

Elections, Exchange Rates & Central Bank Reform in Latin America

by

Rodolfo Cermeño,* Robin Grier** & Kevin Grier**

*División de Economía, Centro de Investigación y Docencia Económicas (CIDE), Carret. México-Toluca 3655, 01210 México D.F., Mexico. Email: rodolfo.cermeno@cide.edu. Tel: (52-55) 5727-9800 ext.2714, Fax: (52-55) 5727-9878

**Department of Economics, University of Oklahoma, Norman OK 73019. For the academic year 2005-2006: Department of Political Science, Duke University, Durham NC 27708. Email: rgrier@duke.edu, angus@duke.edu. Tel: (919) 660-4352, (919) 660-4331. Fax: (919) 660-4330.

November 2005

I. Introduction

While central bank reform has been widely prescribed for developing countries, the efficacy of central bank independence is still controversial. Most of the empirical work on the economic effects of central bank independence (hereafter, CBI) focus on a sub-set of industrialized countries and the results of these studies often do not hold up when developing countries are considered.¹ One of the reasons for the mixed empirical findings may be the difficulty of measuring CBI, especially in developing countries, where the use of legal status to determine CBI may be inappropriate insofar as real world practices diverge significantly from the laws on the books.² Most of the CBI literature uses a quantitative index or a measure of leadership turnover to measure independence, which forces the index number to be linearly related to the economic variable under study.³ Other times the measure is an average of several different cardinal rankings, which raises the question of which rankings should be included to best measure CBI .

We take a different approach in this paper. Instead of trying to find the right combination of rankings to “best” measure CBI, we use a simple before and after approach to investigate whether the timing of central bank reforms (hereafter CBR) affects the strength of electorally timed real exchange rate (hereafter, RER) depreciations, as well as testing for direct effects of CBR on the RER or RER uncertainty.⁴

We focus on Latin America for three reasons. First, because central bank reform has been widespread in the region in the 1990s. Jácome (2001,p.4), writing about Latin America central bank reform, states that a “common denominator in these changes was the autonomy...granted to central banks in the design and execution of monetary policy as a means of securing price stability.” Second, there is already a literature arguing that politicians in Latin America actively

manipulate exchange rate depreciations so they do not coincide with elections. If the central bank reform is genuine and central bankers' preferences are less concerned with election outcomes, reforms that increase the autonomy of a central bank could also increase exchange rate stability. Third, most countries in the region have fixed election dates, so that the timing of the election is truly exogenous with respect to the evolution of macroeconomic variables.

Our sample is composed of 9 Latin American countries (Brazil, Chile, Colombia, Costa Rica, Ecuador, Mexico, Peru, Uruguay and Venezuela) that adopted central bank reform during the 1980-2000 period. Our baseline model for the evolution of the real exchange rate is based on the work of Goldfajn & Valdés (1999). We extend their work by embedding it in a statistical model which allows for both conditional heteroskedasticity and cross sectional correlation in the error process, following Cermeño & Grier (2005). This allows us to both more efficiently estimate the coefficients in the conditional mean equation as well as to directly test hypotheses about how events affect the predictability of the real exchange rate. Specifically, we test whether the timing of central bank reforms affects the strength of electorally timed RER depreciations, as well as for any direct effects of central bank reform on the RER or RER uncertainty, which is a novel aspect of this paper.

In an initial Least Squares panel model that ignores the possible effects of central bank reform, we confirm the conventional wisdom that there is significant post-election depreciation, even in the real exchange rate. However, when we incorporate dummy variables representing the adoption of CBR and use a statistical model that allows for conditionally heteroskedastic and correlated errors, we find that the adoption of CBR is significantly negatively partially correlated with both the average rate of RER depreciation and uncertainty about future values of the RER.

With respect to elections, we find that post-election real depreciations were a pre-reform phenomenon in these countries.⁵

Section II of the paper discusses the possible relationship between central bank reform, exchange rate depreciation, and elections in Latin America. Section III constructs a statistical model of the real exchange rate, while Section IV discusses the results. Section V concludes.

II. Central Bank Reform, Exchange Rates, and Elections in Latin America

We study the real (as opposed to the nominal) exchange rate because it is the relevant variable for economic decisions and outcomes, even though government policies are often stated in terms of nominal exchange rate objectives.⁶ Given that there is not a one-to-one, or even necessarily a monotonic, relationship between nominal and real exchange rate fluctuations, studying only the nominal exchange rate can give misleading inferences about whether politics affects the economically more important real exchange rate.

In this section we discuss how central bank reform and national elections can influence the evolution of the real exchange rate. In the following section, we develop a statistical model of the RER that we use as a baseline to test the hypotheses presented here.

A. Central Bank Reform and the RER.

All of the countries in our sample have undertaken significant CBR during the 1980-2000 period. Jácome (2001) characterizes these reforms and shows that significant increases in central bank autonomy were accomplished in three ways. First, many countries in the region, such as Brazil, Chile, Colombia, Costa Rica, Mexico, and Peru, have changed the charter of the central bank so that its sole (or at least primary) objective is now price stability. Second, the

reforms in this period have reduced the political dependence of central banks in the region on the executive branch of government. For example, executive appointments to the central banks of Brazil, Chile, Colombia, Costa Rica, Mexico, and Venezuela must now be confirmed by the legislature.⁷ In addition, the term of appointment for the central bank's Board of Directors in these countries no longer matches that of the presidential term.

Lastly, Latin American countries have increased the economic autonomy of their central banks. Jácome (2001, p.8) characterizes economic autonomy as “central bank freedom to formulate and implement monetary policy ...it should also include a legal prohibition or severe limitations on government financing—consistent with central bank's financial programming and the policy target—from the central bank, since this is often the key root of inflation.” An example of increased economic autonomy can be found in the reforms undertaken by Chile, Mexico, Peru, and Venezuela, all of whom outlawed central bank credit to the government except in cases of emergency.

