Inflation Targeting in Emerging Market Countries. Too Much Exchange Rate Intervention?: A Test *

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This version: July 2002

Abstract

Lately, many emerging market countries (EMC) have engaged inflation targeting (IT). But a recent strand of literature finds evidence of 'fear of floating' amongst EMC. Limiting the flexibility of the exchange rate has the risk of turning it into an anchor in the eyes of the public. In this paper we test whether the interest rate defenses of the exchange rate have been excessive or not in these countries. We find that in some this is not the case, as they were aimed to prevent deviations of the exchange rate from its long run equilibrium value, while other countries seem to have intervened to any fluctuation of the exchange rate. We link these findings with measures of liability dollarization, credibility, and pass-through.

JEL Classification: E58, F31

Keywords: Inflation Targeting, Emerging Market Countries, Exchange Rates

*We would like to thank Martin Uribe and participants of the International Economics Brown Bag Lunch at the University of Pennsylvania for helpful comments. All errors remain ours.

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1 Introduction

After the continuous round of Emerging Market Countries' (EMC) currency crises during the second half of the 90s, floating exchange rates seemed to win once again the favor of the economics profession. Proponents of this view usually end up recommending EMC to join the true floaters club, where much of the developed world already has membership.

If one believes in classifications, the trend towards joining this club seems to have been favorable. According to the IMF, in 1999 only 11% of its member countries were classified as having a pegged exchange rate regime compared to a staggering 97% in 1970. There seems to be, however, a considerable discrepancy between the exchange rate regime countries say they subscribe and what they are in reality. The Asian countries prior to the 1997 financial crisis illustrate this point handsomely: most currencies were tied to the U.S. dollar over extended periods of time but only Thailand was classified as a true peg, Philippines as a float, and the rest a myriad of in-between labels.

This disparity has drawn a considerable amount of academic attention. A study by Calvo and Reinhart (2002), which included 39 countries in Africa, Asia, Europe and the Western Hemisphere, finds that countries that say they allow their exchange rate to float mostly do not. According to the authors, there seems to be an epidemic case of 'fear of floating'. They find that exchange rate variability is too low relative to the performance of true floaters like the U.S.and Japan, even though shocks to EMC tend to be larger. Moreover, the high variability of international reserves and interest rates observed shows that central banks have intervened consistently to stabilize their exchange rates. Levy Yeyati and Sturzenegger (1999) construct a *de facto* classification of exchange rate regimes, based in the behavior of nominal exchange rates and international reserves, and find similar results.

In particular, several EMC have recently started to pursue inflation targeting, that is already much in vogue among developed countries (see Masson et al., 1997, and Mishkin and Schmidt-Hebbel, 2000). Inflation targeting is defined as "...a framework for monetary policy characterized by the public announcement of official quantitative targets (or target ranges) for the inflation rate over one or more time horizons, and by explicit acknowledgment that low, stable inflation is monetary policy's primary long-run goal " (Bernanke et al., 1999, pp. 4).

There is in the literature of inflation targeting in small open economies

considerable agreement about the necessity of monetary policy rules to give a role to exchange rates (see, for instance Mishkin and Schmidt-Hebbel, 2000).[1] There is ample evidence, on the other hand, that some EMC that recently engaged inflation targeting have shown 'fear of floating'. Several reasons can induce central banks to limit exchange rate fluctuations, as liability dollarization and a high pass-through coefficient (see Calvo and Reinhart, 2002). We would expect those countries with higher external debts to limit more the flexibility of the exchange rate,[2] given the potentially adverse effect in the balance sheet of their firms. Additionaly, a high pass-through might induce the central bank to limit the volatility of the exchange rate, as it may increase the volatility of inflation.

The problem with limiting the exchange rate flexibility too much is that, in Mishkin's words: "...runs the risk of transforming the exchange rate into a nominal anchor for monetary policy that takes precedence over the inflation target, at least in the eyes of the public" (Mishkin, 2000). Once the public believes there is an exchange rate target, the window of speculative attacks is open (see Kumhof, 2000). Mishkin argued that central banks in EMC should smooth short-run exchange-rate fluctuations that help mitigate potentially destabilizing the effects of abrupt exchange rate changes, while making it clear to the public that they will allow exchange rates to reach their market-determined level over longer horizons (Ball, 2000, makes a similar argument).

In this paper, we provide a test of the extent of the interest rate defense of the exchange rate among a group of EMC that have recently joined the inflation targeting club. We do so by estimating forward-looking monetary policy reaction functions that can be regarded as a generalization of the interest rate rule proposed by Taylor (1993). We compare the results of a model in which the central bank does not take into account the exchange rate in setting its interest rate with two models, one in which it takes into account only deviations of the exchange rate from its long run value, and one in which it reacts to any fluctuation of the exchange rate. If this last representation is valid, then intervention would be considered excessive.

We find that in the cases of Chile, Israel and the Czech Republic the interventions have not been excessive, as they were aimed to prevent deviations of the exchange rate from its long run equilibrium value, while Mexico and South Africa's central banks seem to have intervened to any fluctuation of

[1] See Taylor, 2001, for an opposite view.

[2] Either through direct foreign exchange interventions or interest rate defenses.

the exchange rate. We also argue that the difference in the behavior of these countries' central banks is due to lower credibility and higher pass-through from depreciation to inflation in the latter group of countries. As their shift to inflation targeting is only recent, it is possible however that in the future the exchange rate will lose its role as an anchor even in these countries.

The paper proceeds as follows. In section 2 we describe the methodology and the test to assess the degree to which central banks in EMC defend the exchange rate through interest rate interventions. In section 3 we explain the data used to estimate the model, whose results are shown in section 4. In section 5 we link the main findings of section 4 with measures of liability dollarization, credibility, and pass-through. Section 6 concludes.

2 Monetary Policy Rules for EMC

Several reasons might induce EMC to avoid sharp fluctuations in the exchange rate, as lack of credibility (Calvo and Reinhart, 2002), a high pass-through coefficient (Goldfajn and Werlang, 2000), the existence of large foreign currency debt, and a high degree of dollarization. Mishkin (2000) argues that some EMC that engaged in inflation targeting have gone too far in the limitation of exchange rate flexibility, with the risk of transforming the nominal exchange rate in the nominal anchor in the eyes of the public. He suggests that one possible way to avoid this problem is for central banks in EMC to adopt a transparent policy of smoothing short-run exchange rate fluctuations, while making it clear that they will allow exchange rates to reach their long run level.

