IS LATIN AMERICA OVERCOMING ITS FEAR OF FLOATING?*

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This paper analyzes the evolution of fear of floating (FOF) and its effect on output in Chile, Colombia and Mexico. It shows that there has been a gradual rise in exchange-rate volatility as the period of floating lengthens in each country. The paper analyzes the implications of this evolution for the behavior of output. It finds that the reduction of FOF has tended to decrease output volatility in Chile. However, the opposite phenomenon has happened in Mexico, while the results for Colombia are ambiguous.

JEL: F4, O23, O54
Keywords: Floating exchange rates, Fear of Floating, Chile, Colombia, Mexico.

1. INTRODUCTION

Fear of floating (FOF) has become a widely used term to characterize exchange rate management in emerging market economies. In particular, it makes reference to the use of monetary policy to stabilize the exchange rate within a floating regime, a practice that results in a low level of volatility of this variable in relation to the interest rate and foreign reserves. Several studies have documented empirically this phenomenon (see Hausmann et al., 1999; Calvo and Reinhart, 2002) and questioned the ability of emerging markets to actually reap the benefits, for instance in the form of an autonomous monetary policy, of flexible exchange rates.

One common explanation for this behavior is that it arises from the potentially negative macroeconomic effects of large currency depreciations, such as surges in inflation or economic contractions. However, floating regimes are

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a relatively new phenomenon among emerging market economies. As a result, the conclusions presented in those studies were derived from the observation of relatively short periods of currency float (as opposed to, for example, within-band fluctuation).

The actual operation of floating regimes is likely to change as experience accumulates. In particular, the short-term macroeconomic effects of exchange-rate fluctuations may weaken as the private sector gradually adjusts to the new environment of continuous, two-way fluctuations in the exchange rate (rather than the one-way, permanent exchange-rate changes typical of more controlled regimes). However, this very same reduction in the short-run transmission of the exchange rate to the economy would give local authorities more freedom to let the exchange rate fluctuate. There is thus a self-reinforcing mechanism that could lead to increasing levels of exchange-rate volatility over time.

The purpose of this paper is to analyze empirically these two predictions, namely that, as the float period in a country lengthens, (1) the degree of FoF, as reflected in the level of exchange-rate volatility, should decline, and (2) the short-term effect of exchange-rate fluctuations on output also should weaken. The countries considered are Chile and Colombia, which adopted a float in 1999 under tranquil conditions, and Mexico, that made the transition in the midst of a financial crisis. The analysis sheds light on the question of whether the conditions for an autonomous monetary policy – i.e., disconnected from the vagaries of the exchange rate – are gradually emerging in these countries after the adoption of the float.

The paper is organized as follows: section 2 presents descriptive statistics comparing the average level of exchange-rate volatility during the periods of exchange-rate band and float in the three countries. Section 3 discusses the reasons why the degree of FoF may decline over time, as countries accumulate experience on the operation of the new system, and shows to what extent this has already happened. Section 4 tests whether the effect of the exchange rate on output has weakened in the recent period, and assesses the net effect of the higher levels of exchange-rate volatility on output stability. Section 5 concludes with a summary of results.

2. Exchange Rate Regimes and Fear of Floating

Several studies have documented the existence of a trend for emerging market economies to formally adopt a floating exchange rate regime (for instance, see Calderón and Schmidt-Hebbel, 2003). In some notable cases, the regime change was forced by the outburst of a currency crisis (see, for example, Carstens and Werner 2000 on the Mexican transition). In other cases, however, it was a discretionary decision linked to the introduction of explicit inflation-targeting regimes (see, for example, Morandé and Schmidt-Hebbel 1999 on the Chilean case and Clavijo 2002 on Colombia). But exchange-rate fluctuations can be disruptive in emerging market economies. In particular, if there is a high degree of pass-through from the exchange rate to local prices, then currency depreciations can be highly
inflationary. In addition, for reasons such as the existence of currency mismatches in the private sector's balance sheets, currency depreciations can be at the same time contractionary.

As a result, some analysts (see, e.g., Rogoff et al., 2003) have argued that this trend to increasingly flexible exchange rates has been a formal rather than a real phenomenon, in the sense that emerging market economies typically suffer from FOF. In other words, they use monetary policy to dampen fluctuations in the exchange rate. The result is that local interest rates and foreign reserves, rather than the exchange rate, perform the major role in the adjustment to different types of asset market shocks.

Consider the evidence presented by Calvo and Reinhart (2002), which is based on data for the period from January 1973 to April 1999. The probability that the monthly changes in the interest rate fall within a narrow band of ±0.5 percentage points in the US and Japan is 80.7 and 86.4 percent, respectively. These high probabilities are indicative of a relatively low degree of interest-rate volatility. In contrast, during the period of “managed floating” in Colombia, the probability was 62.6 percent, while in Chile and Mexico the respective figures were only 11.1 and 16.7 percent. Even after switching from an exchange-rate band to a floating regime in December of 1994, the mentioned probability in Mexico remained a very low 9.4 percent. On the contrary, the probability of small monthly changes in the exchange rate tends to be comparatively high in the mentioned Latin American countries.

However, the period of currency float in Mexico studied by Calvo and Reinhart (2002) is relatively short when compared to those of crawling pegs and exchange-rate bands. Likewise, Chile and Colombia did not abandon their exchange-rate bands until late 1999. It is, therefore, interesting to look at the evidence using the longer floating periods available to date; as argued below, there are reasons to expect the degree of FOF to decline, in endogenous way, as the period of floating lengthens in each country.

