22.57	-21.91	-21.08
Schwarz	-23.53	-23.42	-23.20	-22.81

C. Contemporaneous Correlations 3/

	Cyclical Output	Inflation	Exchange Rate Depreciation	Money Growth
		Unrestricted Model		
Cyclical output	0.0010	0.18	0.05	0.18
Inflation		0.0008	0.08	0.12
Exchange rate depreciation			0.0140	0.50
Monetary growth				0.0033
		Restricted Model		
Cyclical output	0.0010	0.18	0.005	0.17
Inflation		0.0008	0.08	0.12
Exchange rate depreciation			0.0147	0.47
Money growth				0.0033

1/ Critical value for cyclical output is taken from Perron (1989) with $\lambda=0.3$, all other critical values are taken from Gilkey and Schmidt (1989).
2/ Selected lags are underlined.
3/ The main diagonal contains the standard errors.

5. Ordering of the variables

The impulse responses are fairly robust, and although they do not change qualitatively when the order of the variables in the VAR is changed, the size of the responses does. As elaborated below, this is due to the fact that money and the exchange rate are positively correlated, and their effects on output are partially offsetting. In particular, the output boom following an exchange rate-based stabilization is larger, when money is "most exogenous" that is, when it is placed first in the ordering (see Table A2, columns (2)). This is because, money growth does not fall contemporaneously--slowing the economy--as the rate of exchange rate devaluation falls. Similarly, the output contraction following a money-based stabilization is larger when the exchange rate is "most exogenous (see Table A3, columns (1)). The reason is that the exchange rate depreciation does not decline contemporaneously--boosting the economy--as money growth falls.

6. Coefficient stability

Coefficient stability before and after the collapse of the "Tablita Plan" in 1982:Q4, was tested using likelihood ratio tests on the VAR system and individually on each equation. In these tests, all five coefficients in each equation were allowed to change in the unconstrained case, and breaks tested over the period from 1981:Q4 to 1983:Q4 (see Table A4).

The results suggest that there is no significant evidence of a break in the data. The VAR system wide tests for instability fail to find statistically significant evidence of structural instability. The tests for individual equations also suggest, by and large, that there is no evidence of instability (there is only some weak evidence of instability in the money equation during the second half of 1983).

7. Alternative exogenous variables

The economic linkages between Uruguay and Argentina are important, and need to be explicitly accounted for, to accurately separate the external shocks from domestic shocks. Since there is no way to determine a-priori the best variable to capture the impact of Argentina on Uruguay, it is important to verify that our results are robust to alternative ways of controlling for Argentina. In this connection, the VAR model was re-estimated with two alternative exogenous variables: the bilateral real exchange rate and the bilateral terms of trade (see Table A5). These alternative estimates were used to calculate impulse responses for a temporary exchange rate- and money-based stabilizations (see Figures A1 and A2, respectively). By and large, these impulses responses are qualitatively the same as before, and support the recession-now-versus-recession-latter hypothesis.

Table A2. Output Impulse Responses to Exchange Rate Stabilization 1/

Quarters	Permanent		Temporary		Temporary 10		Gradual Permanent	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
0	-0.45	0.36	-0.45	0.36	-0.45	0.36	-0.04	0.03
1	2.15	4.21	2.19	4.18	2.15	4.21	0.15	0.41
2	3.63	6.60	3.48	6.16	3.63	6.60	0.48	0.99
3	4.18	7.60	3.69	6.54	4.18	7.76	0.85	1.67
4	4.18	7.76	3.30	5.99	4.18	7.76	1.23	2.36
5	3.91	7.49	2.65	5.01	3.91	7.49	1.58	3.04
6	3.53	7.04	1.91	3.88	3.53	7.04	1.90	3.67
7	3.12	6.52	1.19	2.74	3.12	6.52	2.19	4.27
8	2.72	5.99	0.52	1.65	2.72	5.49	2.44	4.82
9	2.36	5.49	-0.07	0.63	2.36	5.49	2.66	5.33
10	2.04	5.01	-0.60	-0.30	2.04	5.01	2.84	5.80
11	1.76	4.58	-1.05	-1.16	2.22	4.20	3.05	6.20
12	1.52	4.18	-1.49	-1.90	-0.62	-0.03	2.99	6.20
16	0.83	2.90	-1.35	-2.14	-2.97	4.27	1.93	4.74
20	0.45	2.02	-0.79	-1.55	-1.87	-3.29	1.07	3.31
24	0.25	1.41	-0.43	-1.09	-1.04	2.32	0.59	2.30
28	0.14	0.98	-0.24	-0.76	-0.57	-1.63	0.32	1.60
32	0.07	0.68	-0.13	-0.53	-0.31	-1.14	0.18	1.12

1/ The ordering used for columns (1) places the exchange rate first followed by money and inflation, and finally cyclical output; the ordering for columns (2) reverses the order of the exchange rate and money.

