Capital Flows and Private Investment in Mexico

Carlos A. Ibarra*

Fecha de recepción: 3 de julio de 2012; fecha de aceptación: 24 de abril de 2013.

Abstract: Based on the so-called bounds testing approach, the paper studies the long-run effect of capital flows and the real exchange rate on Mexico's private investment from 1988 through 2008, presenting two main results. First, while capital inflows can potentially increase investment, in practice they may lower it, because, as capital flows in, the peso appreciates. Second, although both FDI and portfolio inflows can increase investment, the effect from FDI is significantly smaller —in contrast to a frequent finding in the literature for other countries. Both results help to explain the low "transfer" of capital flows to investment in Mexico, and more generally the low levels of investment observed in the country.

Keywords: capital flows, FDI, portfolio investments, investment determinants, real exchange rate, bounds testing approach, Mexico.

Flujos de capital e inversión privada en México

Resumen: Con base en el llamado enfoque de pruebas límite, el artículo estudia el efecto de largo plazo de los flujos de capital y el tipo de cambio real sobre la inversión privada en México de 1988 a 2008, con dos resultados principales. Primero, aunque potencialmente los flujos de capital pueden aumentar la inversión, en la práctica el efecto puede ser el opuesto, debido a que, conforme el capital fluye, el peso se aprecia. Segundo, si bien tanto la inversión extranjera directa (IED) como la de cartera pueden aumentar la inversión, el efecto de la IED es significativamente menor, en contraste con un hallazgo frecuente en la literatura para otros países. Los resultados anteriores ayudan a entender la baja "transferencia" de los flujos de capital a la inversión y —más en general— los bajos niveles de inversión observados en México.

Palabras clave: flujos de capital, IED, inversión de cartera, determinantes de la inversión, tipo de cambio real, enfoque de pruebas límite, México.

JEL classification: C22, E22, F21, F43, O11, O54.

*Carlos A. Ibarra, carlos.ibarra@udlap.mx, Professor, Departamento de Economía, Universidad de las Américas Puebla. Thanks to Jaime Ros for early discussions on the subject, participants at a conference in honor of Julio López at UNAM and various anonymous referees for their comments, Isabel Arceo for her excellent research assistance, and Conacyt (project 154347) for its financial support.

Introduction

For developing countries, international capital flows can be a source of both threat and opportunity. An inflow of capital represents the opportunity to gain resources from the rest of the world ("to make a transfer"), and thus achieve higher levels of investment through a deficit in the current account. Capital inflows, however, may also appreciate the recipient country's currency in real terms, reducing profit margins in the tradables sector and thus depressing rather than encouraging domestic investment.

The mix of threat and opportunity is familiar to Mexico. Since the late 1980s, as the government liberalized and privatized the economy, the country accumulated a rich experience with capital flows —an experience that makes the Mexican an interesting case study for developing countries more generally. Capital inflows surged twice, increasing in one case by more than 10 percentage points of GDP. In addition, their composition changed over time, with a clear shift from portfolio investment to foreign direct investment (FDI) after the peso crisis of December 1994. Irrespective of the changes in composition, though, as capital flowed in, the peso appreciated.

Despite its renewed access to foreign capital, the Mexican economy grew slowly, with an average GDP growth rate of 3.2 per cent from 1988 to 2007. The problem lies in part in the relatively low levels of investment observed in the country. For much of the 1980s, government investment fell, eventually settling at levels of less than 4 per cent of GDP. While private investment increased and became the main source of capital formation, total investment generally remained below 20 per cent of GDP. In this context of depressed levels, investment appears to have benefited from the inflows of capital: as capital flowed in, investment increased. But despite the positive correlation, during each episode of capital surge the "transfer" to investment was relatively low —with investment increasing in one case by less than half the rise in capital inflows.

The above observations raise several questions: Is there a significant effect of capital flows on investment, once the influence of other determinants, possibly correlated with capital flows, is controlled for? Does the composition of the capital flows matter, as suggested by multi-country studies that have found a stronger effect of FDI on capital formation compared with that of portfolio investments? Finally, what is the role of the real exchange rate in the low transfer of capital flows to investment observed in Mexico?

