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Effects of U.S. Interest Rates on the Real Exchange Rate in Mexico

André Varella Mollick
The University of Texas Rio Grande Valley, andre.mollick@utrgv.edu

E C O N O M I C S   B U L L E T I N

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Andre Mollick
ITESM−Campus Monterrey

Abstract

Using monthly data to bond and equity markets in Mexico from U.S. investors, we search for responses in the vector autoregressions (VARs) − on the real exchange rate and reserves in Mexico − to shocks in U.S. interest rates and to the Mexican M2/Reserves ratio over the years 1988−2001. The ratio M2/Reserves measures the degree of financial vulnerability and brings this literature closer to theoretical constructions. Shocks to U.S. interest rates explain not more than 7.4% of the variance of international reserves and only 5.5% of real exchange rate changes under conventional specifications. Blending M2/Reserves with real exchange rates at the end of the VAR, external shocks explain 12.5% of the variance of real exchange rate one year after the shock and 12.8% of the variance of M2/Reserves. Typically, the responses in Mexico of U.S. interest rate shocks are as expected: higher shocks to U.S. interest rates move Mexican M2/Reserves up, depreciating the real exchange rate in Mexico.

Assistant Professor, Department of Economics, ITESM Campus Monterrey, avarella@campus.mty.itesm.mx A previous version of this paper was presented at the XXXII Research Congress of Monterrey's Tec and at workshops at Trinity University in San Antonio. I wish to thank, without implicating, Edgardo Ayala, Jorge González, Jorge Ibarra and Joao Faria for helpful comments and encouragement. I also acknowledge research assistance by Neftalí Valdez in early stages of this work.
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1. Introduction

Several empirical studies have pointed out the importance of external factors on macroeconomic series of emerging markets. The vector autoregressions (VAR) in Calvo et al. (1993) show that foreign components of U.S. interest rates and other indicators (income, real estate and equity markets) are able to explain around 50% of the variance of the real exchange rate and foreign exchange reserves in ten Latin American economies. Chuhan et al. (1998) also report that external variables explain from one third to one half of bond and equity flows from the U.S. to Asian and Latin American countries. Levy and Sturzenegger (2000) claim that, in their VAR, the European business cycle (German interest rates) affects foreign exchange reserves and the real exchange rate in several Latin American economies during the early 90s, replicating the conjecture to Europe. Adding domestic factors, Kim (2000) uses a structural VAR (SVAR), in which, despite the introduction of domestic productivity and demand shocks, external factors (world interest rates) prevail in explaining several capital and current accounts.

In 2001, very low levels of U.S. interest rates are back to the scene, which makes important to revise this literature and the evidence. This paper adds to the existing evidence in some ways. We attempt to cover the whole of the 90s, which is a period when several phases happened in U.S. credit markets. The period includes the low level of rates around 3% in 1992, the recovery of the U.S. economy and the subsequent rise of rates, and also comprehends considerable fluctuations in interest rates during the 1998 external crises caused by the Russian debt default and a domestic credit crunch. The FED pushed rates down to 4.75% during the fall of 1998 and in mid-1999 started to hike gradually until the level of 6.50% in May of 2000. From that level, the monetary policy target was suddenly reduced in early January of 2001 following the slowdown at the end of 2000. We thus conjecture whether economic effects due to external factors holds in a period not limited to the U.S. recession of the early 90s. Mexico is chosen in this study for several reasons. Among them are: i) it has very strong commercial ties with the U.S.; ii) its currency has appreciated notably since 1999; iii) it underwent economic reforms earlier than most Latin American countries; and iv) it is a large and representative economy of Latin America.

Keeping the VAR methodology, this paper uses empirical studies in determining which external and domestic factors to consider. While concentrating on U.S. interest rates as external shocks seems warranted, the domestic factor requires more analysis. We explore one indicator that hitherto has not been checked in this literature: the ratio M2/Reserves. As emphasized by Calvo and Mendoza (1996) the ratio M2/Reserves is a very good indicator of crisis and financial difficulties. The larger the ratio, the lower is the ability of a country to weather a speculative attack on its currency. It turns out that a rising ratio of M2/Reserves correctly anticipated the Mexican crisis of December of 1994. Exploring such mechanism, this paper links the original hypothesis with theoretical work under interest rate smoothing, such as Kumhof (2000). On the external front, we employ U.S. interest rates through the intended Federal Funds target rate. As dependent variables, we concentrate on funds by U.S. investors to Mexico into equity and bond markets gathered by the U.S. Treasury Department. Such data were also used by Chuhan et al. (1998) and Sarno and Taylor (1999) for evidence on the early 90s and are exempt of bias due to central bank intervention. We also investigate responses in the real exchange rate and the amount of foreign exchange reserves in Mexico, which were the major endogenous variables in the benchmark model of Calvo et al. (1993).