Table A3. Output Impulse Responses to Money Based Stabilization 1/

Quarters	Permanent (1)	Permanent (2)	Temporary (1)	Temporary (2)	Temporary 10 (1)	Temporary 10 (2)	Gradual Permanent (1)	Gradual Permanent (2)
0	-3.60	-3.25	-3.60	-3.25	-3.60	-3.25	-0.33	-0.30
1	-6.79	-3.48	-6.48	-3.19	-6.79	-3.48	-0.97	-0.62
2	-7.84	-3.94	-6.94	-3.34	-7.84	-3.94	-1.70	-0.98
3	-7.92	-3.70	-6.32	-2.75	-7.92	-3.70	-2.43	-1.32
4	-7.51	-3.25	-5.20	-1.96	-7.51	-3.25	-3.12	-1.62
5	-6.90	-2.74	-3.90	-1.14	-6.90	-2.74	-3.75	-1.87
6	-6.22	-2.26	-2.56	-0.40	-6.22	-2.26	-4.31	-2.07
7	-5.55	-1.84	-1.29	0.24	-5.55	-1.84	-4.81	-2.24
8	-4.91	-1.48	-0.11	0.78	-4.91	-1.48	-5.24	-2.37
9	-4.33	-1.18	0.96	1.22	-4.33	-1.18	-5.62	-2.47
10	-3.81	-0.94	1.92	1.57	-3.81	-0.94	-5.95	-2.56
11	-3.34	-0.74	2.78	1.86	0.26	2.59	-5.93	-2.33
12	-2.93	-0.59	3.19	1.78	4.15	3.00	-5.58	-2.07
16	-1.72	-0.23	2.46	0.96	5.56	2.59	-3.61	-0.94
20	-1.00	-0.09	1.48	0.39	3.48	1.10	-2.14	-0.38
24	-0.58	-0.01	0.50	0.06	1.18	0.17	-0.73	-0.06
28	-0.34	-0.01	0.50	0.06	1.18	0.17	-0.73	-0.06
32	-0.20	0.00	0.29	0.02	0.68	0.06	-0.43	-0.02

1/ The ordering used for columns (1) places the exchange rate first followed by money and inflation, and finally cyclical output; the ordering for columns (2) reverses the order of the exchange rate and money.

Table A4. Likelihood Ratio Tests for Coefficient Stability 1/

Break	VAR Model	Equation			
		Cyclical Output	Inflation	Exchange Rate Depreciation	Monetary Growth
1981:Q4	8.07	0.92	1.59	2.04	2.08
1982:Q1	6.77	2.37	0.99	2.01	0.86
:Q2	7.38	2.25	1.88	2.02	0.77
:Q3	7.76	2.63	1.57	2.09	1.04
:Q4	10.31	5.86	1.11	2.09	0.95
1983:Q1	15.91	6.76	0.91	6.68	0.34
:Q2	21.70	6.30	0.80	8.67	5.89
:Q3	27.90	6.14	6.85	6.05	9.34
:Q4	27.33	6.10	5.48	6.27	9.56*

1/ The χ^2 statistics have 20 degrees of freedom for the VAR system, and 5 degrees of freedom for individual equations. An asterisk denotes significant at 10 percent.

Table A5. VAR Estimates, Using Bilateral Real Exchange Rate with Argentina (Q) and Terms of Trade (TOT), 62 Observations from 1975:Q3-90:Q4,

(Standard Errors in Parenthesis)