To address the previous questions, this paper studies econometrically the determination of private investment in Mexico. The study focuses on the estimation of "long-run," or level, effects, relying for that purpose on the bounds testing approach of Pesaran *et al*. (2001). Among its various advantages, the approach allows including in the same equation variables with different orders of integration —a critical advantage in our case, as will be seen.

The period under study runs from the first quarter of 1988 (after the opening of the economy, and once private investment had become the main source of capital formation in the country) to the second quarter of 2008 (thus leaving the impact of the Lesser Depression for future research). The sample choice is motivated by the belief that the Mexican economy was transformed by the liberalization of its trade regime in the mid-1980s, a transformation that presumably changed the way the economy reacts to variables like the real exchange rate. But in addition, for most of the 1980s, Mexico received very little capital from abroad, recording an average of only 0.4 per cent of GDP from 1983 to 1987. Moreover, the flows of capital were quite stable, particularly when judged by what came later on. In any event, for comparative reasons, some of the equations in the paper, which will be duly identified, were estimated for an extended sample beginning in the first quarter of 1983 —although as expected the results are not particularly satisfactory.

The rest of the paper is organized as follows. Section I explains in more detail Mexico's macroeconomic evolution since the late 1980s. Section II describes the data and methodology, while section III analyzes the estimation results. Section IV summarizes the findings and offers some final remarks. An appendix gives data sources and definitions.

I. Capital Flows and Investment in Mexico

Based on the financial account balance from the balance of payments, we can identify three episodes in the recent behavior of capital flows to Mexico. The first two correspond to situations of relatively large inflows, with an average of 5.3 per cent of GDP from 1988 to 1993, and 4.6 per cent from 1996 to 2001. During the third episode from 2002 to 2007, in contrast, capital inflows reached only 3 per cent of GDP. Besides their differences in average values, the episodes also show interesting shorter-term dynamics. Thus, during the first two episodes not only were capital flows relatively large on average, but they increased steadily, rising by more than 10 per-

centage points of GDP from beginning to end during the first one, and by 6 points during the second one. During the third episode, in contrast, capital flows declined by 3 points (table 1).

There were also clear changes in composition. Initially the inflows were led by portfolio investments, which rose from 0.5 per cent of GDP in 1988 up to 9.7 per cent in 1993; other types of flows remained small and stable. The second episode, in contrast, was led by FDI, which increased from 2.7 per cent of GDP in 1996 to 7.6 per cent in 2001; during those years portfolio investments declined in 3 percentage points of GDP. Finally, the recent reduc-

Table 1. Mexico: Investment, capital flows, and real exchange rate

	1988-1993	*1996-2001*	*2002-2007*
Investment, % of GDP:	*Annual average (first year, final year)*		
Total investment	19.0 (16.8, 20.7)	19.0 (16.1, 19.7)	20.6 (19.4, 22.5)
Private investment, PI	14.4 (12.1, 16.6)	16.0 (13.2, 16.5)	16.7 (15.7, 18.6)
Government investment, GI	4.6 (4.7, 4.1)	3.0 (2.9, 3.2)	3.8 (3.7, 3.9)
Capital flows, % of GDP:	*Annual average (first year, final year)*		
Financial account balance, FAB	5.3 (-0.2, 10.9)	4.6 (1.2, 7.2)	3.0 (5.9, 3.0)
Foreign direct investment, FDI	1.4 (1.4, 1.5)	4.3 (2.7, 7.6)	4.2 (6.0, 4.1)
Foreign portfolio investment, FPI	3.7 (0.5, 9.7)	1.6 (3.9, 0.9)	0.8 (-0.3, 2.0)
Foreign bank loans, LOANS	1.0 (-1.3, 0.9)	-1.3 (-3.5, -0.3)	-0.3 (-0.8, 1.4)
Domestic capital outflow, DCO	0.8 (0.9, 1.2)	0.0 (1.9, 1.0)	1.7 (-1.0, 4.5)
Real exchange rate indices, 1988=100:	*Annual average (first year, final year)*		
Real effective exchange rate, REER	84.3 (100, 66.0)	72.3 (92.5, 56.4)	64.8 (54.9, 67.6)
Bilateral real exchange rate	81.5 (100, 61.2)	77.5 (96.5, 60.9)	68.9 (62.0, 67.9)
Relative unit labor cost	85.3 (100, 67.1)	97.2 (127.4, 70.2)	68.2 (67.9, 63.1)