The main results of this study can be summarized briefly. A shock to U.S. interest rates is felt as expected on M2/Reserves in Mexico, moving the ratio higher and persistently. U.S.

shocks explain 12.8% of the variance of M2/Reserves one year after the shock. In the monthly sample used in this paper from 1988 to 2001, a shock to U.S. interest rates explains not more than 7.4% of reserves variations and not more than 5.5% of real exchange rate changes under the Calvo et al. (1993) specification. Blending the M2/Reserves argument with real exchange rates as the final series in the orderings, external shocks explain 12.5% of the variance of real exchange rate one year after the shock. Typically, the responses in Mexico of U.S. interest rate shocks are as expected: higher standard deviation in U.S. interest rates moves Mexican M2/Reserves up and depreciates the Mexican real exchange rate.

This paper is structured as follows. Section 2 discusses our hypothesis, section 3 summarizes the data and major features of the inflows into Mexico, while section 4 presents the estimations. Section 5 reviews the work and presents extensions for further study.

2. Hypothesis

The amount of money into bonds (bnd) and equities (eqt) sent by U.S. investors at time t (within a month in our data) to Mexico can be modeled as:

$$Bnd_t = f\,(u_t^{i*}, u_t^{m2r}, u_t^{bnd}) \quad (1)$$

$$Eqt_t = g\,(u_t^{i*}, u_t^{m2r}, u_t^{eqt}) \quad (2),$$

where: u_t^{i*} are shocks to the U.S. interest rate, u_t^{m2r} are shocks to the domestic M2/Reserves ratio, u_t^{bnd} are shocks to the bond flows, and u_t^{eqt} are shocks to the equity flows. Higher interest rates in the U.S. should discourage the flow of funds into Latin American markets. A higher ratio of M2/Reserves should also lead to lower flows since the risk is higher of a financial or currency crisis. See Calvo and Mendoza (1996) for a theoretical model based on “herd behavior” and for an analysis of the 1994 financial crisis in Mexico based on its (rising) M2/Reserves ratio. Kaminsky and Reinhart (1999) verify, under a probabilistic approach for a sample of 20 countries, that growing M2/Reserves increases the likelihood of crisis.

Since the structural shocks in (1) and (2) are unobserved, some identifying assumptions are needed to uncover structural shocks from the observed series. In order to extract the two structural shocks (u_t^{i*} and u_t^{m2r}), we use a two-variable system in which the observed series are related to the structural shocks as follows:

$$Y_t = \sum_{i=0}^{\infty} A_i\, U_{t-i} = A(L)\, U_t \quad (3),$$

where $Y_t = (\Delta i^*_t, \Delta m2r_t)'$, $U_t = (u_t^{i*}, u_t^{m2r})'$, $A(L) = \Sigma_{t=0}^{\infty} A_i L^i$, L is the lag operator and A_i is the matrix of impulse responses of endogenous variables to structural shocks. Then:

$$\Delta i^*_t = a_{11}(L)\, u_t^{i*} \quad (4a)$$

$$\Delta m2r_t = a_{21}(L)\, u_t^{i*} + a_{22}(L)\, u_t^{m2r} \quad (4b),$$

where $a_{ij}(L)$ are polynomials in L. Note that the system is of very low dimension and one does not need to assume many restrictions. In fact, all is needed in (4a) and (4b) is that the world interest rate is exogenous and that shocks to M2/Reserves are orthogonal to shocks in the world interest rate.[1] Examples of innovations in (4a) are shifts to the marginal productivity of capital and changes in monetary policy. The latter includes a more aggressive or lenient Federal Reserve Board in response to inflation threats and growth prospects.[2] Examples of innovations to equation (4b) are more complicated since two factors are included: M2 and foreign exchange reserves. Factors affecting M2 are pertained to domestic monetary policy or money demand (e.g., a boom in income that pushes the monetary aggregate up), while factors moving reserves are related to current account movements and credibility factors. We require in (4a) and (4b) that there is no connection between the innovations, which is plausible if the shocks respond to different forces.

As in Ahmed et al. (1993), the VAR is estimated for the system of observed variables. In the modified VAR, the external series follows an autoregressive process and the domestic series are modeled as functions of their own lags and of lags of the external variables:

$$\Delta i^*_t = c^1 + \Sigma b_k^{11} \Delta i^*_{t-k} + v_t^1 \quad (5a),$$
$$\Delta m2r_t = c^2 + \Sigma b_k^{21} \Delta \iota^*_{t-k} + \Sigma b_k^{22} \Delta m2r_{t-k} + v_t^2 \quad (5b),$$
$$\Delta bnd_t = c^3 + \Sigma b_k^{31} \Delta i^*_{t-k} + \Sigma b_k^{32} \Delta m2r_{t-k} + \Sigma b_k^{33} \Delta bnd_{t-k} + v_t^3 \quad (5c),$$
$$\Delta eqt_t = c^4 + \Sigma b_k^{41} \Delta \iota^*_{t-k} + \Sigma b_k^{42} \Delta m2r_{t-k} + \Sigma b_k^{43} \Delta eqt_{t-k} + v_t^4 \quad (5d),$$

where the vector of v_t^i are reduced-form innovations. The VAR is of dimension 3 and its last row is either (5c) or (5d) depending on whether financial market (fixed income or stocks) is considered. Structural shocks can be recovered as linear combinations of reduced-form innovations. Disturbances should be orthogonal to each other and the long-run matrix must be lower triangular, which is obtained by either (5a)-(5b)-(5c) or (5a)-(5b)-(5d).