If central bank reform has been an effective and credible means for Latin American governments to reduce monetary manipulation, then we would expect to see any pre-reform relationship between RER depreciation and elections to be diminished in the conditional mean equation. Swinburne & Castello-Branco (1991) argue that laws which purport to safeguard CB independence may be useless if there are other ways (that is, non-statutory ways) in which politicians can influence the central bank. If this is the case in our sample, then we should see no difference between the pre- and post-reform period.

The effect of CBR on RER uncertainty is less clear cut as it revolves around the relative predictability of governments vs. central bankers as well as the credibility of the undertaken

reform. If monetary policy is more predictable under an independent central bank than it is under direct government control, then CBR should lower uncertainty. If, however, the reform is not fully credible, agents' expectations will be a weighted average of the outcomes predicted for each policymaker (that is, the independent central bank and the government), and the variance of the forecast errors may well increase. A finding that CBR reduces uncertainty would be evidence in favor of the idea that, on average, Latin American CBR was credible and that central bank policies are generally more predictable than the government's exchange rate policies.

While there is little debate that Latin American countries have significantly increased the autonomy of their central banks during our sample period, measuring the degree of central bank independence is controversial.⁸ As noted in the introduction, most of the literature uses cardinal rankings to measure CBI, which forces the index number to have a linear relationship to the dependent variable.⁹ We take a different approach and investigate whether the timing of central bank reforms alters the nature of electorally timed RER depreciations.

B. Elections and the RER

1. Delayed Depreciations

While most analysts agree that real exchange rate overvaluation will negatively affect the economy in the long run, there is a lot of anecdotal evidence that nominal exchange rate depreciations are politically costly and that policymakers try to avoid currency depreciations before an election.¹⁰ For example, Cooper (1971) argues that nominal devaluations are costly to developing country governments, especially finance ministers, who often are fired right after a devaluation takes place. Ben-Porath (1975) shows that the Israeli government has never devalued its currency less than eighteen months before an election.

Stein & Streb (1998) argue that policymakers postpone exchange rate corrections at least in part because of the increased inflation they often bring. Thus they shift inflation problems to the next period, presumably after the election takes place. Méon (2004) constructs a model where politicians avoid pre-election depreciations of the exchange rate because it sends a signal to voters that they are incompetent. In an empirical study of 39 large nominal devaluations in democratic countries, Edwards (1994) finds that devaluation is significantly more likely in the post-election period and argues that policymakers can “devalue immediately and blame it on your predecessors.”

Likewise, Gavin & Perotti (1997) show that policymakers are more likely to abandon a fixed peg regime early on in their terms and not close to an election period. Klein & Marion (1997) find support for this finding in a study of Latin American countries from 1956-1991, where the likelihood of abandoning an exchange rate peg is highest right after a presidential election.¹¹

In this paper we are interested in whether the stylized fact that depreciations are delayed until after elections will continue to hold when we (1) embed the test in a generously parameterized statistical model that also controls for conditional heteroskedasticity and cross sectional dependence; (2) confine the test to elections with exogenous dates; (3) and use real, rather than nominal, exchange rates as the relevant variable. We also seek to test whether any election date- real exchange rate link that we discover is altered when a country reforms its central bank.

2. Increased Uncertainty

While the effect of elections on exchange rate uncertainty is less studied, it is a potentially important phenomenon as exchange rate uncertainty has been linked to reduced exports and even reduced economic growth.¹² An Alesina (1987) style rational partisan model implies that a contested election between political parties with different policy preferences creates uncertainty about the post-election inflation rate (and by extension the post-election real exchange rate). Grier & Grier (2000), using a simple univariate GARCH model, find exactly this result for Mexican inflation.¹³

We will test for increased electoral uncertainty by allowing a level shift in the conditional variance of the RER during post-election periods. As in the case of electorally timed depreciations, we will also investigate whether the advent of CBR has any influence on how elections affect exchange rate predictability.

In the next two sections, we set out our statistical model of the real exchange rate and test whether the timing of elections and CBR play a significant role in the determination of real exchange rates in our 9 Latin American countries.

III. A Statistical Model of the Real Exchange Rate

A. Variables

Our sample is a monthly panel of 9 Latin American countries from 1980-2000, encompassing a total of forty presidential elections. We chose this sample of countries because they have complete data and their elections are conducted at regular intervals, which means that

their timing is exogenous to economic variables. In this way we avoid issues of simultaneity between the economy and the election date.¹⁴

Our real exchange rate data comes both from J.P. Morgan and the IMF's International Financial Statistics (IFS).¹⁵ In these data, higher values of the index imply a higher real value of the currency under study. Thus, real appreciations are denoted by increases in the index.

In order to test whether elections delay real exchange rate depreciations, we construct an electoral dummy variable called *Post* with data from Georgetown's Political Database of the Americas, IFE's election guide, and Bienen & van de Walle (1991). *Post* is equal to one for the month of the election and the subsequent five months.¹⁶ Appendix 1 provides a list of election dates for all the countries in the sample. Based on the results discussed above, we would expect to find a negative and significant coefficient on *Post*, reflecting the delayed real exchange rate depreciation that occurs after the election date.

Between 1988 and 1995, as documented in Jácome (2001), each of the nine countries we study has enacted substantial central bank reform legislation granting increased independence to the central bank. Appendix 1 provides the dates of central bank reform in each country.

To test for the effect of these changes on the RER process, we create a variable $Reform_{it}$, which is equal to 0 before reform was undertaken in country i and equal to 1 after that date.¹⁷ In addition, we interact this variable with *Post* to investigate whether the CBR has significantly changed the relationship between the political business cycle and the mean and conditional variance of the real exchange rate in Latin America. It is important to note that the nine reform dates are spread out over these 7 years, with 1 each in 1988 and 89, none in 1990, 1 in 1991, 2 each in 1992 and 93, none in 1994 and 2 in 1995. This wide range of reform dates means that it

is unlikely that there is a single event that is both causing CBR and influencing the RER process.¹⁸

We control for economic variables which affect the real exchange rate by adopting as our baseline model the empirical model of Goldfajn & Valdés (1999). They identify terms of trade, trade liberalization, government spending, and the international interest rate as important factors in the determination of the real exchange rate.