Sources: Bank of Mexico and Mexico's National Institute of Statistics (INEGI). *Notes:* Investment corresponds to gross fixed capital formation. The investment ratios are based on National Accounting data in real pesos. Capital-flow ratios are calculated at purchasing power parity (author's calculations). The effective rate is the multilateral rate calculated by the Bank of Mexico, based on world consumer prices. The bilateral exchange rate is the consumer price ratio between the USA and Mexico. The relative unit labor cost is the manufacturing cost ratio between the USA and Mexico (series begins in 1989). In all cases a lower index indicates a real peso appreciation.

tion in capital inflows mainly resulted from a combination of smaller FDI flows and a sharp rise in domestic capital outflows.

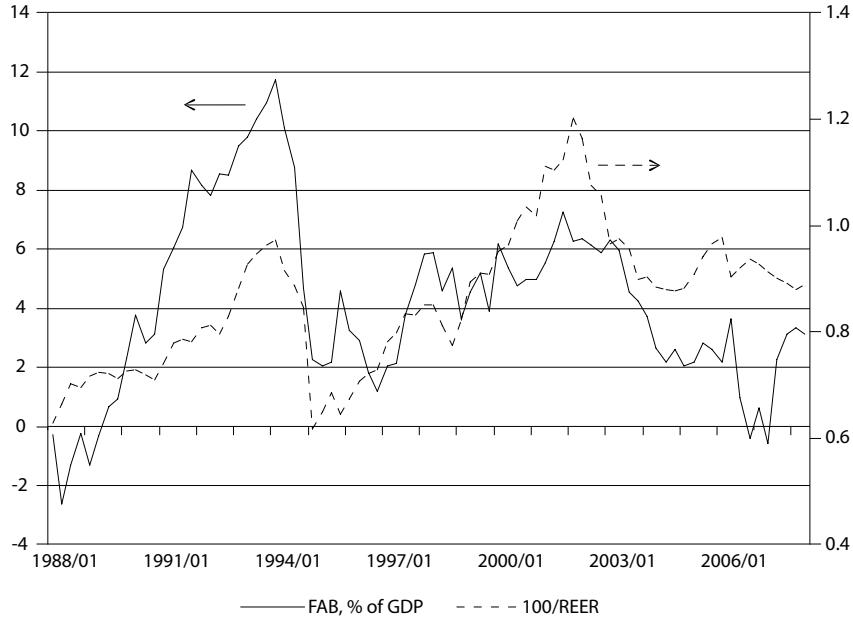
As is well known, since the late 1980s Mexico has suffered from a problem of slow economic growth. Part of the problem lies in the low levels of investment observed in the country. During the period under study, total investment (gross fixed capital formation) remained below 20 per cent of GDP —except since 2005, when it crossed that threshold—. The low levels of investment reflect to some extent the behavior of government investment, which initially fell and then stabilized at levels of less than 4 per cent of GDP.

In this context of generally depressed levels, private investment experienced important changes over time. At first sight, the direction of those changes seems to be correlated with the evolution of capital flows. Thus, as capital flowed in, private investment increased —from 12.1 per cent of GDP in 1988 (following the debt crisis of the early 1980s) to 16.6 per cent in 1993, and from 13.2 per cent in 1996 (following the financial crisis of 1995) to 16.5 per cent in 2001. Interestingly, during the final episode, with capital flows falling, private investment increased by about three points, up to 18.6 per cent of GDP in 2007.

The correlation between capital flows and private investment is to be expected from the macroeconomic identities that link capital flows with the current account balance, and the latter with the gap between domestic investment and saving: an inflow of capital makes it possible to finance a higher deficit in the current account, which in turn allows investment to increase for given levels of domestic saving. But in Mexico the "transfer" of capital flows to investment has been relatively small. The situation is particularly clear in the first episode (Trigueros, 1998). While capital flows increased by more than 10 percentage points of GDP, private investment did it by 4.5 points (and total investment by about 4 points). During the second episode, with capital flows increasing by 6 points, private and total investment did it by 3.3 and 3.6 points, respectively.