In addition to systems (5a)-(5c) or (5a)-(5d) above, we present estimations of the conventional specification in Calvo et al. (1993) as well. The models based on (5) can be summarized in Wold causal ordering as: [i*, m2r, bnd] or [i*, m2r, eqt]. The specification put forward by Calvo et al. (1993) is: [i*, res, rer], where reserves are represented by (res), and the real exchange rate by (rer). We can also combine our empirical model under M2/Reserves with the benchmark specification to obtain two additional VAR orderings: [i*, m2r, res] and [i*, m2r, rer]. The former is not well specified, however, given that foreign exchange reserves affect inversely the ratio M2/Reserves, but the latter is what we call the hybrid model. The hybrid model blends the benchmark model of Calvo et al. (1993) with the theoretical idea in Calvo and Mendoza (1996).

3. The Data

[1] In section 4 we report the correlation among the series. It turns out that M2/Reserves in Mexico is correlated with the U.S. federal funds rate (0.49). However, for technical identification we need that *shocks* to the series are unrelated to the other shocks, which certainly is not the same as the sample correlation coefficient between the two series is low or close to zero.

[2] See Clarida et al. (2000) for evidence that the FED during the Volcker-Greenspan tenures has adopted a more aggressive stance on inflation control than their predecessors.

The period of analysis comprises various swings as U.S. interest rates reached the 3% levels during 1993 and then staged a recovery. See figure 1 for the behavior of the U.S. Federal Funds target rate for our sample under monthly data. The first chart in the figure documents a significant declining period that goes from 1989 until 1992, which is the one covered by Calvo et al. (1993). The sharp reduction in U.S. rates is responsible in their model for up to 50% of the (positive) variation in foreign exchange reserves and for real exchange rate appreciation in most Latin American countries during 1988-1991. The upward moves in 1994 and in 1999-2000 are much less striking than the abrupt decline from 1989 to 1993.

Figure 1 also contains the patterns of U.S. flows into Mexico as well as Mexican data. In Mexico the bond and equity flow series fluctuate around their means and appear insensitive to U.S. interest rate swings. The M2/Reserves series has spikes in mid-1990 and again in late 1994 with the currency crisis that forced the abandon of exchange rate bands.[3] The figure has U.S. capital flow data on gross and net purchases of non-U.S. securities (equities and bonds) in Mexico for the period from January 1988 to April 2001. Mexico is responsible for an important share of U.S. flows into the Latin American region and the peso has benefited lately from a sustained real exchange rate appreciation together with reserves accumulation. See figure 1.

The capital movements data come from the U.S. Treasury Department and belong to the *Treasury International Capital* (TIC) Reports. Such data are aggregated by type of capital flows and form perhaps the most comprehensive available data set on a monthly basis for portfolio flows. The TIC data represent U.S. investor's purchases and sales of long-term foreign securities as reported by commercial banks, bank holding companies, brokers and dealers, foreign banks, and non-banking enterprises in the U.S. In this paper we consider two particular types of capital: U.S. funds into equities and bonds to Mexico. The data on bonds cover the purchase and sale of foreign bonds from and to U.S. investors to Mexico. We focus on gross bond inflows instead of net bond inflows. Consistent with the literature, we choose to do so because net bond flows are influenced by countries' gross purchases of foreign assets (sterilization by central banks, for example) and the repurchases of the countries' own external obligations. Since the net bond outflows are influenced by many non-market factors, for which it is not possible to clean the data, we can only meaningfully study *gross bond inflows*. For equity flows, we can study the *net equity flows* since they are not influenced by central banks' operations.

For bonds and equity flows series towards Mexico, we use historical data from the database "U.S. transactions with foreigners in long-term securities" from the U.S. Department of the Treasury (www.ustreas.gov/tic). U.S. target and T-bill rates are from the U.S Federal Reserve of Saint Louis (www.frsbsl.org). Other series come from Mexico's central bank (Banxico, www.banxico.org.mx). They are: M2 on the tables "*Agregados Monetarios y Financiamiento*", "end of period spot exchange rate" determined by Banxico based on an average of wholesale foreign exchange transactions, "Total Reserves minus Gold", and the index of the real exchange rate (*tipo de cambio real*). The nominal exchange rate is used to convert domestic M2 into M2 in dollars in order to obtain the ratio M2/Reserves.

4. Results

4.1. Preliminary Results and Pretesting

[3] Calvo and Mendoza (1996) list three factors when explaining why huge gaps in stocks during 1990 in Mexico did not bring about a crisis as they did in 1994. First, in 1990 the environment was different with rates very low in the U.S. that contributed to flows into Latin America. Second, the Mexican government could then finance its debt through ajustabonos, an option no longer available in 1994. Third, foreign investors were not main holders of Mexican public debt in 1990 as they were in 1994.