Shocks to the terms of trade, either through a fall in the price of exports or an increase in the price of imports, can have a negative income effect on small, open economies (see Diaz-Alejandro (1982)). For example, a rise in the price of imports can cause a reduction in a country's permanent income, which would reduce people's demand for non-tradables and cause a depreciation in the real exchange rate. On the other hand, Edwards (1989) identifies a possible substitution effect, in that production may move from the non-tradables to the tradables sector, resulting in an increase in the price of non-tradables and a real exchange rate appreciation. The effect of a terms of trade shock thus depends on whether the substitution effect is stronger than the income effect. We use a terms of trade index from the World Bank's World Tables, where 1987 is equal to 100. The data is yearly and is divided by 12 and interpolated using July as the base month.

Goldfajn & Valdés use economic openness (measured as the sum of exports and imports as a percentage of GDP) as a proxy for trade liberalization. They argue that a reduction in import tariffs would bring about a fall in the price of non-tradables in order to bring the labor market back into equilibrium.¹⁹ We measure openness as the ratio of exports and imports to

GDP. The trade data is available monthly from the IMF IFS CD-ROM. GDP figures are interpolated from yearly data from the same source.

The effect of a permanent increase in the size of government can have two different effects on the price of non-tradables. Increased government spending can cause a real exchange rate appreciation if the government increases overall demand for non-tradable goods. If new government spending instead goes toward imported goods (Goldfajn & Valdés use the example of imported military equipment), then the increased expenditures will be associated with a real exchange rate depreciation. We measure the size of government with monthly data on general government expenditures as a percentage of GDP from the IMF-IFS CD-ROM.

We measure the international interest rate with the 3 month US Treasury bill rate in secondary markets, which is taken from the St. Louis Fed's FRED database and is reported monthly over the sample. As Goldfajn & Valdés point out, changes in the international interest can have both short run and long run effects on the real exchange rate. If we assume that savings are inelastic in the short run, then a fall in the international interest rate will translate into increased capital inflows into developing countries. In the long run however, when savings should be more elastic, the result of a lower international rate should mean a drop in net foreign assets.

Finally, we include lagged RER values on the right hand side of our models to capture any persistence in the series. This is especially important in our case because un-modeled serial correlation can cause spurious findings of conditional heteroskedasticity. We also consider several lags of the economic control variables as nothing in the theory specifies the exact timing of the relationships. Basically, we want to let the baseline model fit the data as well as possible

in order to make the test for the existence of effects from elections or CBR as stringent and credible as possible.

B. Statistical Model

We seek to estimate how elections and central bank reform affect the RER (both its mean and its predictability) in a panel model that controls for the relevant economic variables and allows for a time-varying covariance matrix. Given the widespread evidence that financial time series exhibit volatility clustering, it is important on efficiency grounds to model that clustering. Beyond the efficiency gains, having a parametric model of the conditional variance, allows us to directly test hypotheses about how elections and CBR affect the predictability of the RER as well as its level.

In order to determine an appropriate functional form of the model, we conduct several pre-tests. Specifically, we implement panel unit root tests on the different variables discussed above, finding in each case that the series are not stationary.²⁰ We next investigate any possible co-integrating relationships by means of panel unit root tests, of which we found none. These results indicate that the data should be first-differenced and the model estimated in growth rates.

We also tested for the existence of individual effects in both the conditional mean and the conditional variance, finding pervasive and significant individual effects in the mean and the variance. The differencing described above will remove any individual effect from the mean equation and we will include country specific fixed effects in our conditional variance model.²¹

We also test for the best fitting lag structure of the independent variables and find that 12 lags of RER growth, and 3-month moving averages of terms of trade, openness, and government

spending are appropriate.²² The U.S. t-bill rate is contemporaneously related to the RER in these countries and we interpret this correlation as one way causation from the US to Latin America.²³

Our model allows for both conditional and unconditional heteroskedasticity and conditional cross-sectional correlation of the error terms. Equations 1 - 3 below present the specifics.²⁴

$$\ln(R_{it}) = \alpha_0 + \sum_{j=1}^{12} \alpha_j \ln(R_{it-j}) + \alpha_5 \ln(\text{totma}_{it}) + \alpha_6 \ln(\text{openma}_{it}) + \alpha_7 \ln(\text{govma}_{it}) + \alpha_8 \ln(\text{tbill}_t) + \beta \text{Post}_{it} + \epsilon_{it} \quad (1)$$

$$h_{iit} = N_1 \epsilon_{iit-1}^2 + N_2 h_{iit-1} + N_3 Br_t + N_4 Ch_t + N_5 Col_t + N_6 Cr_t + N_7 Ec_t + N_8 Mex_t + N_9 Per_t + N_{10} Ur_t + N_{11} Ve_t + 2 \text{Post}_{it} \quad \text{For all } i = 1 - N \quad (2)$$

$$h_{ikt} = D_{ik} * h_{iit} * h_{kkt} \quad \text{For all } i \dots k \quad (3)$$

Here i indexes countries and t indexes time. The error terms are assumed to be distributed multivariate normal with mean zero and variance H_t . The diagonal elements of H_t are given in equation 2 and the off-diagonal elements in equation 3. The covariance specification follows Bollerslev (1990).

The key coefficients testing for electoral effects on the RER process are β and 2. If politicians purposefully delay putting off needed real exchange rate depreciations until after elections, then β will be negative and significant. If elections create additional RER uncertainty, then 2 will be positive and significant.

After examining the results of this initial model, we continue by adding a dummy for CBR in each country along with interaction variables between CBR and the electoral dummies.