Given the slow growth of the Mexican economy, and the relatively low levels of investment that accompany it, an important question is why the transfer of capital flows to investment has not been larger. Part of the explanation could be the simultaneous fall in government investment, which through its negative effect on infrastructure and the provision of other goods and services could affect private investment negatively. This, however, is unlikely to be a quantitatively important factor, given the small changes in government investment recorded in Mexico since 1988. In addition, the estimations in the paper cast doubt on the existence of a

Figure 1. Mexico: Financial account balance and real exchange rate



Source: Author's calculations with data from Bank of Mexico and Mexico's National Institute of Statistics (INEGI). *Notes:* Period: 1988Q1-2008Q2, 82 observations; FAB corresponds to the cumulative balance over the previous four quarters; the real exchange rate index is shown inverted, so that a rise indicates an appreciation of the peso.

positive correlation between the two components of investment during the period under analysis.

A potentially more important role could be played by the real exchange rate. As is well known, capital inflows can become a "mixed blessing" for the receiving country (see for example Reinhart and Reinhart, 1998; Prasad *et al.,* 2007): on one side, as just mentioned, they allow the country to run a deficit in the current account, making it possible to reach higher levels of investment without having to increase domestic saving; on the other, though, the inflows tend to appreciate the currency in real terms, which by its negative effect on profitability in the tradables sector may end up depressing investment and triggering instead a consumption boom.

The evolution of the Mexican peso's real exchange rate is closely correlated with capital flows; econometrically, it can be shown that the correlation persists after controlling for the influence of standard determinants

of the real exchange rate like government consumption, the terms of trade, and the Balassa-Samuelson effect (Ibarra, 2011). As a result, during each of the two episodes of capital surge the real exchange rate appreciated by more than 30 per cent. From 2002 to 2007, in contrast, with smaller and declining capital inflows, the appreciation stopped and partially reversed (recall table 1 and see figure 1). By its negative effect on profitability, the real appreciation of the peso may have contributed not only to the generally low levels of investment observed in Mexico, but also to the relatively small transfer of capital flows.

II. Data and Methodology

To study the influence of capital flows, the real exchange rate, and other macroeconomic variables on private investment, we are interested in estimating equations of the form,

$$PI_{LR} = \delta_0 + \delta_1 Z_1 + \delta_2 Z_2 + \cdots \delta_k Z_k \qquad (1)$$

where PI_{LR} is the "long-run" level of real private investment (gross fixed capital formation by the private sector), there are k potential determinants Z_i, and to capture the long-run effects all the variables are measured in levels.

Following the bounds testing approach of Pesaran et *al.* (2001), equation (1) can be implicitly estimated by means of an Autoregressive Distributed Lag (ARDL) model in error-correction form,

$$\Delta PI_t = \Sigma_{j=1}^{n} a_j \Delta PI_{t-j} + \Sigma_{i=1}^{k} \Sigma_{j=0}^{n} b_{i,j} \Delta Z_{i,t-j} + \sigma PI_{t-1} + \Sigma_{i=1}^{k} d_i Z_{i,t-1} + d_0 \qquad (2)$$

where Δ indicates the first difference of the variable, and σ measures the speed of adjustment of PI toward its long-run equilibrium defined by equation (1). Equation (2) can be expanded to test whether an unrestricted linear trend should be included, and whether in that case the main results of the estimation would be altered (Pesaran *et al.*, 2001, eq. 16).

Estimation by bounds testing involves three steps. In the first step the statistical adequacy of the model is tested. This requires determining the optimal number of lags for the variables in first difference —using, for example, Akaike's information criterion— and confirming that the standard diagnostic tests are satisfied. The step is critical not only because

bounds testing needs uncorrelated residuals, but also because ARDL models deal with the potential problem of endogeneity by including in the estimation a sufficiently general lag structure. This allows the procedure to yield unbiased estimates of the long-run coefficients even if some of the regressors are endogenous (Pesaran and Shin, 1998).