In this section we test whether central banks in EMC have been pursuing policies aimed to maintain exchange rate stability or not, and whether this intervention has been excessive (in Mishkin's terms) or not. In particular, following Clarida et al. (1997) we estimate forward-looking monetary policy reaction functions that can be regarded as a generalization of the interest rate rule proposed by Taylor (1993). We compare the results of a model in which the central bank does not take into account the exchange rate in setting its interest rate with two models, one in which it takes into account only deviations of the exchange rate from its long run value, and one in which it reacts to any fluctuation of the exchange rate. If this last representation is valid, then intervention would be considered excessive.

2.1 Estimation Procedure

2.1.1 Baseline Estimation

In the baseline case, we assume that the central bank has a target for the short-term nominal interest rate that is based on expected inflation and the expected output gap

$$r_t^* = \bar{r} + \beta(E[\pi_{t+n}|\ \ _t] - \pi^*) + \gamma(E[y_t|\ \ _t] - y^*) \tag{1}$$

where $\bar{r}$ is the equilibrium nominal interest rate, π_{t+n} is the rate of inflation between periods t and $t+n$, y_t is real output growth, π^* is the inflation target, y^* is the long run or steady state real output growth, and $\ _t$ is the information set available to the central bank at the time it sets the interest rate.

There is ample international evidence that central banks smooth changes in interest rates (see Sack, 1998). To capture this regularity, we assume that the actual interest rate set by the central bank adjusts only partially to the target,

$$r_t = (1-\rho)r_t^* + \rho r_{t-1} + \upsilon_t \tag{2}$$

where $\rho \in [0,1]$ measures the smoothness of interest rate changes. To derive a testable relationship, first define $\alpha \equiv \bar{r} - \beta\pi^*$ and $x_t \equiv y_t - y^*$ and combine (1) and (2) to get

$$r_t = (1-\rho)\{\alpha + \beta E[\pi_{t+n}|\ \ _t] + \gamma E[x_t|\ \ _t]\} + \rho r_{t-1} + \upsilon_t \tag{3}$$

We eliminate the unobserved forecast variables by rewriting (3) in terms of the realized variables as follows

$$r_t = (1-\rho)\alpha + (1-\rho)\beta\pi_{t+n} + (1-\rho)\gamma x_t + \rho r_{t-1} + \varepsilon_t \tag{4}$$

where the first two terms in ε_t are the forecast errors of inflation and output, respectively,

$$\varepsilon_t \equiv -(1-\rho)\{\beta(\pi_{t+n} - E[\pi_{t+n}|\ \ _t]) + \gamma(x_t - E[x_t|\ \ _t])\} + \upsilon_t$$

Let $u_t \in \quad_t$. Then, since $E[\varepsilon_t|u_t] = 0$, equation (4) implies the following set of orthogonality conditions

$$E[r_t - (1-\rho)\alpha - (1-\rho)\beta\pi_{t+n} - (1-\rho)\gamma x_t - \rho r_{t-1}|u_t] = 0$$

We estimate the vector of parameters $[\alpha, \beta, \gamma, \rho]$ by GMM, separately for each country. The instrument vector can contain any lagged variable that can help forecast inflation and the output gap. We use lagged values of the output gap, CPI inflation, interest rates, the depreciation rate and the trade balance.

The countries included are Chile and Israel from January 1994 to December 1999, South Africa from April 1995 to December 1999, Mexico from January 1996 to December 1999, and the Czech Republic from January 1995 to December 1999. We do not pursue the estimation for Brazil, since it maintained a soft peg until December 1998. [3]

2.1.2 Alternative Specifications

To test the extent of the exchange rate intervention, and in particular Mishkin's claim that foreign exchange intervention is excessive in EMC, we can expand equation (1) as follows

$$r_t^* = \bar{r} + \beta(E[\pi_{t+n}|\ _t] - \pi^*) + \gamma(E[y_t|\ _t] - y^*) + \theta(E[er_t|\ _t] - er^*)$$

where er_t is the depreciation of the exchange rate (defined as the number of home currency units needed to purchase one U.S. dollar), and er_t^* is the expected depreciation rate. Let $cer_t \equiv er_t - er^*$; then, the analog of equation (4) is

$$r_t = (1-\rho)\alpha + (1-\rho)\beta\pi_{t+n} + (1-\rho)\gamma x_t + (1-\rho)\theta cer_t + \rho r_{t-1} + \varepsilon_t \quad (5)$$

where ε_t contains an extra term to account for the forecast error in the exchange rate. We proceed to estimate the parameter vector $[\alpha, \beta, \gamma, \theta, \rho]$ as before.

[3] We assume that interest rates and inflation rates are I(0). Although standard Dickey-Fuller tests of the null that they are I(1) have very low power against the alternative of stationarity in such a small sample as ours, surprisingly we can reject the presence of a unit root at the 5% significance level for almost all countries.

We can compare the results of estimating equation (5) with those of estimating an alternative policy reaction function where only the deviation from the long run equilibrium exchange rate is included as an additional factor. We measure it with the deviation from GSDEEMER value for the period. GSDEEMER is short for Goldman Sachs Dynamic Equilibrium Emerging Markets Exchange Rates (see Ades, 1996 and 1997), and is a function of the long-run fundamentals that drive the long-run equilibrium real exchange rate, as the terms of trade, the degree of openness to foreign trade, the amount and composition of government expenditures, productivity, and the international interest rate.[4] In this case, the analog of equation (4) is

$$r_t = (1-\rho)\alpha + (1-\rho)\beta\pi_{t+n} + (1-\rho)\gamma x_t + (1-\rho)\delta z_t + \rho r_{t-1} + \varepsilon_t \qquad (6)$$

where z_t is the deviation from the GSDEEMER value. A positive value implies that the exchange rate is overvalued compared to the long-run equilibrium exchange rate. We would expect δ to be negative, as the central bank should raise the interest rate when the exchange rate is undervalued with respect to its long run value. We proceed to estimate the vector $[\alpha, \beta, \gamma, \delta, \rho]$ as before, but we now include lagged values of the deviation from GSDEEMER in the instrument's vector.