Our main indicator of exchange-rate volatility will be calculated according to the approach followed in the literature on “foreign-exchange-market pressure” (see Girton and Roper, 1977). The underlying idea is that, given a shock to local assets markets, the adjustment to a new equilibrium can take the form of different combinations of changes in the exchange rate, the interest rate and foreign reserves. Given this possibility of different combinations between the variables, the relevant indicator of the exchange rate's role in the adjustment process is its volatility in relation to that of the interest rate and reserves.¹

¹ Belke et al. (2004) seem to question the relevance of the notion of FOF based on their observation of a positive correlation between exchange-rate and interest-rate volatility in emerging market economies, an observation that they interpret as evidence of the influence of exogenous events such as shifts in international financial markets. However, FOF may be present irrespective of the mentioned correlation. The question is, given a shock that affects the local assets markets, to what extent authorities allow the exchange rate to absorb the shock vis-à-vis the interest rate.
Table 1 presents these calculations. The first columns show the standard deviation of the monthly change in the exchange rate and foreign reserves (expressed in percentage) and in the local interest rate (in percentage points). All the series were previously detrended using the Hodrick-Prescott filter. The calculations were carried out for separate sub-periods, according to the evolution of the exchange-rate regime in each country. The sample begins in early 1989, when inflation was under control in all countries and the period of heavy capital inflows was about to start, and it ends in September 2005.

### Table 1

**Relative Exchange-Rate Volatility**

<table>
<thead>
<tr>
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<th>Standard deviation of monthly changes in:</th>
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<tbody>
<tr>
<td></td>
<td>(A) Exchange rate</td>
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<tr>
<td></td>
<td>(B) Interest rate</td>
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<tr>
<td></td>
<td>(C) International reserves</td>
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<td></td>
<td>(A) (B)</td>
</tr>
<tr>
<td></td>
<td>(A) (C)</td>
</tr>
<tr>
<td>Chile, 02.1989-09.1999 (band)</td>
<td>1.48</td>
</tr>
<tr>
<td>Chile, 10.1999-09.2005 (float)</td>
<td>2.39</td>
</tr>
<tr>
<td>Colombia, 02.1989-10.1991 (crawl)</td>
<td>0.22</td>
</tr>
<tr>
<td>Colombia, 11.1991-09.1999 (band)</td>
<td>2.20</td>
</tr>
<tr>
<td>Colombia, 10.1999-09.2005 (float)</td>
<td>1.89</td>
</tr>
<tr>
<td>Mexico, 02.1989-10.1991 (crawl)</td>
<td>0.18</td>
</tr>
<tr>
<td>Mexico, 11.1991-11.1994 (band)</td>
<td>1.17</td>
</tr>
<tr>
<td>Mexico, 01.1996-09.2005 (float)</td>
<td>1.99</td>
</tr>
</tbody>
</table>

Note: Original series were first H-P detrended. The monthly change in exchange rate and reserves is expressed in percentage, while the change in interest rates is in percentage points.

Consider, first, the exchange band period in each country. Although there are differences in the extent to which the countries allowed their currencies to
fluctuate compared to interest rates and reserves, in general relative exchange-rate volatility tended to be quite low. The starkest case is that of Chile, where the volatility ratio between the exchange rate and reserves was only 0.41, and even smaller (0.33) between the exchange rate and the interest rate. Colombia is in the opposite extreme, with relatively high exchange-rate volatility ratios—particularly in relation to the interest rate—, while Mexico is in an intermediate position.

The adoption of a floating regime changed the nature of financial adjustment in the three countries, with a noticeable increase in exchange-rate volatility levels. In Chile, exchange-rate volatility increased from 0.33 to 3.1 in relation to the interest rate, and from 0.41 to 1.04 with respect to foreign reserves. This increase in relative exchange-rate volatility reflected both an increase in its absolute volatility and a sharp fall in the volatility of the interest rate and reserves. Thus, after the change of regime, the Chilean authorities clearly have allowed greater currency flexibility in exchange for a tighter control of the interest rate.

In Colombia, there was a reduction in general volatility levels, with a fall in the volatility of the exchange rate and interest rate, and constant levels for reserves. However, the shift toward a greater role for the exchange rate in the adjustment process is made evident by the fact that the fall in exchange-rate volatility was much smaller than that in the interest rate. Therefore, the exchange rate-interest rate volatility ratio increased from 1.27 to 3.26. On the other hand, exchange-rate volatility with respect to that of reserves actually fell.

In Mexico, both indicators of relative exchange-rate volatility increased. After the shift to float (and leaving aside the observations corresponding to the 1995 Tequila crisis), the exchange rate became more volatile while the opposite happened to reserves; as a result, the volatility of the exchange rate in relation to reserves increased from 0.11 to 0.71. The interest rate also became more volatile; however, because of a stronger rise in exchange-rate volatility, the exchange rate-interest rate volatility ratio rose from 0.77 to 0.88.

### 3. Fear of Floating and Floating Experience

According to the previous section, relative exchange-rate volatility increased in Chile, Colombia and Mexico when comparing average values for the band and floating periods. But period averages can be misleading by suggesting that there was a single, discrete modification in monetary management after the change of regime. Actually, the characteristics of monetary management may evolve endogenously over time. This section analyzes this possibility (see De Gregorio and Tokman, 2004 and Schmidt-Hebbel and Werner, 2002 for related discussion).