The basic correlation coefficients match our priors: the U.S. interest rate is negatively correlated to (gross) bond flows (-0.28) and to (net) equity flows (-0.26) and positively correlated to the ratio M2/Reserves in Mexico (0.49). The ratio M2/Reserves in Mexico is very weakly correlated with bond flows (-0.03) and to equity flows (-0.001). The real exchange rate is positively correlated with the U.S. federal funds rate (0.50), to the ratio M2/Reserves (0.28), and negatively correlated to (gross) bond flows (-0.23) and to (net) equity flows (-0.09). Mexican international reserves show a negative correlation with U.S. interest rates (-0.53) and with the real exchange rate (-0.74), along with an obvious negative relationship with M2/Reserves (-0.61). Reserves also correlate weakly with bond inflows (0.26) and with net foreign flows (-0.09).

Unit root tests in table 1, under the methodologies of Dickey-Fuller and Phillips-Perron, document non-stationarity for most of the series in levels and stationarity in differences. We can not reject, at the 5% significance levels, the null hypothesis that there is a unit root in each of the series (ff, tcr, and res) when expressed in levels, while we are always able to reject the null in first differences. This is in full agreement with more general results by Sarno and Taylor (1999) for various sorts of flows. Bond and equity flows and the ratio M2/Reserves, however, appear to be stationary in levels. Note that both ADF tests and the Phillips-Perron tests yield the same results for all series. The series originally considered by Calvo et alli (1993) in their study (U.S. interest rate series, the real exchange rate and reserves) can be classified as integrated of order 1. The lag selection criterion of the lags in the ADF regressions is based on a data dependent procedure, which usually has more power than when chosen by an information criterion or by an arbitrarily set lag length as showed by Ng and Perron (1995).

4.2. Main Results

The main qualitative results of this paper are summarized in figures 2 to 5.[4] The lag-length for the VAR is chosen by a combination of minimization of the Akaike and Schwarz-Bayes information criteria and sequential likelihood tests procedure, assuming an initial lag-length of 6. In figure 2, we show the plots of impulse responses (IRs) in the VAR [ff, res, tcr] for Mexico. A 1% shock to the U.S. interest rate affects reserves negatively (between -2% and -4%) over the whole forecasted horizon. This is consistent with Calvo et al. (1993). Also, the 1% innovation in foreign exchange reserves implies a strong response of the real exchange rate: an appreciation, which is also in agreement with the major hypothesis. The 5% confidence bands generated by 1,000 Monte Carlo replications rule out a zero response in both cases but do not do so for the response of the real exchange rate to external shocks.

In table 2 the corresponding variance decompositions (VDs) are reported. Under inference based entirely on unit root tests, variance decompositions in the upper part of table 2 suggest external shocks explain – after 12 months - about 7% of the variance in reserves and 5.5% of the variance in the real exchange rate. Shocks in reserves explain about 18.5% of the variance of the real exchange rate over the same period. These figures are much lower than the 50% levels reported in Calvo et al. (1993) for the 1988-1991 period but are here obtained for the VAR in first-differences. Another difference in methodology is that Calvo et al. (1993)

[4] Results for Brazil and Chile are subject to a smaller sample size and are very preliminary. In Brazil, the M2/Reserves plot shows clearly the rise in 1999, while in Chile the M2/Reserves ratio has a U-type pattern at levels much lower than in Brazil and Mexico, suggesting a less prone environment to financial vulnerability.

employ principal components analysis to sort out series that explain much of the variance of reserves and of real exchange rates.

Estimating in levels, the amount of real exchange rate variances explained by reserves becomes almost 52% in the middle panel of table 2, while external shocks continue to have negligible effects. This specification, however, does not match inference based on unit root tests, not satisfying the requirement of a stationary-covariance stochastic process in VARs. Figure 3 reports the IRs in levels. For the specifications in first-differences associated with the upper chart of table 2, the responses die out soon after the shock and are omitted. Note that in both sorts of specifications the Wold decomposition [ff, res, tcr] finds support since the last element in the VAR is found to be much more explained by the other variables. In fact, in first-differences, after 12 months of the shock, Δtcr are explained by their own shocks by 76%, while Δres are explained by 90% and Δff by almost 99%! Matching our priors, U.S. interest rates appear to be the most exogenous of all. A similar pattern is obtained for the VAR in levels (middle chart of table 2).

After reproducing Calvo et al. (1993) for longer (1988-2001) Mexican data, we introduce the results of specifications with M2/Reserves and direct flows of U.S. investors to Mexico. The model was discussed in section 2 above. In figure 3, shocks in U.S. interest rates lead to more than proportional responses in M2/Reserves, implying more financial vulnerability in the sense of Calvo and Mendoza (1996). Higher rates in the U.S. contribute to higher stock imbalances in Mexico. The impact of U.S. interest rates on the direct flows of bonds is, however, close to zero throughout the period. In figure 4, the impulse responses are qualitatively the same as above, under net equity flows instead of bond flows. In the upper chart of table 3, one can see that innovations in U.S. rates explain from 0.2% (1 month) to 14.3% (12 months) of the variations in M2/Reserves in Mexico. Conversely, interest rate shocks are able to explain from 0.6% (1 month) to 32.7% (12 months) of the variations in M2/Reserves in Mexico in the lower part of table 2 when bond flows are investigated. However, the Wold orderings [ff, m2r, flows] are violated in these specifications.