An attractive feature of the bounds testing approach is the possibility of including in the estimated equation variables integrated of order zero $I(0)$ and one $I(1)$ —in contrast to alternative approaches that require the variables to have the same order of integration. This is a significant advantage because, as shown in table 2, while private investment in Mexico is $I(1)$, its possible determinants include both $I(0)$ and $I(1)$ variables. All the equations presented in the paper were tested for parameter stability by the application of Cusum (cumulative sum control chart) and Cusum of squares tests. Out of 60 tests that were performed (two tests for each of 30 equations), there was evidence of instability in only ten cases —which will be duly identified in the text and respective tables. Mostly, the latter cases correspond to preliminary specifications of the investment equation that intentionally include only a limited number of regressors or that leave the real exchange rate out of the equation, or to specifications that are estimated with an extended sample that includes the highly unstable period 1983-1987.

With the statistical adequacy of the model ensured, in the second step the existence of a level —or long-run— relationship is tested, in two ways. The first is a t-test on the speed of adjustment coefficient, σ. For a long-run relationship to be established without ambiguity, the absolute value of the t-statistic must lie above the (asymptotic) upper critical value calculated by Pesaran *et al*. (2001). In that case the existence of a relationship can be accepted even if all the variables in the estimated equation were $I(1)$. The critical values depend on whether the equation includes a linear trend or not. The second is an F-test for the significance of the level coefficients, under the null that σ and the d_i coefficients in equation (2) are jointly equal to zero. Again, the existence of a relationship is accepted when the F-statistic lies above the upper critical bound. For this particular test, in addition to the asymptotic critical values provided by Pesaran *et al*. (2001), Narayan (2005) has calculated critical values for small samples of up to 80 observations and a maximum of k=7 regressors.

After establishing the existence of a long-run relationship, in a final step the short-run segment of the model can be simplified. This is done by deleting, for each variable, the longest non-statistically significant lags (provided the diagnostic tests are not compromised). The simplification of the lag struc-

Table 2. Unit root tests

	Augmented Dickey-Fuller		*Phillips-Perron*	
	Level	*First difference*	*Level*	*First difference*
Domestic capital outflow, DCO	-5.24***	-7.71***	-9.90***	-44.99***
Financial account balance, FAB	-2.60*	-9.21***	-6.54***	-26.21***
Foreign direct investment, FDI	-1.75***	-7.92***	-6.05***	-32.66***
Foreign portfolio investment, FPI	-3.81***	-5.25***	-4.32***	-12.93***
Government investment, GI	-1.07	-6.03***	-7.81***	-25.17***
Inflation rate, INF	-4.84***	-4.34***	-4.67***	-4.71***
Industrial production index, IPI	-1.34	-6.01***	-1.20	-4.96***
Foreign loans, LOANS	-7.43***	-8.39***	-7.62***	-28.85***
Manufactured exports, MEX	-1.49	-2.82*	-1.77	-13.10***
Broad money supply, M2	-0.57	-4.76***	-0.58	-24.44***
Nominal interest rate, NIR	-4.80***	-9.08***	-5.20***	-9.58***
Private investment, PI	-1.08	-3.83***	-1.36	-17.85***
Reserve accumulation, RAC	-4.94***	-6.13***	-7.90***	-43.89***
Real exchange rate, REER	-2.96**	-3.82***	-2.72*	-8.31***
USA industrial production index, USIPI	-0.81	-4.34***	-0.81	-4.47***

Source: Author's own calculations. *Notes:* Period: 1988Q1-2008Q2, 82 observations. The unit root hypothesis is rejected at ***1%; **5%; *10%. The ADF tests include an intercept, with the lag length determined by Akaike (maximum lag of 4). The PP tests include an intercept, with Bartlett kernel and Newey-West bandwidth. Both sets of tests use MacKinnon critical values.

ture generally results in larger and more significant long-run coefficients. At the end of this step, the long-run coefficients can be retrieved as $\delta_i = -d_i/\sigma$.