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2 Rowland (2004) had already noted a small decline in the volatility of the exchange rate in Colombia after the shift to float, using data for a shorter period. However, as the following indicators make clear, this conclusion dramatically changes if relative (rather than absolute) exchange-rate volatility is considered.
The possibility of a gradual change in the degree of FOF can be framed in terms of a circular mechanism: as exchange-rate volatility increases, the behavior of individuals is likely to change in a way that reduces the negative effects of currency fluctuations, in particular depreciations. However, as these effects become less important, the authorities are more likely to let the exchange rate free to fluctuate.

Consider the effect on inflation. In the new system, and particularly as a country approaches a situation of low and stable inflation rates, exchange-rate fluctuations can be largely transitory, in contrast to more-managed systems, which historically tended to feature one-way permanent depreciations. If exchange-rate fluctuations are largely transitory, then firms will have no incentives to change their prices (see McCarthy, 1999 and Baqueiro et al., 2003 for a discussion of this point and some empirical evidence). In this case, currency depreciations will have a smaller inflationary effect.

Note the circularity: if exchange rate changes are perceived as largely transitory, then local prices will not be adjusted upwardly when the currency depreciates. But if local prices are not raised, then the exchange rate does not have to change permanently to keep a relatively stable real exchange rate. This reduction in exchange rate pass-through may allow the central bank to let the exchange rate free to fluctuate, being less concerned for the inflationary impact of depreciations.

A similar reasoning applies to the effect of the exchange rate on output. If currency variations are perceived as largely transitory, then firms will not as easily enter or exit a foreign market when the exchange rate changes, given the sunk costs of such action (see Krugman, 1989). Then the observed effect of the exchange rate on the trade balance, and hence on aggregate demand, will become smaller.

Aggregate demand can be affected also by balance-sheet effects and the possibility of contractionary currency depreciations. Although this is an old topic (see Krugman and Taylor, 1978), it regained prominence in the aftermath of the 1997 East Asian crises. According to some authors, depreciations were disruptive because of the currency mismatches induced by the government’s implicit guarantee that no depreciations would take place (see Furman and Stiglitz, 1998). Presumably, local firms reacted to this guarantee by contracting debt denominated in foreign currency, even if they lacked income of similar denomination.

The shift to float removes this guarantee and thus creates an incentive to avoid currency mismatches. This eliminates the basis for the balance-sheet effect and therefore weakens the impact of currency depreciations on aggregate demand. The new situation allows the central bank to let the exchange rate free to fluctuate without the fear of severe contractionary effects. These two effects would reinforce each other over time, leading to increasing levels of relative exchange-rate volatility.

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3 For instance, Lima et al. (2006) present detailed data showing a large reduction in currency mismatch among Colombia’s firms after the country’s adoption of a floating exchange regime.
The above factors imply that exchange-rate volatility may evolve endogenously after the change of regime; in particular, we would expect to see increasing levels of volatility as the period of floating lengthens in each country. This prediction can be explored by calculating the level of relative exchange-rate volatility in rolling samples, as shown in the series of Figure 1. Each observation in the series is a ratio between the standard deviations of the exchange rate and either the interest rate or foreign reserves, calculated over the previous 12 months. For instance, for Chile the first observation in the series corresponds to the volatility ratio calculated over the period February 1989-January 1990; the next observation corresponds to the ratio calculated over the period March 1989-February 1990, and so forth.

The figure suggests two issues. First, in the three countries there is indeed a change in the mode of financial adjustment after the adoption of the float, in the form of an increase in relative exchange-rate volatility. And second, while this increase is at first timid, it becomes larger as we move to the more recent phases of floating. Toward the end of the sample the exchange rate's volatility ratios, in particular with respect to the interest rate, become much larger than anything seen in the countries' recent history.

Consider Chile. During the first two years of the float (2000-2001), the exchange rate's volatility ratios remained within a range of 1-2. However, starting in 2002 a new trend clearly emerged that is characterized by a steady rise...
Note: The solid (dashed) line series corresponds to the standard-deviation ratio between the monthly change of the exchange rate and the interest rate (reserves) calculated over the previous 2 months. The original series in levels were first Hodrick-Prescott detrended. The monthly changes in the exchange rate and reserves were originally expressed in percentages, while the change in the interest rate is in percentage points.
Source: Central Bank of each country.
in relative exchange-rate volatility, particularly in relation to the interest rate. As a result, by the end of the sample the exchange rate’s volatility ratio was several times higher than the level observed in the early stages of floating. Peaks of close to 10 were reached repeatedly.

The phenomenon is even more pronounced in Colombia, where the exchange rate-interest rate volatility ratio increased from a range of 2-4 in the initial phase of floating, to levels of more than 10 in the final part of the sample. Exchange-rate volatility in Mexico is smaller than in the other two countries (note the different scale), but the trends are similar. In particular, the volatility of the exchange rate with respect to the interest rate increased from less than 2 in the first years of floating, to levels above 3 in 2005.

Thus, while the three countries appear to continue relying on reserves to accommodate shocks, there has been a steady shift, as the period of floating is extended, from the interest rate to the exchange rate as main adjusting variable.

4 Exchange rate and output

This section presents an econometric analysis of output determination in our sample of Latin American countries. The analysis looks for possible changes in the effect of the exchange rate and interest rates on output, as we move from band to floating periods (or from early to late stages of floating in Mexico, as explained below).

The motivation for the exercise is twofold. First, as argued in the previous section, there are reasons to expect a declining effect of the exchange rate on output as exchange-rate volatility increases. Second, a lower degree of FOF can have an increasing or decreasing effect on output volatility, depending on whether the exchange-rate effect on output has become more or less important during the floating period, when compared to the interest-rate effect. In other words, the shift from the interest rate to the exchange rate as the major adjusting variable in the assets market may stabilize or destabilize output, depending on the relative sensitivity of output to those two variables.