Robust and more interesting is the result of our hybrid model in figure 5, boldfaced on the VDs at the bottom of table 3. We then investigate the response of reserves in the dynamic representation with U.S. interest rates and the M2/Reserves ratio affecting the real exchange rate. A shock in U.S. interest rate leads to large and significant increases in M2/Reserves in a hump-shaped pattern. The real exchange rate also depreciates remarkably over the period following an increase in the U.S. target rate. Finally, the 1% innovation in M2/reserves leads to a large and long-lasting depreciation of the peso, which supports the vulnerability hypothesis. The Monte Carlo-generated IR bands rule out zero responses in all cases. Note that the Wold decomposition is supported as the bottom chart of table 3 has proportions of 99%, 87%, and 62% across the diagonal line, justifying econometrically this hybrid model.[5]

5. Final Remarks

This paper proposes a parsimonious model of capital movements in order to explain the forces underlying U.S. capital flows to Mexico. Based on existing evidence and theoretical viewpoints, we select two factors: the *U.S. target interest rate* and the domestic *ratio*

[5] Although the Wold decomposition is not violated for the middle chart of table 3, the specification there [Δff, m2r, res] assumes an inverse relationship between reserves and the M2/Reserves, violating the orthogonality conditions of the errors discussed in section 2. In figure 6, a shock in U.S. interest rate leads to a large and significant increase in Mexican M2/Reserves and reserves fall consistently after the shock. However, this specification should not be given emphasis and figure 5 and the bottom chart of table 3 contain our main result.

M2/Reserves. The former is an example of external shock that has been used extensively by Calvo et al. (1993), Chuhan et al. (1998), and Kim (2000). The latter was shown by Calvo and Mendoza (1996) to explain satisfactorily the Mexican crisis of December of 1994. We find empirically consistent responses in our model. In addition to the results of our own model developed in section 2, we also check for the whole sample the hypothesis put forward originally by Calvo et al. (1993). We report that the model with the series in levels suffers from non-stationarity behavior. In first-differences, their striking results could not be reproduced under our larger sample, which has less abrupt variations in U.S. interest rates for the recent period.

Although our results are robust to stationarity of the series, on a fundamental basis there are factors omitted in the approach. To study bond flows, for instance, Antzoulatos (2000) emphasize supply factors through global bond issuance. To study equity flows, Brennan and Cao (1997) build a model in which U.S. purchases of equities in foreign developing markets are positively associated with the current stock market return in those markets. Both P/E ratios and domestic stock returns have been explored previously by Chuhan et al. (1998). Our research complements this line of investigation, which is more based on finance. A nice example using daily data of this strand of research is Froot et al. (2001) who find that the sensitivity of local stock prices to foreign inflows is positive and large.

Our parsimonious VAR, however, carries several attractive features. First, it does not require a great deal of identifying assumptions. Second, the specification is intuitive, capturing factors very important for the analysis, such as the ratio M2/Reserves correctly anticipating the Mexican currency crisis of December of 1994, as suggested by Calvo and Mendoza (1996). Third, it links the external factors literature to works on crisis, such as Kaminsky and Reinhart (1999) who have shown that growing M2/Reserves increases the likelihood of crisis for a sample of 20 countries over 1970-1995. Fourth, complementing imperfect measures of capital flows (international reserves) that are plagued by central bank intervention, we also employ direct monthly data from U.S. investors to Mexico.

Our research agenda includes extending the results of the hybrid model in this paper to other Latin American countries and investigating more deeply the monetary transmission channel [see e.g., Kumhof (2000)] proposed.

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Table 1. Unit Root Tests: 1988:1 – 2001:4, Monthly Data.

Unit Root Tests	**ff**	**gfb**	**nfe**	**m2r**	**tcr**	**res**
				Series in Levels		
ADF (k)	-2.29(6)	-6.09(1)***	-2.91(6)**	-2.99(1)**	-1.58(8)	-2.19(0)
PP (4)	-1.26	-9.38***	-8.53***	-3.85**	-2.49	-2.19
				Series in First Differences		
ADF (k)	-2.88(5)**	-11.42(2)***	-9.42(5)***	-16.29(0)***	-4.37(7)***	-12.46(0)***
PP (4)	-6.86***¨	-26.90***	-22.16***	-16.62***	-10.62***	-12.53***

Notes: The variables are defined as follows: **ff** stands for the effective federal funds target rate set by the U.S. Federal Reserve. The ff was intended at 6.5% from May 16, 2000 to January 3, 2001, changing gradually since then to the level of 1.75% at the end of 2001. Gross bond flows from the U.S. to Mexico are represented by **gfb** and **nfe** represents the net flow of money into equity markets (domestic minus foreign). Domestic series are represented by **m2r** that measures the ratio of M2 to total foreign exchange reserves in U.S. dollars, **tcr** is the index of the real exchange rate calculated by Banco de Mexico (*tipo de cambio real*), **res** measures the total foreign exchange reserves. See section 3 for details on the data. Depending on what the plots suggest, we include the deterministic trend in the tests. In our sample, only international reserves appear to be driven by a trend. See figure 1. ADF(k) and PP refer to the Dickey-Fuller and Phillips-Perron t-tests for unit roots, respectively. The lag length (k) is chosen by the Campbell-Perron data dependent procedure, whose method is usually superior to a fixed k chosen a priori and to k chosen by the information criterion. See Ng and Perron (1995). The method starts with an upper bound, k_{max}=12, on k. If the last included lag is significant, choose k = k_{max}. If not, reduce k by one until the last lag becomes significant (we use the 5% value of the asymptotic normal distribution to assess significance of the last lag). If no lags are significant, then set k = 0. Next to the ADF critical t-value, in parenthesis is the selected lag length based on this procedure. For the PP test, four lags are chosen by Newey-West truncation procedures. The symbol ** attached to the figure indicates rejection of the null of no-stationarity at the 5% level and the symbol *** means statistic significance at the 1% level.