	Cyclical Output		Inflation		Exchange Rate Depreciation		Money Growth	
Exogeneous variable:	Q	TOT	Q	TOT	Q	TOT	Q	TOT
Coefficient of Determination (R^2)	0.64	0.59	0.61	0.62	0.16	-0.01	0.13	0.12
Adjusted R^2	0.63	0.57	0.59	0.60	0.12	0.06	0.08	0.07
Sum of Squared Errors	0.0580	0.0664	0.0289	0.0474	0.7569	0.9138	0.2048	0.2073
Standard Error of Estimate	0.0312	0.0338	0.0484	0.0286	0.1142	0.1255	0.0594	0.0598
Durbin Watson	2.15	2.10	2.62	2.73	1.96	1.97	2.35	2.33
Lagged Regressors:								
Output	0.492**	0.663**	-0.151	-0.002	-0.158	-0.902**	0.008	-0.092
	(0.104)	(0.095)	(0.095)	(0.080)	(0.375)	(0.353)	(-0.195)	(0.168)
Inflation	-0.006	0.018	0.647**	0.662**	0.977	0.874**	0.621**	0.610**
	(0.059)	(0.063)	(0.054)	(0.053)	(0.214)	(0.234)	(0.111)	(0.112)
Exchange Rate Depreciation	-0.083**	-0.100**	0.179**	0.180**	-0.090	-0.016	-0.130**	-0.120**
	(0.036)	(0.083)	(0.033)	(0.032)	(0.130)	(0.142)	(0.067)	(0.067)
Money Growth	0.089	0.082	0.174**	0.158*	0.113	0.142	0.509**	0.510**
	(0.067)	(0.073)	(0.061)	(0.061)	(0.242)	(0.270)	(0.126)	(0.128)
Exogenous variable indicated by the column header 3/	0.055	-0.000	0.014	0.028	-0.237	0.008	-0.030	0.006
	(0.019)	(0.025)	(0.017)	(0.021)	(0.068)	(0.093)	(0.036)	(0.044)
Homogeneity Tests:								
Sum of the coefficients of nominal variables	0.000	0.000	1.000	1.000	1.000	1.000	1.000	1.000
F(1,57) /2	0.058	0.049	0.032	0.092	3.821	3.202	0.339	0.322
Significance Level	0.810	0.825	0.860	0.763	0.056*	0.079*	0.563	0.573

1/ Significance at 5 and 10 percent is denoted by ** and * respectively.

2/ In the output equation, the test refers to long-run neutrality of nominal variables; in other equations the test refers to price homogeneity of degree one.

3/ The exogeneity of the bilateral real exchange rate was verified by testing for block exogeneity; the likelihood ratio test did not reject block exogeneity ($\chi^2_4 = 7.2$)

8. Monetary regimes in Uruguay since 1972

a. Passive crawling-peg (March 1972-October 1978)

In March 1972, a new government takes office after the November 1971 elections. The exchange rate is devalued by 100 percent, and a passive crawling peg (with dual markets) is implemented, which lasted until October 1978. The commercial rate was depreciated at frequent intervals and the financial rate freely floated. Money was used as the main nominal anchor throughout this period. Financial markets were liberalized in September 1974.

b. Tablita period (active crawling-peg) (October 1978-November 1982)

In October 1978, the two markets were unified and the government adopted a policy of announcing in advance the future values of the exchange rate (the Tablita) as an anti-inflationary tool (see Hanson and de Melo (1985)). The Tablita is abandoned in November 1982, when a floating regime is implemented.

c. Floating period (December 1982-fourth quarter of 1985)

During this period, the peso was basically floating with intervention largely confined to smoothing operations (see Protasi, 1985).

d. Managed floating (fourth quarter of 1985 through end of 1990)

From the fourth quarter of 1985 to the end of 1986, the authorities intervened on a large scale to avoid a significant appreciation in response to an external shock. Since then, intervention played an increasingly important role in setting the pace of exchange rate adjustment in light of external and domestic developments. In September 1990, an exchange rate band was formally implemented with an initial width of 2.5 percent.

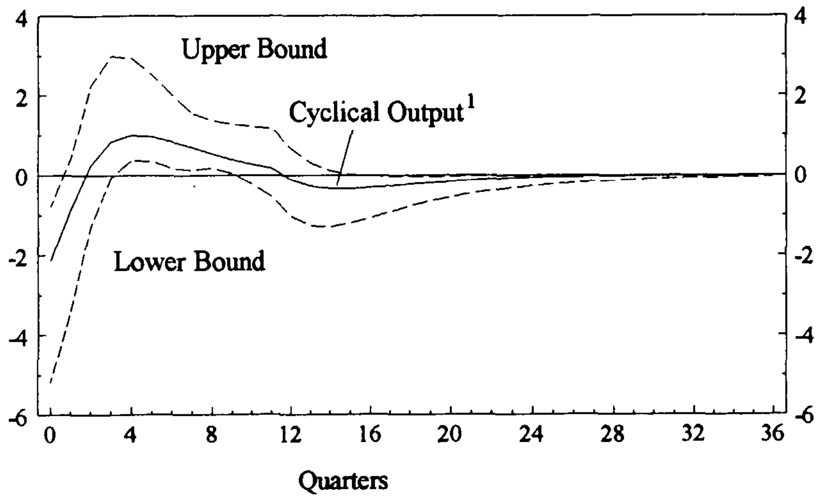
e. January 1991 stabilization plan (active crawling-peg)