The analysis rests on the estimation of error-correction models for the output growth rate in each country. This formulation allows us to analyze both the “level” relationship between the variables –usually interpreted as capturing “long-term” effects–, and the short-term dynamics. The sample period is January 1990 (around the time of adoption of band regimes, with inflation under control, and renewed access to the global capital market in our group of Latin American countries) to September 2005.

In addition to using the entire period, the equations are estimated also for shorter sub-periods with the purpose of detecting possible shifts in the exchange rate and interest-rate coefficients. In Chile and Colombia, the sub-periods are January 1990 to September 1999, and January 1996 to September 2005, each with
117 monthly observations. They correspond to the entire band regime and to the last phase of the band plus the float, respectively.

Mexico made an early shift to float in December of 1994, leaving the band period too small for estimation purposes. In addition, the shift took place in a crisis context. The early part of the floating period was basically characterized by the efforts of Bank of Mexico to reduce inflation and reestablish its credibility, which led to a strong reaction of monetary policy to the exchange rate (Edwards and Savastano, 1998). The main part of the disinflationary period did not end until late 2001. Figure 1 shows that it is precisely after this date, rather than when the float was adopted, that a steady rise in exchange-rate volatility began.

For these reasons, estimations for Mexico were performed for the following two sub-periods: January 1990 to December 2001 (144 observations), and January 1995 to September 2005 (129 observations). The second sub-period corresponds exactly to the float. Note that both sub-periods include the crisis observations, in order to reduce the chance that differences in the estimation results are driven by the crisis itself.

In the analysis that follows, these different estimation periods will be referred to as the “entire period” (January 1990 to September 2005), the “early period” (corresponding to the band regimes in Chile and Colombia, and the band regime plus initial float in Mexico), and the “late period” (last phase of the band plus entire float in Chile and Colombia, and entire float in Mexico).

In each case, the equation estimated has the following form,

\[
\Delta \text{out}_t = \sum_{m=1}^{M} a_m \Delta \text{out}_{t-m} + \sum_{l=0}^{L} b_l \Delta \text{rer}_{t-l} + \sum_{l=0}^{L} c_l \Delta \text{rir}_{t-l} + \sum_{l=0}^{L} d_l \Delta \text{uso}_{t-l} \\
+ \sum_{l=0}^{L} f_l \Delta \text{comm}_{t-l} - \sigma (\text{out}_{t-1} - \text{out}^{fr}_{t-1}) + e_t
\]

where \(\text{out}\) is the 12-month growth rate of output (in percentage), \(\text{rer}\) is the natural log of the real exchange rate index, \(\text{rir}\) is the real interest rate, \(\text{uso}\) is the US output growth rate (in percentage), and \(\text{comm}\) indicates the natural log of an international commodity price quoted in US dollars (in real terms). The “equilibrium” output growth rate (\(\text{out}^{fr}\)) is determined as follows:

\[
\text{out}^{fr}_t = \alpha + \beta \text{rer}_t + \chi \text{rir}_t + \delta \text{uso}_t + \lambda \text{comm}_t
\]

Output is measured by an index of industrial production, the real exchange rate is the ratio of foreign to local prices (thus, a rise in the index indicates a real

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4 Ideally, we should estimate rolling regressions within the floating periods to check for a gradual shift in the coefficients; however, the relatively short sample available for each country does not allow that. For instance, experimentation with 5-year rolling windows yielded very unstable dynamic effects. In any case, the justification for the exercise consists of looking for evidence that the exchange-rate effect on output varies across periods characterized by different levels of exchange-rate volatility.
is Latin America overcoming its fear of floating?

Depreciation of the local currency, and the real interest rate is the difference between the nominal interest rate and the inflation rate. The international commodity price is that of copper in the equations for Chile, coffee in Colombia, and oil in Mexico, all deflated by the US producer price index. This variable is included to separate the effect of the real exchange rate from that of terms-of-trade fluctuations on output. In addition, the equations for Colombia and Mexico include dummy variables that isolate the observations corresponding to extraordinary variations in output (such as the Tequila crisis in Mexico; see the Appendix for precise data definitions and sources).

The initial value of $M$ and $L$ in equation (1) was six. The lag structure was then sequentially simplified according to the statistical significance of the individual coefficients. Thus, the dynamic effects shown below are based on equations that include only those coefficients estimated with p-values of at most 0.10.

The term in parenthesis on the right-hand side of equation (1) is the deviation of the actual output growth rate from its long-run value. This implies that $\sigma$ measures the speed of adjustment toward equilibrium. The equilibrium equation (2) can be accepted when the hypothesis that $\sigma$ equals zero is rejected. For this relationship to be meaningful, the estimated value of $\sigma$ must be negative, indicating that the actual growth rate of output moves over time toward its equilibrium value.

Estimation was carried out following the approach proposed by Pesaran et al. (2001), which does not require pre-testing the variables for order of integration (see Frankel et al., 2002 for an early application). The procedure focuses on the statistical significance of the speed-of-adjustment coefficient. Pesaran et al. (2001) provide separate critical values for the hypothesis that $\sigma$ equals zero depending on whether the variables are integrated of order one or zero [I(1) or I(0), respectively].

If the t-statistic is larger, in absolute terms, than the critical values for the I(1) case, then equation (2) can be accepted irrespective of whether the variables are stationary or not. In contrast, if the estimated t-statistic falls between the I(0) and I(1) critical values, then the equation can be accepted only under the assumption that the variables are stationary. These results were complemented with those from the Engle-Granger procedure, which consists of testing for a unit root in the residuals from equation (2).