Table 2. Variance Decompositions: Mexico: 1988:1 – 2001:4
VARs: [Δ (ff), Δ (res), Δ (tcr)]; [ff, res ,tcr]; and [Δ (ff), m2r, gfb].

Decomp./ Periods	**Shocks in Δ (ff)**	**Shocks in Δ (res)**	**Shocks in Δ (tcr)**
Δ (ff)			
1	100.00	0.00	0.00
6	98.72	1.25	0.03
12	98.72	1.26	0.03
Δ (res)			
1	0.41	99.59	0.00
6	7.35	90.04	2.61
12	7.36	90.03	2.61
Δ (tcr)			
1	0.90	17.58	81.52
6	5.50	18.49	76.01
12	5.53	18.49	75.78
Decomp./ Periods	**Shocks in ff**	**Shocks in res**	**Shocks in tcr**
Ff			
1	100.00	0.00	0.00
6	99.20	0.44	0.36
12	97.48	1.24	1.28
res			
1	2.95	97.05	0.00
6	4.22	95.09	0.69
12	6.12	91.51	2.38
tcr			
1	0.21	13.69	86.10
6	0.40	32.76	66.84
12	0.82	51.81	47.37
Decomp. And Periods	**Shocks in Δ (ff)**	**Shocks in m2r**	**Shocks in gfb**
Δ (ff)			
1	100.00	0.00	0.00
6	93.98	4.82	1.19
12	92.34	5.87	1.19
m2r			
1	0.59	99.41	0.00
6	20.85	78.04	1.12
12	32.68	63.15	4.18
gfb			
1	0.00	6.45	93.55
6	4.88	5.77	89.35
12	9.39	4.36	86.25

Note: The VARs are estimated with 2 lags in first-differences, with 1 lag in levels, and 4 lags in the bottom chart, as implied by minimization of Akaike and Schwarz-Bayes information criteria and sequential likelihood ratio tests starting with order 6. The upper and middle charts specifications come directly from inference based on unit root tests on the Calvo et al. (1993) specification. Reserves (res), M2/Reserves (m2r), gross bond flows (gfb), and the real exchange rate (tcr) are in logarithms. In first-differences, the responses die out soon after the shock and are omitted.

Table 3. Variance Decompositions: Mexico: 1988:1 – 2001:4
[Δ (ff), m2r, nfe]; [Δ(ff), m2r, res]; and [Δ(ff), m2r, tcr].

Decomp./ Periods	**Shocks in Δ (ff)**	**Shocks in m2r**	**Shocks in nfe**
Δ (ff)			
1	100.00	0.00	0.00
6	98.64	0.66	0.70
12	98.11	1.15	0.74
m2r			
1	0.19	99.81	0.00
6	10.98	86.83	2.20
12	14.33	83.35	2.32
nfe			
1	0.39	0.49	99.11
6	1.43	0.56	98.01
12	1.43	0.59	97.98
Decomp./ Periods	**Shocks in Δ (ff)**	**Shocks in m2r**	**Shocks in res**
Δ (ff)			
1	100.00	0.00	0.00
6	99.20	0.76	0.05
12	97.18	2.68	0.14
m2r			
1	0.10	99.90	0.00
6	13.44	84.51	2.05
12	26.48	71.96	1.56
res			
1	0.10	89.00	10.89
6	15.34	73.15	11.51
12	28.63	57.95	13.42
Decomp./ Periods	**Shocks in Δ (ff)**	**Shocks in m2r**	**Shocks in tcr**
Δ (ff)			
1	**100.00**	**0.00**	**0.00**
6	**99.22**	**0.75**	**0.03**
12	**98.76**	**1.16**	**0.08**
m2r			
1	**0.12**	**99.88**	**0.00**
6	**9.91**	**90.07**	**0.02**
12	**12.79**	**87.16**	**0.05**
tcr			
1	**0.24**	**6.15**	**93.62**
6	**7.34**	**17.26**	**75.40**
12	**12.45**	**25.54**	**62.01**

Note: The VARs are estimated with 1 lag in the upper chart of the table, 3 lags in the middle chart and with 1 lag in the lower chart of the table, as implied by minimization of Akaike and Schwarz-Bayes information criteria and sequential likelihood ratio tests starting with order 6. See notes to table 2 on the series. In bold we select our preferred (see text) hybrid system under the Wold ordering [Δff, m2r, tcr] at the bottom chart of the table.