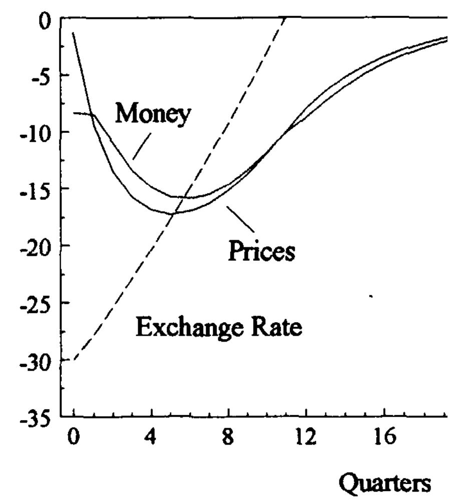
After an important fiscal adjustment during 1990, the rate of devaluation is reduced considerably in January 1991 and begins to be used as the main nominal anchor in an effort to reduce inflation (Talvi, 1994). As of August 1995, the band's upper and lower limit are being devalued at a 2 percent per month and the width of the band is 7 percent.

Figure A1. Temporary Exchange Rate-Based Stabilization, alternative

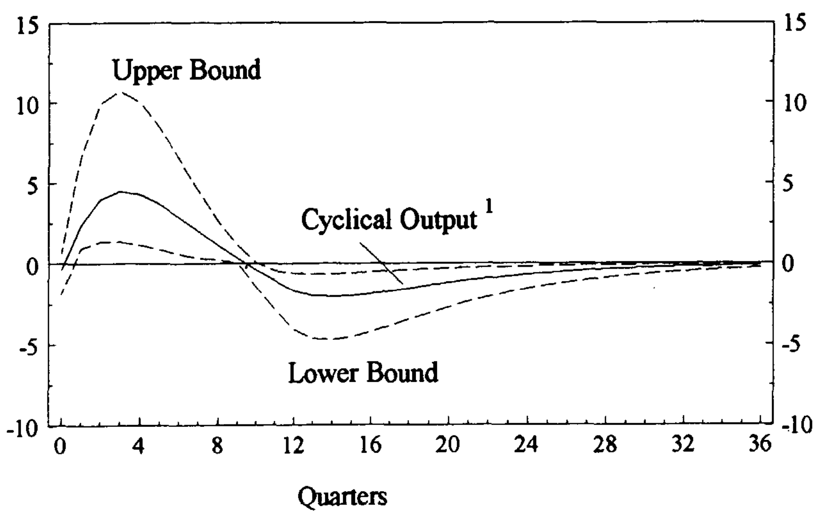
(Percent change, unless otherwise indicated)