The estimation was carried out in two steps. Initially, equation (2) was estimated and the deviations of the output growth rate from its equilibrium level were calculated. In the second step, equation (1) was estimated. The results are presented in Table 2. There are three equations for each country, corresponding to the entire, early and late periods. Section (A) of the table presents the level coefficients, while section (B) focuses on the short-term part of the model. This latter part includes, besides the adjusted $R^2$ and B-G statistic for serial correlation, the estimated error-correction coefficient and Wald tests for the joint significance of each variable’s current and lagged values.
### TABLE 2
ECONOMETRIC RESULTS. OUTPUT EQUATIONS.

Dependent variable: 12-month output growth rate, OLS estimation

<table>
<thead>
<tr>
<th>Long-run coefficients:</th>
<th>CHILE</th>
<th>COLOMBIA</th>
<th>MEXICO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real exchange rate</td>
<td>4.93</td>
<td>-4.64</td>
<td>13.82 *</td>
</tr>
<tr>
<td>Real interest rate</td>
<td>-0.30 **</td>
<td>-0.26 +</td>
<td>-0.22 +</td>
</tr>
<tr>
<td>Commodity price</td>
<td>3.98 **</td>
<td>6.92 ***</td>
<td>4.46 **</td>
</tr>
<tr>
<td>US growth rate</td>
<td>0.24</td>
<td>-0.16</td>
<td>0.44 **</td>
</tr>
<tr>
<td>Crisis dummy</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Recovery dummy</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Constant</td>
<td>-27.55</td>
<td>8.04</td>
<td>-70.07 **</td>
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<tr>
<td>Adj R-sq</td>
<td>0.15</td>
<td>0.14</td>
<td>0.32</td>
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Residual tests:

<table>
<thead>
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<th>Test</th>
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<th>COLOMBIA</th>
<th>MEXICO</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADF</td>
<td>-5.36 ***</td>
<td>-5.08 ***</td>
<td>-8.26 ***</td>
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<tr>
<td>Phillips-Perron</td>
<td>-7.69 ***</td>
<td>-4.99 ***</td>
<td>-8.38 ***</td>
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<tr>
<td>KPSS</td>
<td>0.05 $</td>
<td>0.12 $</td>
<td>0.06 $</td>
</tr>
</tbody>
</table>

Notes to Table 2: Newey-West standard errors used in all models. Details of the short-term specification in Appendix B. ****, ***, *, +: rejects the null that the coefficient equals zero at %, 5%, 0%, 5% respectively. ADF, PP critical values from McKinnon (1988). $, $$: cannot reject the null of stationarity at 0%, % (Kwiatkowski-Phillips-Schmidt-Shin test). #: rejects the null of no long-run relationship at 5% regardless of the order of integration of the variables (Pesaran et al., 2000). ##: rejects the null of no long-run relationship only for I(0) variables (see Pesaran et al., 2000).
TABLE 2 (continued)
ECONOMETRIC RESULTS. OUTPUT EQUATIONS.
Dependent variable: 12-month output growth rate, OLS estimation

(1) CHILE (2) COLOMBIA (3) MEXICO
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**B) Short-term dynamics:**

<table>
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<tr>
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</thead>
<tbody>
<tr>
<td>EC coefficient</td>
<td>-0.29 #</td>
<td>-0.25 ##</td>
<td>-0.75 #</td>
<td>-0.54</td>
<td>-0.47 #</td>
<td>-0.86 #</td>
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<tr>
<td>Wald tests (p-values) on differences of:</td>
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</tr>
<tr>
<td>Real exchange rate</td>
<td>0.0148</td>
<td>0.0015</td>
<td>0.0760</td>
<td>0.0078</td>
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<td>0.0000</td>
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<tr>
<td>Real interest rate</td>
<td>0.0954</td>
<td>0.0019</td>
<td>0.0024</td>
<td>0.0251</td>
<td>0.0112</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0001</td>
<td>0.0014</td>
</tr>
<tr>
<td>Commodity price</td>
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<td>–</td>
<td>–</td>
<td>0.0020</td>
<td>0.0373</td>
<td>0.0010</td>
<td>0.0342</td>
<td>0.0511</td>
<td>0.0700</td>
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<tr>
<td>US growth rate</td>
<td>–</td>
<td>0.0025</td>
<td>–</td>
<td>0.0033</td>
<td>0.0000</td>
<td>0.0934</td>
<td>0.0000</td>
<td>0.0001</td>
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<td>Lagged growth rate</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.1085</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0018</td>
</tr>
<tr>
<td><strong>adj R-sq</strong></td>
<td>0.3103</td>
<td>0.3840</td>
<td>0.4198</td>
<td>0.5225</td>
<td>0.5754</td>
<td>0.5555</td>
<td>0.5711</td>
<td>0.5736</td>
<td>0.4907</td>
</tr>
<tr>
<td>DW</td>
<td>1.9783</td>
<td>2.0170</td>
<td>2.0624</td>
<td>2.0807</td>
<td>2.0735</td>
<td>2.2334</td>
<td>1.9961</td>
<td>2.0515</td>
<td>2.0154</td>
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<tr>
<td>Breusch-Godfrey (1)</td>
<td>0.6258</td>
<td>0.7687</td>
<td>0.1774</td>
<td>0.2827</td>
<td>0.4456</td>
<td>0.0352</td>
<td>0.9270</td>
<td>0.5993</td>
<td>0.7104</td>
</tr>
<tr>
<td>Breusch-Godfrey (3)</td>
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<td>0.4086</td>
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<td>0.1459</td>
<td>0.7023</td>
<td>0.8969</td>
<td>0.7700</td>
</tr>
</tbody>
</table>