The Z_i variables in equations (1) and (2) comprise capital flows, the real exchange rate, and other macroeconomic determinants of investment (see the appendix for details on data sources and definitions, and Peltonen *et al*. (2011) for a theoretical discussion of investment determinants). Total capital flows correspond to the financial account balance (FAB) from the balance of payments. In the final set of equations (see table 6 below), capital flows are disaggregated into foreign direct investment (FDI), portfolio investments (FPI), bank loans (LOANS), and domestic capital outflows (DCO).

Capital flows are expressed as a percentage of GDP, where the latter is measured at purchasing power parity (PPP) to avoid spurious variations in the capital ratio due to changes in the actual real exchange rate: a real depreciation of the peso, for example, would increase the measured ratio of capital flows to GDP, even if no change in the real magnitudes has taken place. Such spurious variations are avoided by using the PPP exchange rate rather than the actual one. As a robustness check, in some equations (duly identified in the tables) capital flows are expressed as a percentage of the financial aggregate M3, also measured at PPP. The premise is that the effect of capital flows on macroeconomic variables that in turn affect investment may depend on the size of capital flows relative to the financial sector specifically (approximated by M3) rather than relative to the economy generally (approximated by GDP).

In addition to capital flows, the set of investment determinants considered in the paper includes government investment (GI), the industrial production index (IPI), and the real effective exchange rate index (REER, where a higher value of the index indicates a real depreciation of the peso). The three variables, together with private investment, are measured in natural logs, so their coefficients can be interpreted as elasticities. The regressors also include the nominal interest rate (NIR) and the inflation rate (INF) as components of the real interest rate, and the broad money supply M2 (Bank of Mexico's definition, in percentage of GDP) as a proxy for domestic credit. Finally, some of the regressions include the accumulation of international reserves at the central bank as a percentage of GDP (RAC), and the natural log of manufactured exports in real dollars (MEX) and the USA industrial production index (USIPI).

The industrial production index is included to capture the accelerator effect of economic activity on investment. Industrial production was chosen instead of GDP to avoid picking up in the estimations the correlation between investment and GDP implicit in the latter's definition. Regarding government investment, the expected sign of the estimated coefficient is ambiguous. Government investment may encourage private investment through the expansion of infrastructure or by increasing the supply of key intermediate goods; on the other hand, it may crowd out private investment in sectors where they can compete with each other. In Mexico's case, during part of the period under analysis there was still significant privatization of public assets. This creates a natural negative correlation between the two components, as government investment was directly substituted by private investment.

The real interest rate is expected to have a negative effect on private investment. In our estimations the real interest rate is calculated simply as the difference between the nominal interest rate and the inflation rate. Rather than including the difference as a single regressor, though, the equations include the components separately. This implies that we expect a negative sign for the coefficient on the nominal interest rate and a positive one for the inflation coefficient. Inflation, however, may have additional effects on investment —for instance, a reduction in inflation may signal greater macroeconomic stability, reduce uncertainty, and hence increase investment. Thus, the estimated coefficient on inflation may capture effects with opposite signs, and as a result the absolute value of the inflation coefficient may be smaller than that on the nominal interest rate. Together with the components of the real interest rate, the regressions include M2. The coefficient on M2 is expected to be positive to the extent that, in addition to the interest-rate channel, there is a credit channel affecting investment.

During the period under analysis economic growth in Mexico was led by manufactured exports. After controlling for the current level of industrial production, a rise in exports could signal faster economic growth in the future and thus encourage higher investment levels. But in addition to controlling for this effect, some equations incorporate manufactured exports mainly to facilitate the interpretation of the estimated coefficient on the real exchange rate. As is well known, in principle the real exchange rate can have opposite effects on investment, and thus in practice the sign of the net effect must be established empirically (see for example Bahmani-Oskooee and Hajilee, 2010). Real currency depreciation may depress investment because it raises the price of imported capital goods in local currency. In addition, if there is a currency mismatch between assets and liabilities —or between spending and income flows— depreciation may compromise the financial situation of firms and reduce investment through balance-sheet effects.