If central banks are following a rule like that specified in equation (6), then foreign exchange intervention would not be considered excessive, as they would only be reacting to deviations from the long-run equilibrium exchange rate. If, on the contrary, equation (5) most accurately describes their monetary policy rule, then they would risk turning the exchange rate in the nominal anchor of the economy. This is likely to happen, as Calvo and Reinhart (2002) claim, if there is lack of credibility. The test is, of course, a joint test of the extent of the foreign exchange intervention and the validity of GSDEEMER as an indicator of equilibrium exchange rates.

As Clarida et al. (1997) point out, it is possible to recover an estimate of the inflation target π^* pursued by the central bank using the estimates of α and β, and the sample average real interest rate. Let ri be the long run equilibrium real interest rate (i.e., $\overline{r} = ri + \pi^*$); then, from the definition of α we get

[4] See Edwards and Savastano (1999) for an asessment of GSDEEMER and a comparison with other single-equation models of real exchange rate misalignment in EMC.

$$\pi^* = \frac{ri - \alpha}{\beta - 1} \tag{7}$$

We use the sample average real interest rate to approximate ri.

3 The Data

We use consumer price index as reported by the International Financial Statistics (IFS) of the IMF to measure inflation in each country. In figure 1 we show annual inflation rates (i.e., π_{t-12}). It can be seen that, as a general trend, inflation decreased to one-digit levels throughout the period in all countries except Mexico. For the estimations, we set $n = 12$ initially (that is, π_{t+n} is the inflation rate for the 12 months after month t). That implies that the ending point is twelve months prior to the latest available data, December 2000.

Nominal exchange rates (see figure 1) and the trade balance are from the IFS, while the deviations from GSDEEMER values are from Goldman, Sachs & Co (see figure 2).[5] It can be seen that periods of overvaluation and undervaluation were not coincident in all countries.

For the Czech Republic, Mexico and South Africa we use industrial production as an indicator of output, given its availability at a monthly frequency. For Chile we use the IMACEC, a monthly index of economic activity. For Israel we use the State of the Economy Index, which encompasses industrial output, retail trade, imports and business employment. The output gap is defined as the residual from the regression of the logarithm of the output indicator on a constant and a linear trend. The data is from the IFS in the cases of Czech Republic, Mexico and South Africa or from the respective central banks in the cases of Chile and Israel, and we seasonally adjust the series before detrending.

The interest rate is the interbank rate for the Czech Republic (PRIBOR), 90-day PRBC for Chile, and T-Bill rates for Israel, Mexico and South Africa. The sources are the IFS and the respective central bank when necessary. Figure 3 shows the index of industrial production and interest rates for all countries. It can be seen that, as a general trend, the period covered by our study was one of increasing output and declining interest rates for all countries.

[5] The dataset is available from the author upon request.

4 Estimation Results

In this section we present our main estimation results. There is an extensive literature estimating Taylor-type monetary rules in EMC, and detailing the institutional aspects of their monetary policies. It is not our intention to enter in these details; we just want to use this methodology to test the extent of the exchange rate intervention (interest rate defense) in these countries, and will reference the readers to more detailed studies of the specific country experiences.

4.1 Chile

Chile reformed the charter of the central bank in 1989, giving it independence and setting as its objectives the stability of prices and the normal functioning of the internal and external payments systems (Corbo, 2000). From then on, the central bank started a policy that brought inflation down from double digits before 1990 to 2.3 percent in 1999. It formally started with an inflation targeting framework only in the year 2000 (Central Bank of Chile, 2000), and publishes an inflation report every four months since then, but has been announcing inflation targets since the beginning of the 90s. [6]

The first two rows of table 1 report the results of the baseline specification. All variables enter with the expected sign and all except the output gap are significantly different from zero. The overall fit is moderate, with an adjusted R-squared of around 60%. Our results indicate that for each percentage point of increase in expected inflation, the nominal interest rate increases by 75 basis points, and thus the real interest rate does not increase. This differs from the findings of Corbo (2000).

The average real interest rate during the 1994-99 period was 7 percent. Equation (7) and the baseline estimates for α and β imply an estimate of the long run inflation target π^* of 2.8 percent, almost the midpoint of the inflation target range declared by the monetary authorities.

The next set of values of table 1 shows the results when the exchange rate depreciation is added to the set of explanatory variables. The exchange rate depreciation enters the equation with the wrong sign, as we can expect a

[6] The Central Bank announces the inflation target of each year on the previous September. The long-run objective is an inflation between 2 and 4 percent a year, defined in terms of the CPI (Central Bank of Chile, 2000).

positive depreciation innovation to be faced with an increase in the nominal interest rate.

The final set of values shows the results when the deviation from GS-DEEMER is added to the set of explanatory variables. In this case all the variables enter with the expected sign and are significantly different from zero. That is, the deviation from output potential and the deviation of the exchange rate from its equilibrium value appear as separate final objectives from the inflation target to the Chilean monetary authorities.[7]

The output gap can be considered as a proxy for the current account deficit, as "...the central bank has a declared separate objective to keep the size of the current account deficit, computed at a normal level of the terms of trade, below 4% of GDP" (Corbo, 2000).

Our results indicate that for each percentage point of deviation of the exchange rate from its long run value, the central bank raises the interest rate seven basis points. That is, the central bank reacts to deviations of the exchange rate from its long run level, but it lets it float otherwise. This is in line from what is stated in the Monetary Policy Document: "Additionally, a pronounced movement of the exchange rate can debilitate, and even bankrupt the financial system, generating a profound recession" (Central Bank of Chile, 2000, our translation).

4.2 Israel

After a decade of high inflation, Israel first introduced an inflation target in the context of the shift to a crawling exchange rate band in 1991. The inflation target was just an input, along with the estimated inflation of the main trading partners, to estimate the required depreciation of the exchange rate in order to keep the real exchange rate unchanged (Bernanke et al., 1999, and Leiderman and Bar-Or, 2000). The monetary regime in place was in that sense ambiguous, as the inflation target coexisted with a nominal exchange rate band. At the end of the 90's capital controls were lifted and the exchange rate band widened substantially, and it became clearer that the inflation target was the key objective of monetary policy.

The estimation results of the monetary policy reaction function appear in table 2. The overall fit is very high in all three specifications, around 85%.

[7] Corbo (2000) finds that the output gap coefficient is not signiticantly different from zero, but there are several differences between his approach and ours.