Figure 1. U.S. Federal Funds intended target rate (FF); and Mexico: Gross Purchase of Mexican Bonds (GFB); Net Purchase of Mexican Equity (NFE) by U.S. investors, International Reserves (RES), the ratio M2/Reserves (M2R), and the real exchange rate (TCR), 1988:01 – 2001:4 (Monthly data).

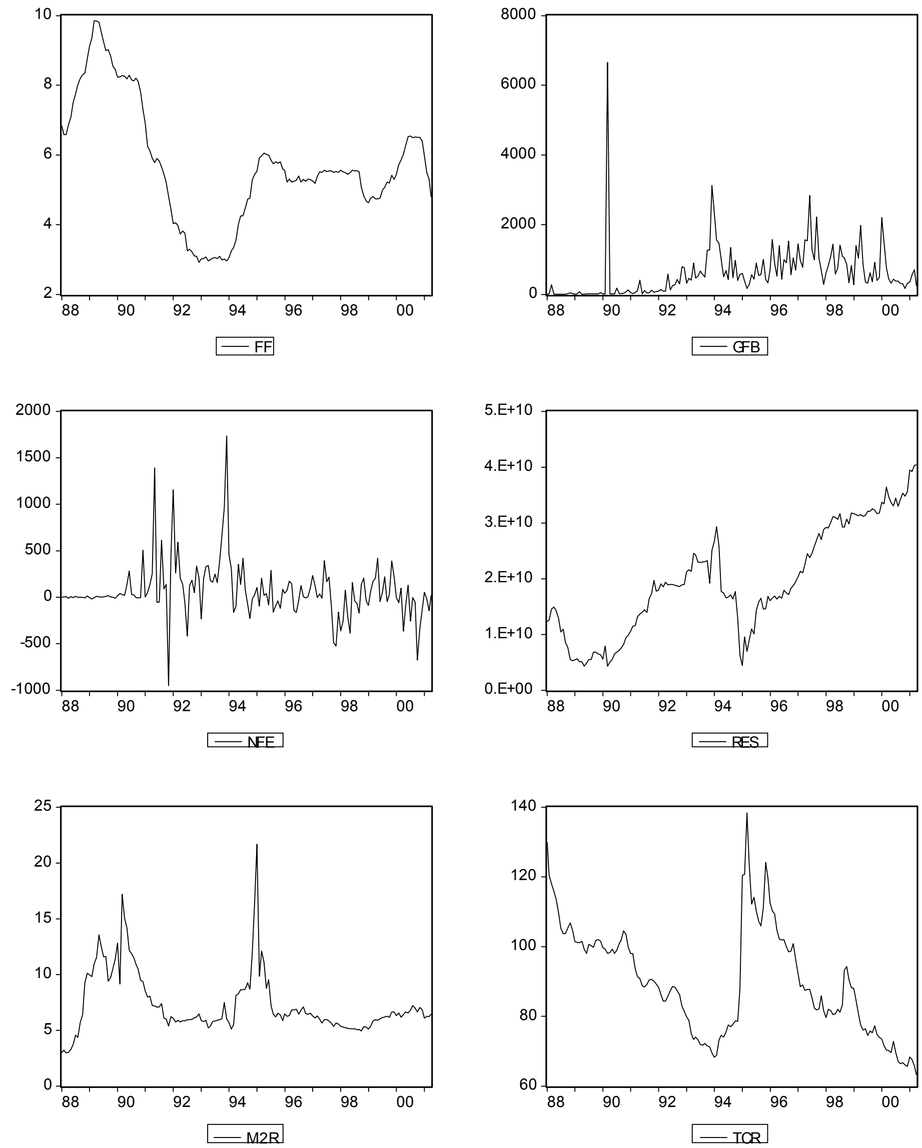

Figure 2. Impulse Responses for [ff, res, tcr]. VDs in table 2, middle chart.

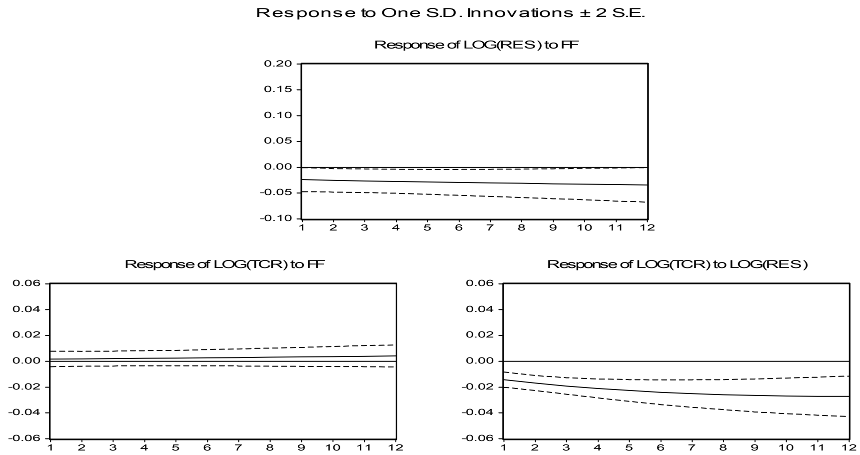

Figure 3. Impulse Responses for [Δ (ff), m2r, gfb]. VDs in table 2, lower chart.