This changes equations (1) and (2) to the following:

$$\ln(R_{it}) = \beta_0 + \sum_{j=1}^{12} \beta_j \ln(R_{it-j}) + \beta_5 \ln(\text{totma}_{it}) + \beta_6 \ln(\text{openma}_{it}) + \beta_7 \ln(\text{govma}_{it}) + \beta_8 \ln(\text{tbill}_t) + \beta_9 \text{Post}_{it} + \beta_{10} \text{Reform}_{it} + \beta_{11} \text{Post}_{it} * \text{Reform}_{it} + \beta_{12} \text{G}_{it} \quad (1')$$

$$h_{iit} = \alpha_1 \text{G}_{iit-1}^2 + \alpha_2 h_{iit-1} + \alpha_3 \text{Br}_t + \alpha_4 \text{Ch}_t + \alpha_5 \text{Col}_t + \alpha_6 \text{Cr}_t + \alpha_7 \text{Ec}_t + \alpha_8 \text{Mex}_t + \alpha_9 \text{Per}_t + \alpha_{10} \text{Ur}_t + \alpha_{11} \text{Ven}_t + \alpha_{12} \text{Post}_{it} + \alpha_{13} \text{PReform}_{it} + \alpha_{14} \text{RPost}_{it} * \text{Reform}_{it} \quad \text{For all } i = 1 - N \quad (2')$$

With this model we can test whether the timing of CBR is significantly partially correlated with direct changes in the RER process and whether it has any influence on how elections affect the RER process.²⁵

IV. Results

Table 1 presents some preliminary results of estimating equation (1) via Least Squares. The coefficient on *Post*, is negative, sizeable (around -14) and significant at the 0.01 level, supporting the argument that politicians seek to delay potentially politically costly real exchange rate depreciations until after an election.

The terms of trade variable is negative, which indicates that improvements in the terms of trade are associated with decreases in the real exchange rate, but is only weakly statistically significant. The openness variable is negative and significant at the .05 level, meaning that greater levels of openness are correlated with lower real exchange rate values. Changes in the t-bill rate are positively and significantly correlated with real exchange rate appreciations, while government spending does not have a significant effect in this specification.

These initial results confirm and extend what others have argued about how elections can distort the evolution of exchange rates. Even when considering the real exchange rate, exogenous election dates, and a statistical model for the evolution of the RER we find that there is significant post-electoral RER depreciation. We are interested though in whether these OLS residuals show evidence of conditional heteroskedasticity and whether changes in the legal status of a nation's central bank affects the finding of post-electoral RER depreciation.

To formally test for conditional heteroskedasticity we take the squared residuals from Table 1 and regress them on various numbers of lags of the squared residuals. The R^2 of these regressions multiplied by the sample size is asymptotically distributed as a P^2 statistic, which we can use to test the null hypothesis of no autocorrelation in the squared residuals. At one lag, the value of the P^2 statistic is 16.26, which is significant at the 0.001 level. At five (ten) lags, the calculated P^2 is 30.37 (41.46), also significant at the 0.001 level. Thus there is evidence of significant and persistent autocorrelation in these squared residuals.

In Table 2, we control for conditional heteroskedasticity and cross sectional dependence by estimating the system of equations 1, 2 and 3 given above via direct numerical maximization of the log likelihood.²⁶ To save space, we do not individually report the estimated coefficients on the 12 lags of the RER, but rather simply report their joint significance level, which in this case is 0.01.²⁷ To test the significance of our estimated covariance model, we can compare the maximized value of the likelihood function here to that obtained in Table 1. This likelihood ratio test yields a calculated Chi-square statistic of 1,666, which means that we can reject at the .001 level the null hypothesis that there is no conditional heteroskedasticity or cross-sectional dependence in these data.²⁸

Table 2 shows that once we model the conditional heteroskedasticity and cross-sectional dependence in the residuals, the size of the electoral effect in the mean equation drops by around 50% and its significance level falls to 0.05. We also find a positive relationship between the post-election dummy and the conditional variance. *Post* has a large positive and significant effect on the conditional variance of RER growth (the coefficient is around 1100 which is larger than 8 of the 9 country fixed effects in the variance). Thus by implementing our covariance model we find that the effect of elections on depreciation is still significant and is accompanied by a large increase in uncertainty associated with the aftermath of elections.²⁹

The lower portion of the table contains the estimated cross-country conditional correlation matrix. Twenty one of the thirty six correlations are positive and significant at the 0.05 level. The countries whose exchange rates shocks are most significantly linked to other countries are Venezuela and Chile, while the countries with the fewest significant links are Uruguay and Ecuador.

As a simple check on the adequacy of our covariance model, we take the normalized residuals from Table 2 and test their squares for autocorrelation. At 1, 5, and 10 lags the calculated P^2 statistics are 0.23, 1.81 and 2.53 respectively, all of which are completely insignificant, indicating that the autocorrelation of the squared residuals found in the OLS model has been eliminated.³⁰

We now turn to consider the effects of central bank reform. Table 3 reports estimates of equations 1', 2' and 3 shown above. Again we do not report the 12 individual RER lag coefficients, but simply note that they are significant as a group at the 0.01 level. The four new variables that did not appear in Table 2 (Reform and Post*Reform in both the conditional mean

and conditional variance equations) are jointly significant at the 0.01 level and three of them are individually significant. Thus, CBR is an important factor for understanding the evolution of the real exchange rate process in these countries. The Goldfajn-Valdes control variables are jointly significant and generally show greater individual statistical significance than they did in the OLS specification reported in Table 1.