Moreover, in both the second and the third specifications the additional variable enters with the expected sign and in a statistically significant way (and both improve the results with respect to the expected inflation parameter). It is also not possible to select among these models based on the test of the overidentifying hypothesis, as the J-statistics of both models imply that it is not possible to reject the overidentifying restrictions (see Hall, 1999). When we use the fitted values of the third specification as an additional variable in the second one, that variable enters in a statistically significant way. This is not true the other way round. This may suggest that the third model is a better representation (Davidson and MacKinnon, 1993). The actual and fitted values can be seen in figure 4.

It seems that the Israeli central bank has been reacting not to any change in the exchange rate, but just to those arising from deviations from its long run value, although results should be taken with caution.

The average real interest rate during the 1994-99 period was 4.9 percent. Equation (7) and the baseline estimates for α and β imply an estimate of the long run inflation target π^* of 5.7 percent, compared to a declared inflation target of 3 to 4 percent in the year 2001 (Leiderman and Bar-Or, 2000).

4.3 South Africa

During most of the 90's South Africa maintained a dual monetary policy, setting explicit monetary growth targets (on M3) to be achieved indirectly through adjusting interest rates, along with an active intervention in the spot and forward foreign exchange markets (see Aron and Muellbauer, 2000).

Financial liberalization in the 80's and the lifting of the remaining capital controls in March of 1995 diminished the usefulness of the monetary targets. At the same time, the South African Reserve Bank (SARB) engaged in heavy (sterilized) intervention to try to avoid the appreciation of the Rand. The SARB claimed it was floating at the time, and that intervention was only to smooth short-term foreign exchange fluctuations. After that, there were exchange rate crises in October 1996, November 1997, and April 1998.

From 1998 on, formal inflation targets have been announced. With the institution of an inflation targeting regime, an explicit inflation target of three to six percent by the year 2002 was announced in the year 2000 (Mboweni, 2000). [8]

[8] Defined on a new CPI measure, the CPIX, which excludes interest rates on mortgage

Aron and Muellbauer (2000) estimate a forward-looking Taylor rule similar to the one we estimate here, but including the U.S. interest rate as additional variable, and find that the SARB appears to reduce the interest rate when inflation expectations increase. Only when they introduce additional variables as the deviation of M3 growth rate from the pre-announced target or dummies for financial liberalization the inflation coefficient has the expected sign or is insignificantly different from zero.

Table 3 shows our estimation results. We started our estimation in April 1995, one month after the financial liberalization measures were in place. In both the baseline estimation and the one including the 12-month foreign exchange depreciation all the variables enter with the expected sign, but in the latter the fit improves from an adjusted R-squared of 80% to one of 85%. The low value for the expected inflation parameter is in line with Aron and Muellbauer's results.

The deviation of M3's rate of growth from its target was included in the set of instruments, but when tested as an additional explanatory variable, the estimation deteriorated in several dimensions. The estimation in which the deviation from GSDEEMER was included yields striking values for most coefficients, and the overall fit of the regression is reduced (see figure 4.C). It seems that the SARB actively used the interest rate to defend the exchange rate, and not just to offset deviations from its long run value.

The average real interest rate during the March 1995-December 1999 period was 8.2 percent. Equation (7) and the baseline estimates for α and β imply an estimate of the long-run inflation target π^* of 2.8 percent, close to the lower band of the inflation target announced for 2002.

4.4 Czech Republic

In the case of the Czech Republic the estimation is made from January 1995 to December 1999, although three distinct monetary regimes were in place in that time. Until mid-1996, there was a regime that combined an exchange rate peg with monetary targeting. In mid-1996 the exchange rate band was widened, with the aim of increasing the autonomy of the domestic monetary policy. [9] After a currency crisis in 1997, inflation targeting was implemented

bonds.

[9] The monetary intervention tried to reduce the impact of capital inflows. For an analysis of the inconvenience of such a combination, see Buscaglia (2000).

from 1998 on (see Czech National Bank, 2000). The long run inflation target was set at 2 percent (+/- 1%), which should be met around 2005.

Table 4 presents our estimation results. The fit is quite low in all three representations, the higher adjusted R-squared being of only 57% (third representation). The expected inflation coefficient is very low in all representations. The deviation from GSDEEMER enters with the expected sign, in a significant way, and it signals a strong reduction in interest rates when the Koruna is overvalued with respect to its long run value (see figure 4.D.). That is, data seems to marginally support the idea that deviations from the equilibrium exchange rates are taken into account by the Czech National Bank when setting interest rates.

Estimates of the long run inflation target vary according to the specification, being of 4 % in the baseline case. This is higher than the stated long-run target, but lower than the average for the period.

4.5 Mexico

Mexico's central bank started setting inflation targets, along with domestic credit expansion targets, since 1995. The monetary policy in place could be characterized like this: the central bank used the inflation target and the estimated real GDP growth to estimate the increase in money demand during the year (see Banco de Mexico, 1995 1996 and 1998). It also established a separated but not unrelated target for the expansion of its domestic credit. All the remaining money demand would have a counterpart in an increase in International Reserves. Lately, however, the central bank has been switching to an inflation targeting regime, publishing inflation reports since the year 2000 (see Banco de Mexico, 2000).

Our estimation results can be seen in table 5. We perform the estimation from 1996 to 1999 since, although in 1995 the authorities claimed to be floating, that was a turbulent year after the 1994 devaluation of the peso. The fit in the first and third representations is much lower than in the second, with an R-squared of around 50% compared to one of 75%. Moreover, the estimates for γ in the first and third representations yield implausible values.

In the second representation, the coefficient on expected inflation does not have the expected sign, but it is not significantly different from zero anyway. The estimation shows clearly that the central bank intervened to offset changes in the exchange rate, and not just to offset deviations from long-run values. It seems that the central bank raised interest rates in 63

basis points for every percentage point increase in the 12-month accumulated devaluation of the exchange rate.

The increase in interest rates to offset changes in the devaluation rate was especially acute in 1998 (see figures 1.E and 4.E), as the central bank also acknowledges in its documents (see Banco de Mexico, 1998).

5 Credibility and Pass-Through

Our results indicate that in the cases of Chile, Israel and the Czech Republic, central banks seem to have considered deviations from the exchange rate's long-run value when setting their interest rates, while in Mexico and South Africa, on the contrary, central banks have reacted to any change in the exchange rate (thus running the risk of putting it as the nominal anchor in the eyes of the public).