Notes to Table 2: Newey-West standard errors used in all models. Details of the short–term specification in Appendix B.
***, ***, *, +: rejects the null that the coefficient equals zero at 1%, 5%, 10%, 15% respectively. ADF, PP critical values from Mc Kinnon (1988). $, $$: cannot reject the null of stationarity at 10%, 1% (Kwiatkowski-Phillips-Schmidt-Shin test). #: rejects the null of no long-run relationship at 5% regardless of the order of integration of the variables (Pesaran et al., 2001). ##: rejects the null of no long-run relationship only for I(0) variables (see Pesaran et al., 2001).
Our main interest is in section (B) of the table, which shows the short-term effect of the exchange rate and interest rate on output. However, for the sake of completeness (and because of its own importance), we will as a preamble consider the long-run part of the model. The fit of the equations is good in Colombia and Mexico, although Chile shows relatively low $R^2$ levels. In all equations, the error-correction coefficient is negative and highly significant, which is consistent with the existence of an equilibrium relationship between the variables (with some statistical ambiguity only in the second equation for Chile). In the same sense, all the unit root tests are consistent with the hypothesis that the residuals from equation (1) are stationary.

There is evidence of a tight link with the US growth rate, particularly in the cases of Colombia and Mexico. In the late period, the link is strongest in Mexico, with a coefficient of more than twice the size of those obtained for Colombia and Chile, presumably as a reflection of the beginning of NAFTA. A noteworthy result is that the oil-price coefficient becomes negative in the Mexican equation for the late period, reflecting the declining importance of this commodity within the country’s exports and the predominance of the contractionary effects that higher oil prices have on the world economy.

As could be expected, the coefficient for the real interest rate is negative and, in most cases, highly significant. Within each country, the estimated value for the coefficient does not change much across periods. The results for the real exchange rate are, in contrast, more complicated: the variation in the size of the estimated coefficients is much larger across countries and periods, and there are sign switches.

Considering the entire estimation period, the real exchange rate coefficient is positive in all countries, although it is not significant in Chile. Thus, a depreciated currency leads to more rapid output growth. The effect is particularly strong in Colombia, although it appears to decline in the late period. In Chile, in contrast, the effect becomes significant and relatively large only in the most recent period. In Mexico, currency depreciations are expansionary in the early period, but contractionary in the late one. These variations seem worth of study in a different paper that would focus on the long-run effects of the real exchange rate.

We now turn to the short-term part of the model. The results will be illustrated by calculating the dynamic effects of the real exchange rate and the real interest rate on the output growth rate, according to the estimated coefficients for the variables in differences [see the first terms on the right-hand side of equation (2)]. In this calculation it is assumed that changes in the relevant variables are transitory but “persistent”, lasting three periods (months). The results are shown in Figures 2-4. As mentioned, they are derived from equations that retain only those variables whose coefficients have p-values of at most 0.10, both individually and in the Wald tests of joint significance.

5 Recall that contractionary effects are usually deemed relevant for the short run, while in the long run the positive impact on the profitability of tradables is expected to dominate; see Frenkel and Taylor (2006) for a general discussion of this point, and Galindo and Ros (2004) for further empirical evidence on Mexico.

6 For a 10% depreciation, the effect on the output growth rate falls from 3.3 points in the early period, to 2.4 points.
FIGURE 2
CHILE: DYNAMIC EFFECTS OF REAL EXCHANGE RATE AND INTEREST RATE SHOCKS ON OUTPUT

Real exchange rate

Real interest rate

Note: The figure shows the dynamic effect percentage on the output growth rate of a 1-point change in the real interest rate and a 5-percent change in the real exchange rate that last for three periods. See Table 2 for details on the equations used in the calculation of these effects.
FIGURE 3
MEXICO: DYNAMIC EFFECTS OF REAL EXCHANGE RATE AND INTEREST RATE SHOCKS ON OUTPUT

Real exchange rate

Real interest rate

Note: See Figure 2.
FIGURE 4
COLOMBIA: DYNAMIC EFFECTS OF REAL EXCHANGE RATE
AND INTEREST RATE SHOCKS ON OUTPUT

Real exchange rate

Real interest rate

Note: See Figure 2.
Consider, first, the case of Chile. According to the model estimated for the entire period, a 1-point rise in the real interest rate leads to a fall of 0.21 points in the output growth rate after five months, while a 5 percent real currency depreciation leads to a fall of 1.71 points in the output growth rate after the same number of months.

The size of the dynamic effect of the interest rate in the early period is similar to that calculated for the entire sample, although the reduction of the output growth rate takes place immediately rather than after several months\(^7\). The effect of the real exchange rate, however, is much larger: a 5 percent currency depreciation in the early period produced a fall of 3.25 points in the output growth rate (after 6 months), rather than the effect of 1.71 estimated for the entire period.

Further evidence of a shift in coefficients is provided by the estimation results for the late period. In particular, although the dynamic effect of the real exchange rate on output growth becomes positive (perhaps because of a loosening of the balance-sheet effect), its absolute size is much smaller than in the earlier period\(^8\). The results from this comparison agree with our expectations, given our previous conclusion that both a consequence of and a favorable condition for greater exchange rate volatility is a decline in the effect of the exchange rate on output.