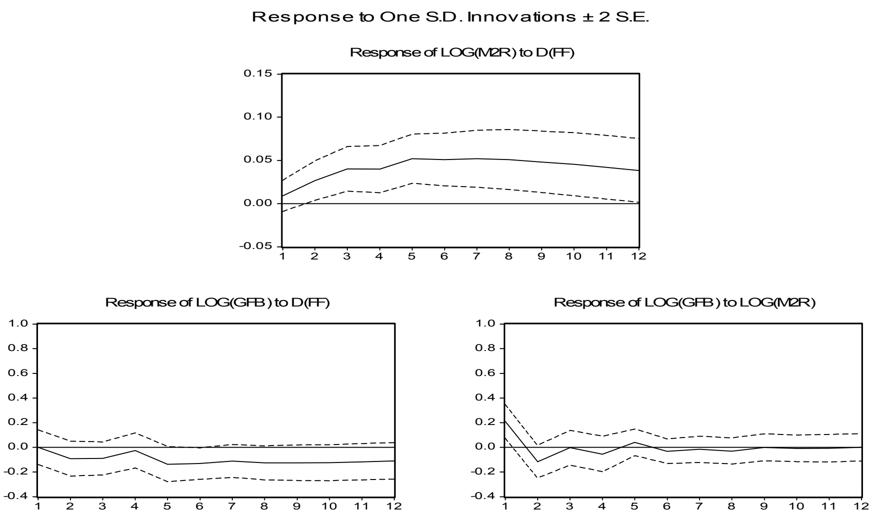

Figure 4. Impulse Responses for [Δ (ff), m2r, nfe]. VDs in table 3 upper chart.

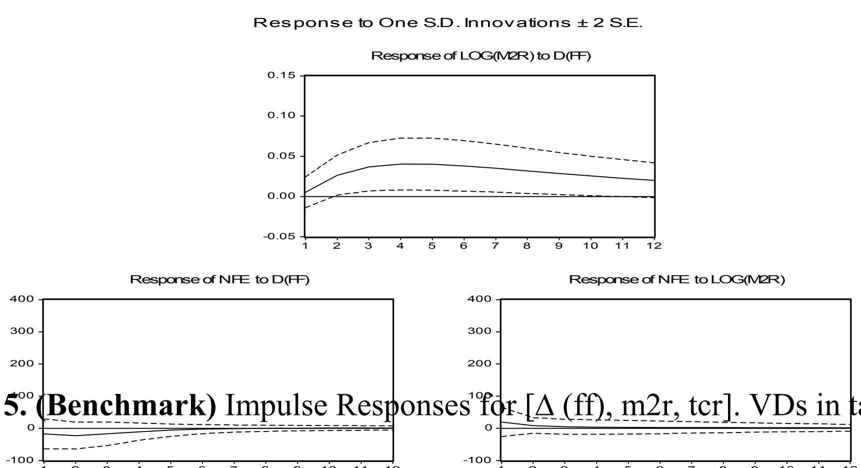

Figure 5. (Benchmark) Impulse Responses for [Δ (ff), m2r, tcr]. VDs in table 3, lower chart.

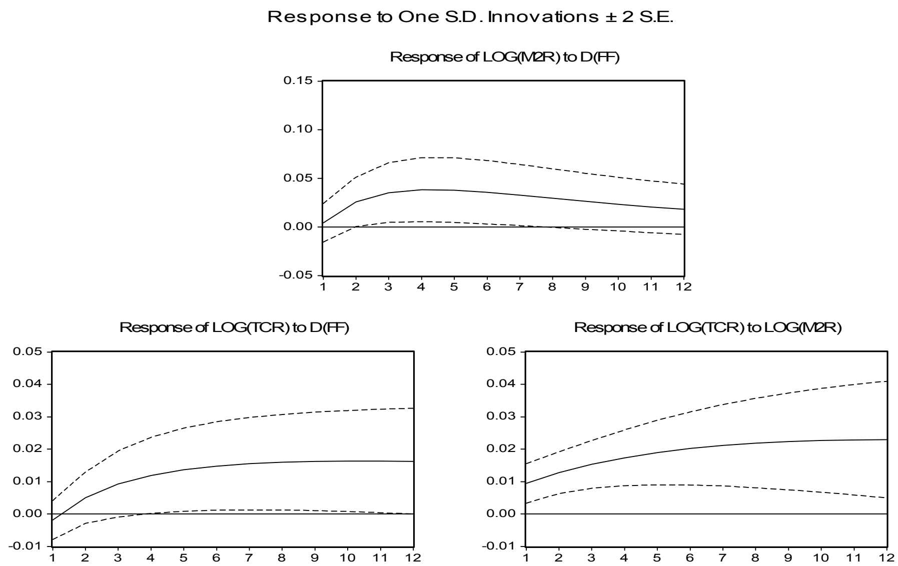

Figure 6. Impulse Responses for [Δ (ff), m2r, res]. VDs in table 3, middle chart.