From Table 3 we can see the following results: (1) *ceteris paribus*, CBR is associated with a lower average rate of RER depreciation and significantly less RER uncertainty. The reform variable is positive (negative) and significant in the conditional mean (variance) equation, meaning that there is less average depreciation and that the RER process is less unpredictable in the post-reform period; (2) the immediate post-election period is associated with increased rates of RER depreciation in the pre-reform data, but this effect is more than completely erased in the post-reform observations. Pre-reform, the RER depreciates almost 13% per month in the post-election period, holding other factors constant, while post-reform this effect completely disappears; and (3) once the change in the effect of elections on RER growth is allowed to change in the pre- and post-reform periods, there is no longer any evidence that elections create additional RER uncertainty. Both Post and (Post*CBR) are insignificant in the conditional variance equation.³¹

In sum, our results clearly show that CBR is correlated with the real exchange rate process in these 9 countries. This is true both directly and in terms of how elections affect the real exchange rate. CBR has on average wiped out electorally motivated RER depreciations, reduced the average rate of RER depreciation and lowered RER uncertainty.

V. Discussion

In this paper we investigate the interaction between real exchange rate depreciations and elections. Our work extends existing research on the subject in three ways: (1) we emphasize the real, instead of the nominal, exchange rate, which is the more relevant economic variable; (2) we use a statistical model which both allows for conditional heteroskedasticity and cross-sectional correlation in the errors and allows us to test for electoral effects on exchange rate uncertainty; and (3) we investigate the role of CBR on the relationship between elections and RER depreciation and the evolution of the RER in general.

We find that real depreciations were significantly delayed until after elections in the pre-CBR data and that the adoption of new CB legislation completely eliminates the effect. We also find that CBR is significantly partially correlated with reduced RER uncertainty and lower average depreciation rates. This is new evidence in favor of the proposition that legal central bank independence can have real economic effects and suggests a policy recommendation that central bank reform accompany democratic reforms in order to mitigate any tendency for elections to create exchange rate instability.

These results are novel in that they test for electoral and reform effects both on the mean and conditional variance of the RER. They are also novel in that they test for effects of CBR using the timing of changes in CBI within each country rather than using a non-time varying CBI index and assuming it to be linearly related to the exchange rate.

Table 1. A LS model of RER growth

$$\begin{aligned}
\ln(R_{it}) = & 1.63 + .06 \ln(R_{it-1}) - .12 \ln(R_{it-2}) - .03 \ln(R_{it-3}) - .08 \ln(R_{it-4}) \\
& (1.2) \quad (3.1) \quad (5.6) \quad (1.4) \quad (3.8) \\
& + .01 \ln(R_{it-5}) - .04 \ln(R_{it-6}) - .05 \ln(R_{it-7}) - .02 \ln(R_{it-8}) \\
& (0.6) \quad (2.1) \quad (2.5) \quad (0.8) \\
& + .01 \ln(R_{it-9}) + .02 \ln(R_{it-10}) - .02 \ln(R_{it-11}) - .004 \ln(R_{it-12}) \\
& (0.5) \quad (1.1) \quad (1.1) \quad (0.2) \\
& - .14 \ln(\text{tot}_{\text{ma}}) + .01 \ln(\text{gov}_{\text{ma}}) - .04 \ln(\text{open}_{\text{ma}}) + 0.06 \ln(\text{tbill}) \\
& (1.5) \quad (1.0) \quad (2.0) \quad (3.6) \\
& - 13.9 \text{ Post} \\
& (3.3)
\end{aligned}$$

LLF = -12396; N=9, T=247

Table 2. A model of RER growth, controlling for conditional heteroskedasticity and cross-sectional dependence

$$\ln(R_{it}) = 0.67 + \sum_{j=1}^{12} \beta_j \ln(R_{it-j}) + .09 \ln(\text{tot}_{ma}) - .009 \ln(\text{open}_{ma}) + .011 \ln(\text{gov}_{ma})$$

(1.1) [.01] (1.9) (0.9) (2.9)

$$+ .06 \ln(\text{tbill}) - 6.91 \text{Post}$$

(6.9) (2.4)

$$h_{iit} = 1.6 g_{iit-1}^2 + .13 h_{iit-1} + 1187.3 \text{Post} + 430.9 \text{Br} + 334.5 \text{Ch} + 188.8 \text{Col} +$$

(15.3) (5.2) (4.8) (3.8) (5.1) (4.2)

$$74.5 \text{Cr} + 2690.9 \text{Ec} + 220.1 \text{Mex} + 273.2 \text{Per} + 404.3 \text{Ur} + 247.0 \text{Ven}$$

(4.3) (7.1) (4.3) (3.6) (4.5) (4.5)

$$h_{ikt} = D_{ik} * h_{iit} * h_{kkt}$$

Matrix of the estimated D_{ik}

	<i>Ch</i>	<i>Col</i>	<i>Cr</i>	<i>Ec</i>	<i>Mex</i>	<i>Per</i>	<i>Ur</i>	<i>Ven</i>
<i>Br</i>	-.01	.18	.14	-.07	.06	.07	.03	.12
<i>Ch</i>		.44	.33	.21	.33	.23	.05	.26
<i>Col</i>			.32	.10	.25	.21	.01	.29
<i>Cr</i>				.05	.14	.32	.12	.19
<i>Ec</i>					.07	.06	-.004	.13
<i>Mex</i>						.13	.09	.22
<i>Per</i>							.06	.20
<i>Ur</i>								.18

Maximized Log-Likelihood = - 10909 N=9 T=247

Numbers in parentheses are asymptotic t-statistics, while the number in brackets is the marginal significance level of the 12 lagged RER growth coefficients (which sum to 0.10).