We observe the opposite results in Mexico. The effect of the interest rate on the output growth rate does not vary much across periods. For instance, a one-point rise in the real interest rate reduced the output growth rate in 0.32 percentage points in the early period and in 0.38 in the late one. But, in contrast to the Chilean case, the exchange-rate effect became much stronger. In the early period, a currency depreciation of 5 percent produced a fall 1.18 points in the output growth rate; for the late period, this effect practically doubles to 2.25 points.

In Colombia, a rise in the interest rate reduces the output growth rate while currency depreciations have the opposite effect. It is readily apparent that the dynamic effects of a change in both the real exchange rate and the real interest rate are more persistent in the early period than in the late one. But the size of the effects is in fact larger for the late period. For instance, the peak effect of a 5% variation in the real exchange rate is a change of about 1.33 points in the output growth rate in the early period but of 2.15 points in the late one.

This result implies that exchange-rate volatility has a stronger influence on output in the recent period when compared to the band regime. However, the effect of the interest rate on output also increased in the late period. For instance, a 1-point rise in the real interest rate produced a fall of 0.46 points in the output growth rate in the early period, but of 0.63 in the late one. By itself, the stronger effect of the interest rate on output makes a policy of greater interest rate control more attractive.

\(^7\) In the early 2000s, there was some debate in Chile about whether the effect of monetary policy on aggregate demand had weakened after the policy’s intermediate objective shifted from a real policy rate to a nominal one in late 2001 (see Morandé, 2002). This shift does not affect our results because we are using, not the policy rate, but directly a market rate.

\(^8\) The dynamic effect of the interest rate also becomes larger in the estimation for the late period; however, the observed effect is positive, which is difficult to interpret; moreover, it differs greatly from the estimated effect for the entire period. These two observations suggest that the observed effect for the late period may be an accident of the chosen estimation period.
The net effect on output stability from the shift to greater exchange-rate volatility will ultimately depend, by definition, on the combined influence of the two factors that we have reviewed separately: the change in the exchange-rate and interest-rate coefficients in the output equations, and the actual trade-off between exchange-rate and interest-rate volatility (that is, how much exchange-rate volatility increases as the range of fluctuation of the interest rate is reduced). One way to look at this net effect, using our output growth equations, is to calculate and compare the dynamic response of output to the mean absolute change of the exchange rate and interest rate in the different periods (see Figures 5-7).

In Chile, the mean absolute change of the real interest rate during the entire, early and late periods was 1.99, 2.86 and 1.13 percentage points, respectively. The corresponding figures for the mean absolute change of the log real exchange rate were 0.0148, 0.0130 and 0.0148. Using these numbers in our output growth equations shows that the net effect of the shift to greater exchange-rate volatility was a reduction in output volatility. This is most clearly seen by comparing the output effects for the entire and early periods. In the case of the real interest rate, the peak effect on output growth falls from -0.63 points in the early period, to -0.43 in the entire period. In the case of the real exchange rate, the peak effect declines from -0.82 to -0.51 points (see Figure 5).

In Mexico, in contrast, the net result appears to be an increase in output volatility. In this country, the mean absolute change in the entire, early and late periods was respectively 1.29, 1.56 and 1.27 for the real interest rate, and 0.0142, 0.0145 and 0.0162 for the log real exchange rate. Substituting these data into the output growth equations shows that the peak effect of the interest rate on output (of close to -0.5 points) basically does not change across periods, while the peak effect of the exchange rate increases from -0.34 in the early period to -0.73 in the late one. In Mexico, therefore, the observed increase in exchange-rate volatility has tended to amplify output volatility, without a compensating effect from the reduction in (relative) interest-rate volatility (see Figure 6).

Finally, Colombia is in an intermediate position. On one side, the reduction in interest-rate volatility has more than offset the increase in the interest-rate coefficient in the output equation, and, as a result, there was a reduction in the contribution of this source to output volatility. In particular, the mean absolute change of the real interest rate during the entire, early and late periods was 0.86, 1.15 and 0.60 percentage points, respectively. Using these data in the output equations yields a peak effect of -0.53 points in the early period but only -0.38 in the late one.

On the other side, though, the increase in the exchange-rate coefficient in the late period, coupled with the slight reduction in absolute exchange-rate volatility, has resulted in greater output volatility from this source. More specifically: the mean absolute change of the log real exchange rate for the entire, early and late periods was 0.0172, 0.0183 and 0.0182, respectively. It can be calculated that the peak effect from this source on the output growth rate increased from 0.49 points in the early period, to 0.78 in the late one (see Figure 7).

These values exclude the crisis year 1995.
Note: The figure shows the dynamic effect on the output growth rate of a variation equal to the mean absolute change in the real interest rate and the real exchange rate that lasts for three periods. See table 2 for details on the equations used in the calculation of these effects.
FIGURE 6
MEXICO: DYNAMIC OUTPUT EFFECTS FROM A MEAN ABSOLUTE CHANGE IN REAL EXCHANGE RATE AND INTEREST RATE

Real exchange rate

Month

Entire period  Early period  Late period

Real interest rate

Month

Entire period  Early period  Late period

Note: See Figure 5.
FIGURE 7
COLOMBIA: DYNAMIC OUTPUT EFFECTS FROM A MEAN ABSOLUTE CHANGE IN REAL EXCHANGE RATE AND INTEREST RATE

Note: See Figure 5.
5. CONCLUSIONS

Some analysts have argued that emerging market economies suffer from fear of floating (FOF); i.e., that despite the formal adoption of floating regimes, they use monetary policy to stabilize the exchange rate at the cost of large interest-rate volatility. This paper shows that this manifestation of FOF is becoming weaker as the period of floating lengthens in Chile, Colombia and Mexico. In other words, exchange-rate volatility levels have risen, but this has been a gradual phenomenon rather than a discrete adjustment at the time of adoption of the float. An important implication is that while the gain in monetary autonomy may have been small in the early stages of floating, it has increased considerably as experience on the operation of the system accumulates.