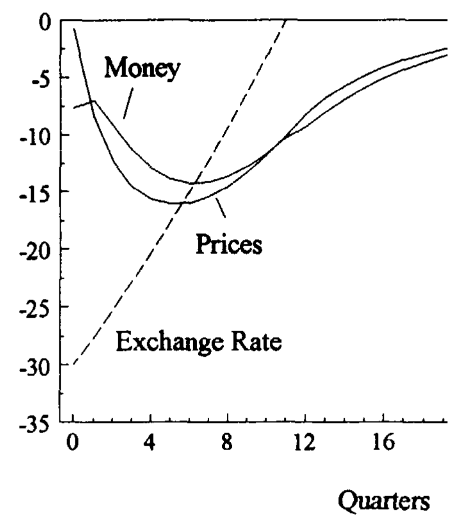
A. Bilateral Real Exchange Rate





B. Bilateral Terms of Trade



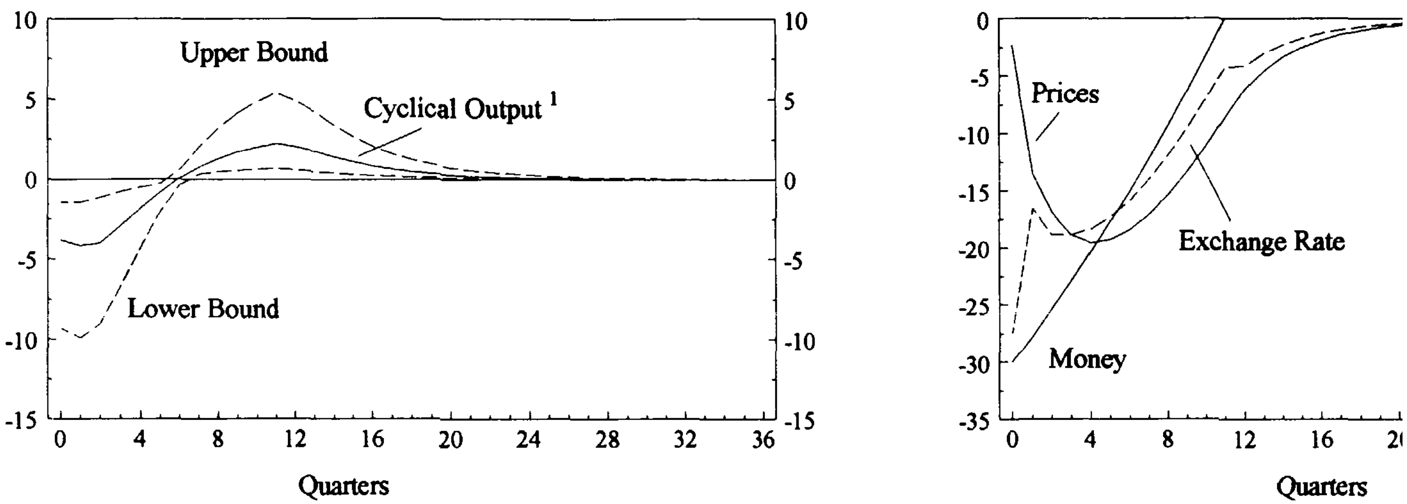


[1] Percent deviation from trend. Upper and lower bounds refer to one standard deviation of the impulse response, calculated

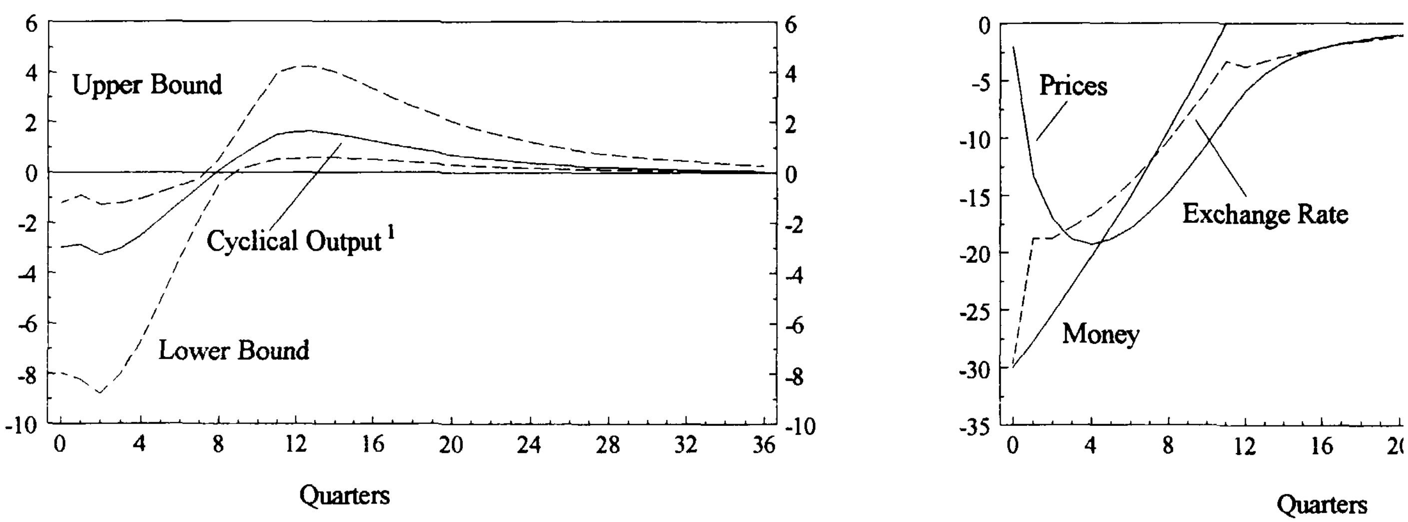
Figure A2. Temporary Money-Based Stabilization, alternative exoge

(Percent change, unless otherwise indicated)

A. Bilateral Real Exchange Rate



B. Bilateral Terms of Trade



[1] Percent deviation from trend. Upper and lower bounds refer to one standard deviation of the impulse response, calculated u

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