Correlation coefficients in bold are significant at the .05 level or better

Table 3: A model of RER growth controlling for conditional heteroskedasticity and cross-sectional dependence with dummies for CBR

$$\ln(R_{it}) = -5.8 + \sum_{j=1}^{12} \beta_j \ln(R_{it-j}) + .11 \ln(\text{tot}_{ma}) - .017 \ln(\text{open}_{ma}) + .010 \ln(\text{gov}_{ma})$$

(0.8) [.01] (2.3) (1.7) (2.5)

$$+ .06 \ln(\text{tbill}) - 9.82 \text{Post} + 15.4 \text{Post*Reform} + 4.22 \text{Reform}$$

(6.9) (3.0) (2.5) (3.9)

$$h_{iit} = 1.6 g_{iit-1}^2 + .13 h_{iit-1} + 446.1 \text{Post} + 702.5 \text{Post*Reform} - 88.5 \text{Reform} + 421.7 \text{Br}$$

(15.3) (5.4) (.99) (1.2) (3.0) (4.0)

$$+ 386.2 \text{Ch} + 213.8 \text{Col} + 121.1 \text{Cr} + 2828.7 \text{Ec} + 279.6 \text{Mex} + 285.9 \text{Pe}$$

(5.9) (4.3) (4.2) (6.5) (4.8) (4.1)

$$+ 477.3 \text{Ur} + 248.7 \text{Ven}$$

(5.0) (5.0)

$$h_{ikt} = D_{ik} * h_{iit} * h_{kkt}$$

Matrix of the estimated D_{ik}

	<i>Ch</i>	<i>Col</i>	<i>Cr</i>	<i>Ec</i>	<i>Mex</i>	<i>Per</i>	<i>Ur</i>	<i>Ven</i>
<i>Br</i>	.004	.18	.15	-.07	.07	.07	.04	.12
<i>Ch</i>		.43	.34	.21	.35	.24	.05	.25
<i>Col</i>			.30	.09	.25	.20	.01	.28
<i>Cr</i>				.06	.13	.32	.11	.19
<i>Ec</i>					.08	.06	-.008	.13
<i>Mex</i>						.19	.08	.22
<i>Per</i>							.06	.20
<i>Ur</i>								.17

Maximized Log-Likelihood = - 10889 N=9 T=247

Numbers in parentheses are asymptotic t-statistics while, the number in brackets is the marginal significance level of the 12 lagged RER growth coefficients (which sum to 0.06).

Correlation coefficients in bold are significant at the .05 level or better

Appendix: Presidential Elections and Central Bank Reform in Latin America, 1980-2000

<u>Country</u>	<u>Election Date</u>	<u>Runoff Date</u>	<u>CB Reform Date</u>
Brazil	1 /1985	n.a.	10/ 1988
	11/ 1989	12/1989	
	10/ 1994	n.a.	
	10/ 1998	n.a.	
Chile	12/ 1989	n.a.	10/ 1989
	12/ 1993	n.a.	
	12/ 1999	1/ 2000	
Colombia	5/ 1982	n.a.	8/ 1991
	5/ 1986	n.a.	
	5/ 1990	n.a.	
	5/ 1994	n.a.	
	5/ 1998	6/ 1998	
Costa Rica	2/ 1982	n.a.	11/ 1995
	2/ 1986	n.a.	
	2/ 1990	n.a.	
	2/ 1994	n.a.	
	2/ 1998	n.a.	
Ecuador	1/ 1984	5/ 1984	5/ 1992
	1/ 1988	5/ 1988	
	4/ 1992	7/ 1992	
	5/ 1996	7/ 1996	
	5/ 1998	7/ 1998	
Mexico	7/ 1982	n.a.	12/ 1993
	7/ 1988	n.a.	
	8/ 1994	n.a.	
	8/ 2000	n.a.	
Peru	5/ 1980	n.a.	1/ 1993
	4/ 1985	n.a.	
	4/ 1990	6/ 1990	
	4/ 1995	n.a.	
	4/ 2000	5/ 2000	
Uruguay	11/ 1984	n.a.	3/ 1995
	11/ 1989	n.a.	
	11/ 1994	n.a.	
	10/ 1999	n.a.	

<u>Country</u>	<u>Election Date</u>	<u>Runoff Date</u>	<u>CB Reform Date</u>
Venezuela	12/ 1983	n.a.	12/1992
	12/ 1988	n.a.	
	12/ 1993	n.a.	
	12/ 1998	n.a.	
	7/ 2000	n.a.	

References

- Alesina, Alberto, 1987, Macroeconomic Policy in a Two-Party System as a Repeated Game, *Quarterly Journal of Economics* 102, 651-78.
- Alesina, Alberto, 1988, Macroeconomics and politics, in Stanley Fischer (ed.), *NBER Macroeconomics Annual* (Cambridge, MA: MIT Press), 17-52.
- Alesina, Alberto and Lawrence H. Summers, 1993, Central bank independence and macroeconomic performance: some comparative evidence, *Journal of Money, Credit and Banking* 25 (2), 151-162.
- Ben-Porath, Yoram, 1975, The years of plenty and the years of famine-a political business cycle? *Kyklos* 28, 400-403.
- Berger, Helge, de Haan, Jakob, and Sylvester Eijffinger, 2001, Central bank independence: an update of theory and evidence, *Journal of Economic Surveys* 15(1), 3-38.
- Bienen, Henry and Nicolas van de Walle, 1991, *Of time and power: leadership duration in the modern world* (Stanford, CA: Stanford University Press).
- Bollerslev, Tim, 1990, Modelling the coherence in short run nominal exchange rates: a multivariate generalized ARCH model, *Review of Economics and Statistics* 72, 498-505.
- Calvo, Guillermo and Carmen Reinhart, 2001, Fixing for your life, in Susan Collins & Dani Rodrik (eds) *Brookings Trade Forum 2000* (Brookings Institution Press).
- Cermeño, Rodolfo and Kevin Grier, 2005, Conditional Heteroskedasticity and Cross-Sectional Dependence in Panel Data: An Empirical Study of Inflation Uncertainty in the G-7 Countries, in Badi Baltagi (ed). *Panel Data Econometrics; Theoretical Contributions and Empirical Applications* (New York: Springer Publishing), forthcoming.
- Cooper, Richard, 1971, Currency devaluations in developing countries, *Essays in international finance* 86, Princeton University.
- Cukierman, Alex, Steven B. Webb and Bilin Neyapti, 1992, Measuring the independence of central banks and its effect on policy outcomes, *The World Bank Economic Review*, 6 (3), 353-398.
- Diaz-Alejandro, Carlos, 1982, Exchange rates and the terms of trade in the Argentine Republic, 1913-1976, in Moises Syrquin and Teitel (Eds.), *Trade, stability, technology, and equity in Latin America* (New York: Academic Press), 27-41.
- Edwards, Sebastian, 1989, Temporary terms of trade disturbances, the real exchange rate, and the current account, *Economica* 56 (223), 343-357.