In this section we attempt to find what are the determinants of the cross-country evidence found. Firstly, we looked into variables related to the degree of liability dollarization. In the first column of panel A in table 6 we show the external debt as percentage of GDP as of 1998.[10] We would expect those countries with higher external debts to limit more the flexibility of the exchange rate, given the potentially adverse effect in the balance sheet of their firms. We found, however, that while Mexico showed the highest external gross indebtness, it was followed by Israel, South Africa coming in a distant third place. It may be the case, nevertheless, that these figures give an incomplete picture of the liability dollarization problem. For once, they are gross external debt figures, and not net ones. In addition, they are not "scaled" by the size of the external sector. A similar devaluation in two countries with the same share of external debt can have a different impact depending on the size of the external sector, and hence on the potential increase in exports following a devaluation. In the second column we scale the external debt by the simple average of exports and imports, and the picture does not change dramatically.

Secondly, we looked for figures that might indicate the presence of some degree of "fiscal dominance" (see Masson et al., 1997). Column 3 in panel A shows the average fiscal deficit as a percentage of GDP for the period 1993-1999. Although measures of fiscal deficit as presented by the IMF are seldom comparable across countries, and we do not know the deepness of

[10] Defined as gross external debt less international reserves.

each country's debt market, the data does not suggest that fiscal dominance might differentiate Mexico and South Africa from the other countries in the sample.

Next, we looked at different measures of credibility. A low credibility might impede the inflation target to become the nominal anchor of the economy, inducing the central bank to target the exchange rate for that purpose. In column 4 of panel A we compare dollarization ratios, calculated as the percentage of total bank deposits denominated in foreign currency. High dollarization ratios might reflect lack of credibility on the domestic currency as a store of value. While Mexico's dollarization ratio does not differ much from those of Chile and the Czech Republic, South Africa's dollarization ratio is the lowest in the sample. In column 1 of panel B we looked at initial inflation rates in the period. High initial inflation rates might constrain the credibility of the central bank to set a low inflation target in the medium term. With the exception of Mexico, we find no significant difference among the countries in the sample. In columns 2 and 3 we looked at interest rate measures. Lack of credibility is typically transformed in higher returns demanded by market participants. The first one is J.P. Morgan's Emerging Markets Bond Index, a measure of sovereign risk. We find that it is significantly higher for Mexico and South Africa than for Chile. Next we looked at historical dicount rates and also find that they are significantly higher for Mexico and South Africa.[11]

Finally, we looked at figures of pass-through from depreciation to inflation. A high pass-through might induce the central bank to limit the volatility of the exchange rate, as it may increase the volatility of inflation. In table 7 we look at correlation coeficients of 12-month inflation rates with 12-month depreciation rates, measured at different lags. We find that pass-through is quite high for South Africa and Mexico, but not for the other countries. [12]

In summary, it seems that a higher pass-through and somewhat lower credibility might have induced the South African and the Mexican central banks to react to any change in the exchange rate, and not only to their deviation from fundamentals.

Of course the adoption of formal inflation targeting schemes is only recent

[11] These are discount rates for equity, but -as currently calculated by the prevailing methodology in EMC- their main determinant is country risk.

[12] Our results coincide with those of Schmidt-Hebbel and Werner (2002) for Chile and Mexico. Note also from figure 1 the inverse relationship of inflation and depreciation in Chile from 1995 on.

in these countries, and it may well be that the role of the exchange rate as an anchor decreased from the year 2000 on.

6 Conclusions

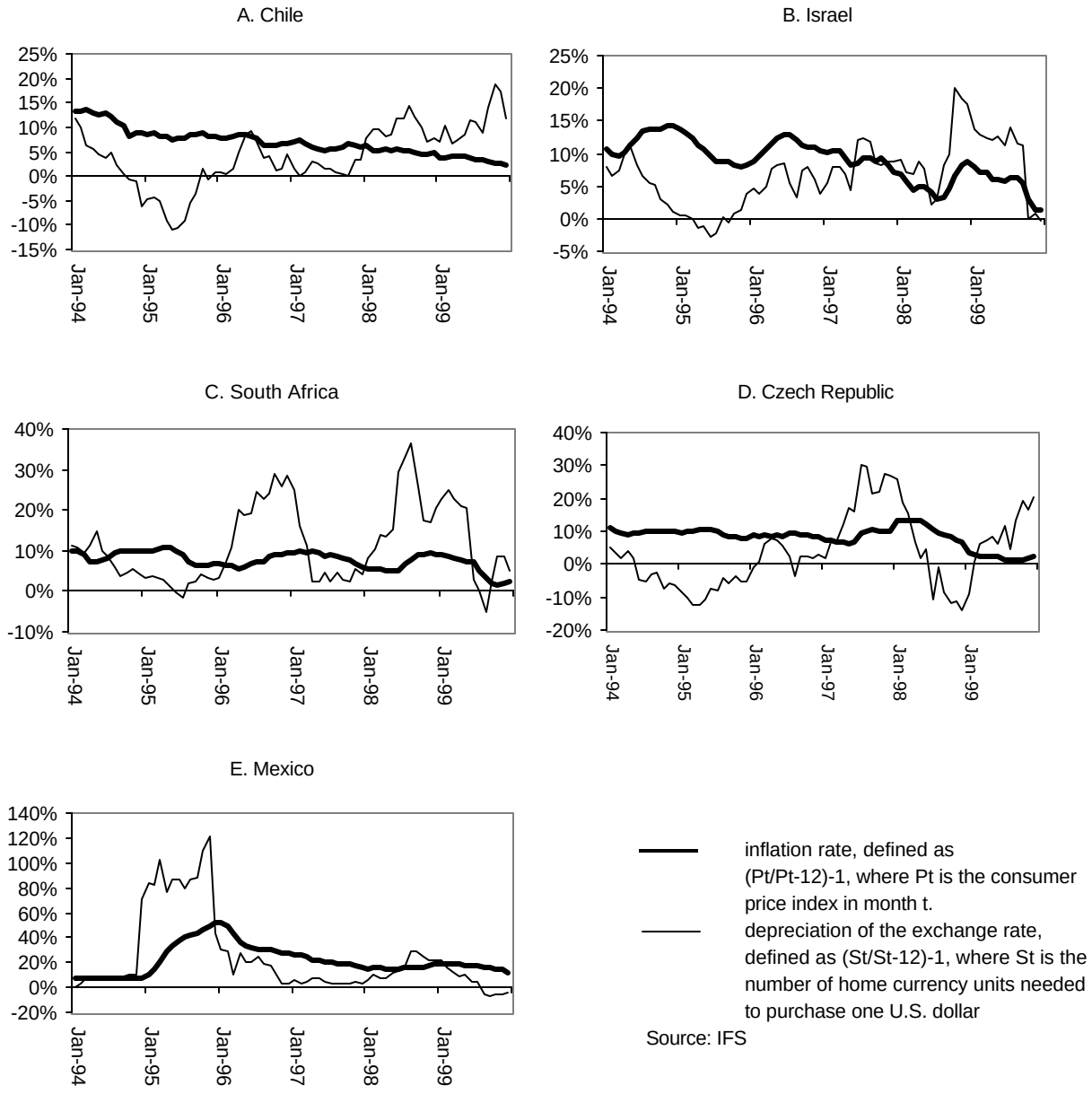
Lately many EMC claim to have adopted floating regimes. In particular, several EMC have recently started to pursue inflation targeting. But a recent strand of literature finds evidence of 'fear of floating' among EMC.