The paper argues that the reduction of FOF may be the result of a circular mechanism, according to which as the exchange rate becomes more volatile, its effects on output and inflation decline; but as this latter happens, the authorities are more likely to let their currencies fluctuate. The econometric analysis of output shows some support for this prediction, as explained below.

From the point of view of output stability, this change in monetary management may be reasonable but it depends on both the specific trade-off between exchange rate and interest rate volatility and on the relative effect of the exchange and interest rates on output. Wider exchange rate fluctuations as the counterpart to greater interest rate control will be desirable to the extent that output is more sensitive to the interest rate than to the exchange rate. As mentioned, the shift to a regime of greater exchange-rate volatility may end up producing a reduction in the sensitivity of output to the exchange rate. A fall in the output effect of the exchange rate becomes both a consequence and a favorable condition for greater exchange-rate flexibility.

The main contribution of this paper is to relate the evolution of FOF with the effect of the exchange rate and interest rate on output. The empirical estimation of output growth equations for Chile, Colombia and Mexico yields mixed results. In Chile, the estimated short-term effect of the exchange rate on output became smaller as the country moved to a regime of greater exchange-rate volatility. In net terms, the contribution of both the exchange rate and interest rate to output-growth volatility declined.

In contrast, in Colombia and Mexico there was a rise in the short-term sensitivity of the output growth rate to both the exchange rate and interest rate in the recent period. In Mexico, the net contribution from the shift to greater exchange-rate volatility appears to be an increment in output volatility, with no offsetting decline from the contribution of the interest rate. In Colombia, the contribution of the exchange rate to output volatility has risen, but at the same time the contribution of the interest rate has declined.
6. REFERENCES


APPENDIX
A) DATA DEFINITIONS AND SOURCES FOR SECTION 4

Output:
The output growth rate corresponds to the 12-month percentage variation in the following indices:
- Chile: Index of manufacturing production. Source: IMF.
- Colombia and Mexico: Index of industrial production. Source: Central banks.

Real exchange rate:
- Chile and Colombia: Central banks’ multilateral real exchange rate indices.
- Mexico: CPI ratio between the US and Mexico, based on central bank data.
  A rise indicates depreciation.

Real interest rate:
Calculated as the difference between the nominal interest rate and the CPI-based 12-month inflation rate, both in percentage. The nominal interest rates are:
- Chile: Average of deposit and lending rates, 90 to 365-day operations.
- Colombia: 90-day CD interest rate for banks and corporations.
- Mexico: 91-day Treasury bill rate from primary auctions.
  Source: Central banks.

Commodity prices:
- Chile: Copper, grade A cathode, LME spot price, cif European ports, US$ per metric ton.
- Mexico: Crude oil, simple average of three spot prices; Dated Brent, West Texas Intermediate, and the Dubai Fateh, US$ per barrel.
  All prices were deflated by the US producer price index calculated by the Bureau of Labor Statistics.
  Source: IMF.

Crisis dummies:
- Colombia: Equal to 1 from December 1998 to July 1999, when the 12-month output growth rate showed values of about minus 20 percent.

- Mexico: Equal to 1 from April 1995 to December 1995, in the aftermath of peso collapse of late 1994, early 1995. The “levels” equation for Mexico also included a “recovery” dummy to isolate the extraordinary high growth rates registered during April 1996 to December 1996, and which basically reflected the output collapse of 1995.
B) SHORT-TERM EQUATION SPECIFICATIONS

All equations in Table 2 include one lag of the error correction term, and the following short-term specifications.

**Chile (1):** lags 1 and 2 of output growth rate, lag 5 of real exchange rate, lags 4 and 5 of real interest rate.

**Chile (2):** lags 1, 2 and 6 of output growth rate, lags 1, 2, 4 and 6 of real exchange rate, current and lags 4 and 5 of real interest rate, lags 3, 5 and 6 of US growth rate.

**Chile (3):** lag 3 of output growth rate, lag 1 of real exchange rate, lag 2 of real interest rate.

**Colombia (1):** lags 1, 2 and 4 to 6 of output growth rate, current real exchange rate, lag 5 of real interest rate, current and lags 2, 5 and 6 of commodity price, and current US growth rate.

**Colombia (2):** lags 1 and 4 to 6 of output growth rate, current real exchange rate, lag 5 of real interest rate, lags 1 and 5 of commodity price, current and lags 2, 3 and 6 of US growth rate.

**Colombia (3):** lags 1, 2 and 4 to 6 of output growth rate, current real exchange rate, lags 2, 3 and 6 of real interest rate, current and lag 2 of commodity price, current and lag 5 of US growth rate.

**Mexico (1):** lags 1, 2 and 6 of output growth rate, current and lags 2 to 5 of real exchange rate, lags 1, 2, 4 and 6 of real interest rate, lag 6 of commodity price, current and lags 2, 4 and 5 of US growth rate.

**Mexico (2):** lags 1, 3 and 6 of output growth rate, current and lags 3 and 4 of real exchange rate, lags 1, 4 and 6 of real interest rate, current commodity price, current and lags 2 and 4 to 6 of US growth rate.

**Mexico (3):** lags 2, 3 and 6 of output growth rate, lags 3 and 4 of real exchange rate, lags 3, 4 and 6 of real interest rate, lag 6 of commodity price, current and lag 2 of US growth rate.