- Edwards, Sebastian, 1994, The political economy of inflation and stabilization in developing countries, *Economic Development and Cultural Change* 42, 235-266.
- Engle, Robert, 1982, Autoregressive conditional heteroskedasticity with estimates of the variance of UK inflation, *Econometrica* (50): 987-1007.
- Franzese, R.J. Jr., 1999, Partially independent central banks, politically responsive governments, and inflation, *American Journal of Political Science* 43 (3), 681-706.
- Franzese, R.J., 2002, Electoral and Partisan Cycles in Economic Policies and Outcomes, *Annual Reviews of Political Science* 5, 369-421
- Franzese, R.J., 2003, Multiple hands on the wheel: empirically modeling partial delegation and shared control of monetary policy in the open and institutionalized economy, *Political Analysis* 11(4): 445-474.
- Gavin, Michael and Roberto Perotti, 1997, Fiscal policy, *NBER Macroeconomics Annual*.
- Georgetown Election Data (<http://www.georgetown.edu/pdba/Elecdata/Calendar>)
- Grier, Kevin and Fausto Hernández, 2004, The real exchange rate and its real effects: the cases of Mexico and the USA, *Journal of Applied Economics* 7(1): 1-25.
- Grier, Robin and Kevin Grier, 2000, Political cycles in non-traditional settings: theory and evidence from the case of Mexico, *The Journal of Law and Economics* 43 (1), 239-263.
- Grilli, Vittorio, Donato Maciandaro and Guido Tabellini, 1991, Political and monetary institutions and public financial policies in the industrial countries, *Economic Policy* (13), 342-392.
- Goldfajn, Ilan and Rodrigo Valdés, 1999, The aftermath of appreciations, *The Quarterly Journal of Economics*, February, 114 (1), 229-262.
- Haggard, Stephan and Robert R. Kaufman, 1995, *The political economy of democratic transitions* (Princeton, NJ: Princeton University Press).
- IFE's election guide (<http://www.ifes.org/eguide/elecguide.htm>).
- Jácome, Luis, 2001, Legal central bank independence and inflation in Latin America during the 1990s, IMF Working Paper #212.
- Keefer, Phil and David Stasavage, 2003, The limits of delegation: veto players, central bank independence, and the credibility of monetary policy, *American Political Science Review* 97 (3): 407-423.

- Klein, Michael and Nancy Marion, 1997, Explaining the duration of exchange rate pegs, *Journal of Development Economics* 54, 387-404.
- Leblang, David, 2003, To devalue or to defend? The political economy of exchange rate policy, *International Studies Quarterly* 47 (4): 533-559.
- Mangano, Gabriel, 1998, Measuring Central Bank Independence: A Tale of Subjectivity and of Its Consequences, *Oxford Economic Papers* 50 (3): 468-492.
- Méon, Pierre-Guillaume, 2004, Why are realignments postponed? A model of exchange rate revisions with opportunistic governments, *The Manchester School* 72(3): 298-316.
- Posen, Adam, 1998, Central bank independence and disinflationary credibility: a missing link? *Oxford Economic Papers* 50 (3), 335-359.
- Stein, Ernesto H. and Jorge M. Streb, 1998, Political stabilization cycles in high inflation economies, *Journal of Development Economics* 56 (June), 159-180.
- St. Louis Federal Reserve, FRED (<http://research.stlouisfed.org/fred2/>).
- Swinburne, Mark and Marta Castello-Branco, 1990, Central bank independence and central bank functions, in Patrick Downes and Reza Vaez-Zadeh (Eds.) *The evolving role of central banks* (Washington, D.C.: International Monetary Fund), 414-445.

Notes

* Earlier versions of this paper were presented at Duke University, the 2004 Midwest Political Science Association meetings and the 2003 Southern Economics Association meetings. We thank participants for their valuable comments and suggestions.

1. Temple (1998) argues that the link between CBI and inflation is only robust in high income countries, while Cukierman, Webb, and Neyapti (1992) find no statistically significant relationship between CBI and low inflation in a group of developing countries.

2. See Cukierman et.al. (1992).

3. While the various indices of CBI may not be linearly related to the real exchange rate, they do give a good qualitative demonstration of the effect of recent central bank reforms in the region. For instance, Cukierman created an index of CBI in the 1980s that included 7 of the countries under study here (all but Colombia and Ecuador). The average independence rating for those countries was .36. Jácome (2003) updates Cukierman's index for the late 1990s and finds that the average rating for those seven countries had increased to .72. This increase was not driven by 1 or 2 outliers, as large increases in central bank independence took place in each of the countries.

4. One reason we study the real exchange rate instead of the inflation rate in the region is because several of these countries experienced hyperinflation during our sample period, which makes modeling the average inflation nearly impossible.

5. Since we use a dummy variable for the adoption of reforms, it is possible that there is some third factor driving both the reduction in average depreciations, exchange rate uncertainty, and the decision to reform the central bank. This is frequently the case in any empirical application; that is to say alternative explanations abound for almost any empirical result.

6. The real exchange rate between a pair of countries (say Country A and B) is defined as the cost of a basket of goods in Country A over the cost of the same basket of goods in Country B. Mathematically, this can be expressed as the nominal exchange rate multiplied by the ratio of the price levels in the two countries.