On the other hand, a depreciation of the currency changes relative prices in favor of the home tradables sector. The likely result is an expansion of exports and industrial production, and therefore of investment. Thus, the real exchange rate may affect investment indirectly through these channels. But in addition the depreciation may increase profit margins in the tradables sector (Ibarra, 2008), in that way encouraging higher investment levels for given levels of exports and industrial production. Thus, once the effect of exports and industrial production is controlled for, a positive coeffi-

cient on the real exchange rate may be interpreted as evidence of the profitability effect of the real exchange rate on investment (Kouri, 1978; Ros and Skott, 1998; Frenkel and Ros, 2006; Gala, 2008; Razmi *et al*., 2009).

Finally, all the equations include a 0-1 dummy for the period from 1995Q1 to 2008Q2, following the peso crisis of December 1994. In all the estimations the dummy shows a negative, strongly significant coefficient, indicating that after the currency crisis there was a persistent fall in the level of private investment in Mexico. Including the post-crisis dummy is important to accept, without ambiguity, the existence of a long-run equation for investment. But for comparison, some equations that exclude the post-crisis dummy are presented in the paper (see table 3b).

III. Determinants of Private Investment in Mexico

Following Akaike's criterion, all the equations were estimated with three lags in the first-differenced variables (in some equations the Schwarz criterion suggested a smaller number of lags, but the diagnostics were less satisfactory). In addition to the speed of adjustment, the tables below report the estimated long-run coefficients. As explained in the previous section, the long-run coefficients were calculated after simplifying the lag structure of the short-run segment of the equations. However, to avoid a possible bias due to pre-testing, the bounds tests were carried out before the simplification, with a full lag structure.

The estimation results will be presented in three parts. The first part (tables 3a and b) focuses on the identification of the determinants of private investment, excluding capital flows; the goal is to establish the effect of the real exchange rate on investment. In the second part (tables 4a and b), total capital flows, as measured by the financial account balance, are added as a possible determinant of investment. The analysis centers on the role of the real exchange rate as a transmission channel for the effect of capital flows on investment. This part also explores (briefly) the possible significance of short-run effects, with the help of Granger causality tests applied to an error correction model for investment. Finally, in the third part (table 6), capital flows are disaggregated into their major components (FDI, portfolio, etc.), which allows us to test for differences in the size of their respective effects on private investment.

Thus, excluding for the moment capital flows, tables 3a and b present a first set of estimation results. As just mentioned, the main purpose of these initial estimations is to establish the sign and statistical significance of the

real exchange rate effect on investment. Table 3a includes the current value of the real exchange rate, while table 3b includes the one-year lag, as suggested by some authors (Blecker, 2009). To explore the robustness of the results, the initial specifications are very simple, starting with only the real exchange rate and the industrial production index as possible determinants of investment, and gradually adding the other determinants mentioned in the previous section. With very few exceptions, the diagnostic tests are satisfactory. The existence of a long-run relationship is amply accepted by the *F*-test, generally at 1 per cent of significance, and irrespective of using the asymptotic or the small-sample critical values; the only exception is in one of the equations that exclude the post-crisis dummy (see table 3b, column 5). In the great majority of cases, the *t*-test yields the same result.

The estimated coefficients have the expected sign, and their individual *p*-values clearly suggest that the variables are statistically significant —with the exception, to some degree, of M2 and manufactured exports (recall that, since the series may be non-stationary, the individual *p*-values are only indicative). As indicated in the tables, in some specifications M2 is statistically significant only in the short run. The coefficient on the industrial production index is highly significant, with an estimated value typically greater than 2. This indicates the existence of a strong acceleration effect on private investment.[1] Manufactured exports increase investment, even after controlling for their indirect effect via industrial production (except in table 3b, column 4, which excludes the post-crisis dummy). This makes sense if we recall that, particularly after the enactment of NAFTA in 1994, economic growth in Mexico has been led by manufactured exports. As mentioned in the previous section, higher export levels not only increase industrial production today, but also may signal faster economic growth in the future, thus encouraging investment.

Given the close integration of the USA and Mexican industrial sectors, particularly after the enactment of NAFTA, it could be wondered whether the USA industrial production affects investment levels in Mexico. A perhaps obvious channel is the effect of USA production on Mexican manufactured exports and from there on industrial production. Thus, more specifically it could be wondered whether an increase in USA production, for given levels of manufactured exports and industrial production in Mexico, has a positive effect on investment in the country.