There is in the literature of inflation targeting in small open economies considerable agreement about the necessity of monetary policy rules to give a role to exchange rates. Several reasons can induce central banks to limit exchange rate fluctuations, as liability dollarization and a high pass-through coefficient. The problem with limiting too much the exchange rate flexibility is that, in Mishkin's words: "...runs the risk of transforming the exchange rate into a nominal anchor for monetary policy that takes precedence over the inflation target, at least in the eyes of the public" (Mishkin, 2000).

In this paper we test whether the intervention in the exchange rate has been excessive or not in some EMC that have recently engaged IT. For that purpose, we estimate forward-looking monetary policy reaction functions that can be regarded as a generalization of the interest rate rule proposed by Taylor (1993). We compare the results of a model in which the central bank does not take into account the exchange rate in setting its interest rate with two models, one in which it takes into account only deviations of the exchange rate from its long run value, and one in which it reacts to any fluctuation of the exchange rate. If this last representation is valid, then intervention would be considered excessive.

We find that in the cases of Chile, Israel and the Czech Republic the interventions have not been excessive, as they were aimed to prevent deviations of the exchange rate from its long run equilibrium value, while Mexico and South Africa's central banks seem to have intervened to any fluctuation of the exchange rate. We also argue that the difference in the behavior of these countries' central banks is due to lower credibility and higher pass-through from depreciation to inflation among the latter group of countries. As their shift to inflation targeting is only recent, it is possible however that in the future the exchange rate will lose its role as an anchor even in these countries.

Figure 1. Inflation and Depreciation Rates (yoy)



inflation rate, defined as (Pt/Pt-12)-1, where Pt is the consumer price index in month t.

depreciation of the exchange rate, defined as (St/St-12)-1, where St is the number of home currency units needed to purchase one U.S. dollar

Source: IFS

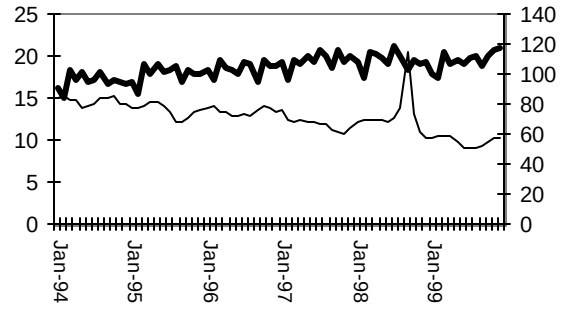
Figure 2. Deviation From GSDEEMER

GSDEEMER: Goldman Sachs Dynamic Equilibrium Emerging Markets Exchange Rates

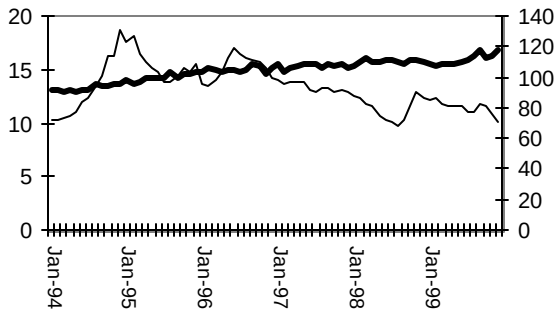
Source: Goldman, Sachs & Co.

Figure 3. Industrial Production and Interest Rates

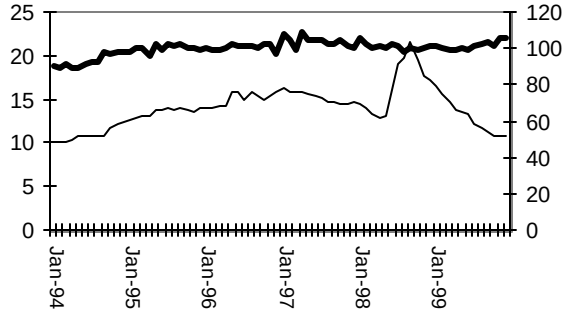
A. Chile



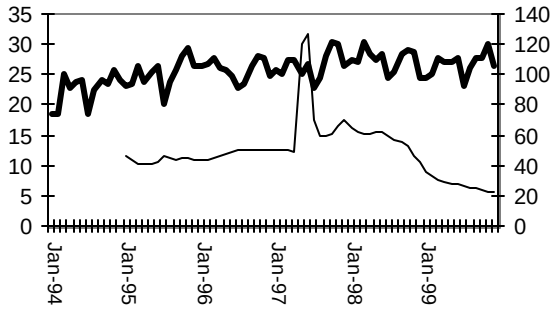
B. Israel



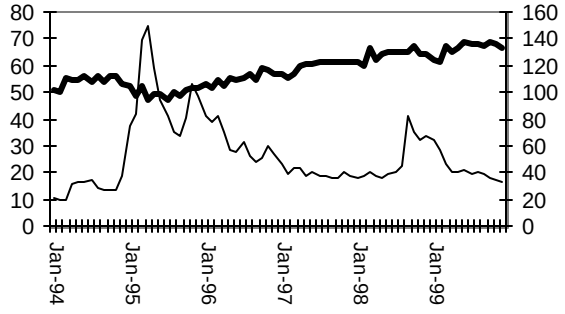
C. South Africa



D. Czech Republic



E. Mexico



industrial production index (right axis)

interest rate (left axis)