7. In this paper, we implicitly assume that there are two actors: the Central Bank and the government. Clearly, this is a simplification as the government is unlikely to speak with one voice. For a nice theoretical model of the effect of multiple interests and veto power on central bank independence, see Keefer & Stasavage (2003).

8. Early indices of central bank independence (hereafter, CBI) constructed by Grilli et.al. (1991) and Cukierman et.al. (1992) generated an extensive empirical literature looking for the economic effects of CBI. Initial cross-sectional evidence (See Alesina & Summers (1993), Alesina (1998), Grilli et.al. (1991) and Cukierman et.al. (1992)) from developed countries showed a negative link between CBI and inflation. These results have been questioned by Posen (1998) who argue that they do not necessarily prove any causal connection between CBI and changes in inflation. Others argue that the results linking inflation and CBI are not robust. For example, Mangano (1998) regresses various indices of CBI on average inflation and finds

that almost 90% of the regression coefficients are not statistically significant, while Banian et.al. (1998) argue that almost none of the component variables included in the Cukierman index of independence is significantly related to inflation. Temple (1998) warns against the influence of outliers and argues that the link between CBI and inflation is only robust in high income countries. See Berger et.al. (2001) and Franzese (2002) for a good review of this literature.

9. While the various indices of CBI may not be linearly related to the real exchange rate, they do give a good qualitative demonstration of the effect of recent central bank reforms in the region. For instance, Cukierman created an index of CBI in the 1980s that included 7 of the countries under study here (all but Colombia and Ecuador). The average independence rating for those countries was .36. Jácome (2003) updates Cukierman's index for the late 1990s and finds that the average rating for those seven countries had increased to .72. This increase was not driven by 1 or 2 outliers, as large increases in central bank independence took place in each of the countries.

10. A nominal depreciation is not the only way a government can lower its real exchange rate. It could also keep the domestic inflation rate consistently lower than the inflation rate of its trading partners by restricting the money supply. Similar to a nominal devaluation though, deflation before an election would also be politically painful.

11. On the other hand, Leblang (2003) finds no evidence for increased post-election devaluations in his large panel study. In his data, the number of attacks is higher post-election than pre-election, but governments consistently defend against these attacks in the post-election period.

12. For example, Grier & Hernández (2004) show that exchange rate uncertainty has a negative and significant effect on the growth rate of Mexican industrial production.

13. Further, given the surprising frequency with which candidates run on one platform only to deliver another in Latin America, it is intuitively plausible that elections might generate increased uncertainty about the time path of macro variables. Carlos Menem in Argentina, Alberto Fujimori in Peru, and Fernando Henrique Cardoso in Brazil are recent examples of this phenomenon.

14. Several of the countries in the sample have experienced a transition from military to civilian rule during the 1980-2000 time period, which could potentially create a situation of reverse causation. That is, a military government may be handing back the reins of government to civilians because the economy is in a bad state. Haggard & Kaufman (1995) point to the initial democratic elections in Brazil and Uruguay as two cases where economic problems may have sped up the process of democratization. In results not reported in this paper, we investigated this possibility by creating a separate Post dummy for the these two cases and found that it (the supplemental dummy) was insignificant in all specifications.

15. For 7 of the 9 countries (all but Costa Rica and Uruguay) in the sample, we use monthly trade-weighted real exchange rate data from J.P. Morgan www.jpmorgan.com/MarketDataInd/Forex/currIndex.html (Data retrieved 10/01/02). We were able to add Costa Rica and Uruguay using the IMF-IFS CD-ROM. The correlation coefficient between the two RER measures for countries which appear in both data sets ranges from .94 to

.99.

16. In the case of run-off elections, *Post* is equal to one for the month of the run-off and the subsequent five months.
17. The important date is when the reforms started to have effects, which could potentially be either before (through expectations) or after (through inertia) the enactment date. In the absence of any outside information, we take the enactment date as the relevant date. If we are systematically wrong, our reform variable will be biased against finding any effects of reform.
18. That is to say, it is unlikely that any results we find will be spurious due to a third, unmodeled, factor that is moving both CBR and the RER.
19. They also point out that “this result depends on the assumption that the cross price elasticities of excess demand of non-tradables with respect to both exportables and importables are positive.”
20. Details of these tests are available on request. When we consider the data country by country using traditional unit root tests, the results are overwhelmingly similar to the panel test results.
21. To pre-test for individual effects in the conditional variance, we take the squared OLS residuals, construct estimated individual error variances for each country and then test the null hypothesis that all the error variances are equal.
22. The 3 month moving average includes the second through fourth lags of the variables.
23. That is to say, we assume that the U.S. t-bill rate is uncorrelated with the error term in the exchange rate equation.
24. This type of model was first proposed by Cermeño & Grier (2005).
25. Franzese (1999, 2003) uses a model where all the independent variables would be interacted with the reform variable. In our case, this is not computationally feasible given the number of extra coefficients involved and the difficulty of estimating large numbers of coefficients using nonlinear methods, especially given that our panel approach greatly exacerbates these problems. Our advantage is that we can investigate the effect of reform on uncertainty.
26. Engle (1982) demonstrates in the univariate case, that while least squares is still the best linear estimator in this setting, it can be extremely inefficient compared to the non-linear estimator accounting for the conditional heteroskedasticity.
27. In these data, RER growth is not very persistent, as indicated by the small sum of the lag coefficients. The initial values tend to be negative and significant while the later values are generally positive and significant.
28. The critical value at the .005 level with 9 degrees of freedom is 21.96.

29. Grier & Hernandez (2004) show for the case of Mexico that real exchange rate uncertainty has a significant negative partial correlation with the growth of industrial production.

30. Recall that the OLS specification showed that 12 lags were sufficient to deal with correlation in the level of the residuals but that there was very strong correlation in the squared OLS residuals.

31. The post reform election effect is given by the sum of the post and post*reform variables. This sum is positive, but not statistically significantly different from zero, which allows us to make the claim that the electoral effect completely disappears.