Source: IFS, and central banks

Figure 4. Interest Rates

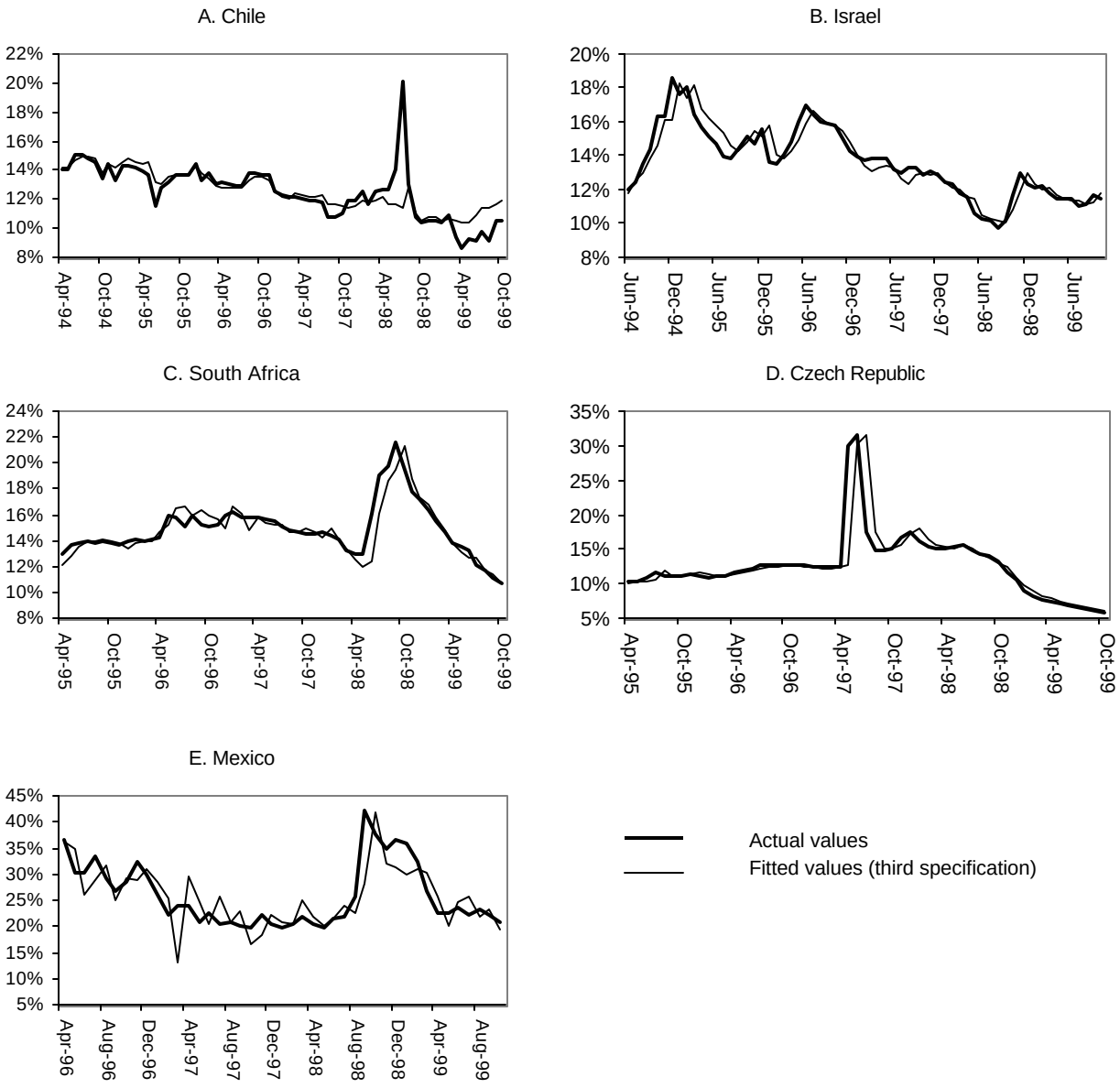


Table 1. Chile´s Central Bank Reaction Function

	a	b	g	r	q	d
Baseline	0,07	0,75	0,13	0,77		
(t-value)	(3.2)	(3.6)	(0.7)	(13.3)		
Adding:						
FX depreciation	0,08	0,80	0,19	0,45	-0,29	
(t-value)	(6.9)	(3.6)	(0.7)	(13.3)	(-3,6)	
Deviation from GSDEEMER	0,09	0,75	0,38	0,25		-0,07
(t-value)	(14,0)	(12,7)	(2,4)	(7,5)		(-2,1)

Estimate of p* for Baseline Specification

$\pi^* = 2.8\ \%$

The sample is 1994:01 to 1999:12. The instruments are: c, r_{t-2}, r_{t-3}, p_{t-1}, p_{t-2}, p_{t-3}, x_{t-1}, x_{t-2}, x_{t-3}, cer_{t-1}, cer_{t-2}, cer_{t-3}, three lagged values of the trade balance, and z_{t-1}, z_{t-2}, z_{t-3} in the third specification. Estimates were obtained by GMM. Estimate of π^* assumes that the long run equilibrium real interest rate is equal to its sample average, 7 percent.

Table 2. Israel´s Central Bank Reaction Function

	a	b	g	r	q	d
Baseline	0,11	-0,08	0,75	0,91		
(t-value)	(1,5)	(-0,3)	(0,9)	(19,6)		
Adding:						
FX depreciation	0,05	0,41	1,07	0,87	0,69	
(t-value)	(1,6)	(2,3)	(2,0)	(24,7)	(4,1)	
Deviation from GSDEEMER	0,09	0,66	0,98	0,88		-0,44
(t-value)	(2,3)	(3,1)	(0,6)	(21,8)		(-3,9)

Estimate of p* for Baseline Specification

$\pi^* = 5.7\ \%$

The sample is 1994:01 to 1999:12. The instruments are: c, r_{t-2}, r_{t-3}, p_{t-1}, p_{t-2}, p_{t-3}, x_{t-1}, x_{t-2}, x_{t-3}, three lagged values of the 12-month change in the exchange rate and z_{t-1}, z_{t-2}, z_{t-3} in the third specification. Estimates were obtained by GMM. Estimate of π^* assumes that the long run equilibrium real interest rate is equal to its sample average, 4.9 percent.

Table 3. South Africas´s Central Bank Reaction Function

	a	b	g	r	q	d
Baseline	0,08	0,39	0,76	0,89		
(t-value)	(1,9)	(1,6)	(4,6)	(35,1)		
Adding:						
FX depreciation	0,10	0,02	0,81	0,83	0,17	
(t-value)	(2,8)	(0,1)	(7,9)	(24,1)	(5.2)	
Deviation from GSDEEMER	0,3	-1,65	-1,06	1,1		0,57
(t-value)	(5,6)	(-7,7)	(-4,8)	(34,8)		(4,9)

Estimate of p* for Baseline Specification

$\pi^* = 2.8\ \%$

The sample is 1995:04 to 1999:12. The instruments are: *c*, r_{t-2}, r_{t-3}, p_{t-1}, π_{t-2}, π_{t-3}, x_{t-1}, x_{t-2}, x_{t-3}, three lagged values of the 12-month change in the exchange rate, the deviation of the rate of growth of M3 with respect to announced target, and z_{t-1}, z_{t-2}, z_{t-3} in the third specification. Estimates were obtained by GMM. Estimate of π^* assumes that the long run equilibrium real interest rate is equal to its sample average, 8.2 percent.

Table 4. Czech Republic´s Central Bank Reaction Function

	α	β	γ	ρ	θ	δ
Baseline	0,09	0,01	1,32	0,93		
(t-value)	(0,9)	(0,2)	(2,5)	(16,7)		
Adding:						
FX depreciation	0,08	0,05	1,35	0,92	0,21	
(t-value)	(0,7)	(0,9)	(2,5)	(14,1)	(1,7)	
Deviation from GSDEEMER	0,48	0,09	1,00	0,97		-4,25
(t-value)	(2,4)	(1,3)	(1,1)	(45,6)		(-3,6)

Estimate of p* for Baseline Specification

$\pi^* = 4.0\ \%$

The sample is 1996:07 to 1999:12. The instruments are: *c*, r_{t-2}, r_{t-3}, p_{t-1}, p_{t-2}, p_{t-3}, x_{t-1}, x_{t-2}, x_{t-3}, three lagged values of the 12-month change in the exchange rate, and z_{t-1}, z_{t-2}, z_{t-3} in the third specification. Estimates were obtained by GMM. Estimate of π^* assumes that the long run equilibrium real interest rate is equal to its sample average, 5.1 percent.

Table 5. Mexico´s Central Bank Reaction Function

	a	b	g	r	q	d
Baseline	0,34	-2,30	47,8	0,96		
(t-value)	(0,7)	(-0,8)	(2,8)	(9,4)		
Adding:						
FX depreciation	0,24	-0,40	0,95	0,5	0,63	
(t-value)	(3,1)	(-1,8)	(1,5)	(3,5)	(2,9)	
Deviation from GSDEEMER	0,35	-1,06	14,38	0,85		-0,56
(t-value)	(1,1)	(-1,1)	(3,1)	(7,7)		(-0,8)

Estimate of π^* for Baseline Specification

$\pi^* = 4.0\ \%$

The sample is 1996:07 to 1999:12. The instruments are: c, r_{t-2}, r_{t-3}, p_{t-1}, p_{t-2}, p_{t-3}, x_{t-1}, x_{t-2}, x_{t-3}, three lagged values of the 12-month change in the exchange rate, and z_{t-1}, z_{t-2}, z_{t-3} in the third specification. Estimates were obtained by GMM. Estimate of π^* assumes that the long run equilibrium real interest rate is equal to its sample average, 6.3 percent.

Table 6. Selected Macroeconomic Indicators

Panel A.

	External Debt (as % of GDP) (1)	External Debt / Openness (2)	Fiscal Deficit (as % of GDP) (3)	Dollarization Ratios (4)
Chile	22.3%	105%	-0.88%	12.1 % (1994-99)
Israel	31.2%	125%	7.07%	27.0 % (1999)
South Africa	24.1%	114%	4.61%	2.3 % (1995-99)
Czech Republic	21.0%	42%	3.12%	12.0 % (2001)
Mexico	34.2%	117%	0.21%	14.0 % (1996-99)

Panel B

	Initial Annual Inflation (5)	Sovereign Spread (EMBI Global) (6)	Long Term Discount Rates (7)
Chile	13.2%	187 bps.	13.1%
Israel	10.6%		11.1%
South Africa	11.0%	375 bps.	14.9%
Czech Republic	9.5%		
Mexico	31.1%	619 bps.	16.0%

(1) Defined as Gross External Debt less International Reserves, as percentage of GDP, in year 1998. Source: Goldman Sachs (2001).
(2) Defined as Gross External Debt less International Reserves, as percentage of the simple average of exports and imports. Source: Goldman Sachs (2000)
(3) Average 1993-1999. Source: Goldman Sachs (2001). Unfortunately, measures of fiscal deficit are seldom comparable across countries. Chilean data, for example, does not include its central bank cuasi-fiscal deficit, Mexican data does not include the cost of the banking sector bailout, and so forth.
(4) Defined as deposits in foreign currency as percentage of total deposits. Source: Central Bank's websites.
(5) Annual inflation rate at the beginning of the estimation period in each case. Source: IFS
(6) As of August 1999. Source: JP Morgan
(7) Source: Goldman Sachs (1999).

Table 7. Simple Correlation Coefficients for Annual Inflation and Nominal Exchange Rate Depreciations

	Chile	Israel	South Africa	Czech Republic	Mexico
	94:01-99:12	94:01-99:12	94:01-99:12	94:01-99:12	94:01-99:12
Contemporaneous	-0.39	-0.19	0.04	-0.12	0.50
One-month lag	-0.39	-0.18	0.18	0.03	0.62
Two-month lag	-0.36	-0.24	0.28	0.16	0.71
Three-month lag	-0.33	-0.33	0.33	0.27	0.78
Four-month lag	-0.31	-0.35	0.31	0.34	0.81
Five-month lag	-0.29	-0.36	0.23	0.39	0.79
Six-month lag	-0.27	-0.36	0.16	0.44	0.76
Seven-month lag	-0.26	-0.37	0.07	0.44	0.73
Eight-month lag	-0.26	-0.38	0.04	0.43	0.68
Nine-month lag	-0.27	-0.38	0.00	0.40	0.64
Ten-month lag	-0.27	-0.40	-0.04	0.34	0.58
Eleven-month lag	-0.25	-0.44	-0.11	0.25	0.51
Twelve-month lag	-0.24	-0.47	-0.21	0.13	0.44

Source: Author's calculations, based on IFS data

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