[1] Lederman *et al.* (2003) show that investment in Mexico responds more strongly to output from the tradables sector (which includes the industrial sector) than to non-tradable output.

To answer this question, the last column in table 3a includes not only manufactured exports but also the USA industrial production index as a possible determinant of private investment. While relatively large and statistically significant, the estimated coefficient on USA industrial production shows an unexpected negative sign. Although it is not the focus of the present paper, there may be at least two possible explanations for the unexpected result. One is that the close correlation between the Mexican and USA industrial production indices makes it difficult in purely statistical terms to estimate with precision the effect of the latter on investment in Mexico.

The above explanation does not seem very plausible, however, given that the coefficient on USA industrial production is consistently negative and statistically significant across different specifications of the investment equation —from very simple ones such as equations (1) and (2) in table 3a after the inclusion of USA industrial production as an additional regressor, to equation (3) that allows for a linear trend thus making sure that the USA industrial production is not picking up the effect of a deterministic trend, to the complete equation shown in column (6) (results available from the author). An alternative explanation is that, for given levels of exports and production in Mexico, an increase in USA industrial production attracts capital that otherwise would be invested in Mexico, thus resulting in a reduction of investment. This possibly calls for further research.

As expected, the nominal interest rate and the inflation rate affect investment in opposite directions. The absolute value of the estimated coefficient on the inflation rate is smaller than that on the nominal interest rate; the difference, according to the Wald tests reported in the tables, is statistically significant (except in the last column of table 3a). As explained above, the difference in the estimated coefficients suggests that inflation affects investment through additional channels besides the real interest rate. Controlling for the real interest rate, M2 may have an additional, positive effect on investment (this will become clearer in table 5b, once capital flows are included in the equations). If, as generally done, M2 is understood as an indicator of credit levels, the results suggest the existence of a credit channel on private investment (Lederman *et al*., 2003).

Government investment affects private investment negatively (see Pérez, 2004 for a similar result, and Ramírez, 1994 for evidence of complementarity before 1988). Although its statistical significance varies, the negative effect is robust, appearing from the simplest specifications that include only the industrial production index and the real exchange rate, to the fullest ones presented in the paper (again, with the exception of columns 4

and 5 in table 3b, which exclude the post-crisis dummy). The absolute value of the estimated coefficient is well below unity, which indicates less than full crowding out. In any event, during the period under analysis government investment was small and stable (recall table 1), and thus necessarily had a minor role in the determination of private investment.[2]

Turning to the main point of interest, the estimations yield a consistently positive, very significant coefficient on the real exchange rate, in either current or lagged value. The result obtains whether the investment equation in addition includes only the industrial production index and government investment (table 3a, columns 1 and 2, and table 3b, column 1) or a full set of determinants, and whether a linear trend is included or not. It also obtains when the post-crisis dummy is omitted from the equation, although as noted in that case the tests for the existence of a long-run relationship mostly fail (table 3b, columns 4 and 5). It should be stressed that the positive effect from the real exchange rate remains when the equations include not only the industrial production index but also manufactured exports. As explained in the previous section, this suggests that the estimation is capturing the effect of the real exchange rate on investment through profit margins rather than through trade volumes. From this result, it will be argued that the behavior of the real exchange rate is central to understanding the effect of capital flows on private investment in Mexico.

Table 3a. Investment determinants, I

Dependent variable: Private investment, PI
Long-run coefficients from error-correction ARDL *models*
OLS *estimation, 1988Q1-2008Q2, 82 observations*

	(1)	*(2)*	*(3)*	*(4)*[a]	*(5)*[a]	*(6)*[a]
Speed of adjustment, σ	-0.457	-0.573	-0.685	-0.746	-0.735	-0.651
Real exchange rate, REER	0.45 (0.01)	0.26 (0.04)	0.24 (0.02)	0.44 (0.00)	0.38 (0.00)	0.45 (0.00)
Industrial production index, IPI	2.73 (0.00)	2.81 (0.00)	2.29 (0.00)	2.74 (0.00)	2.44 (0.00)	3.21 (0.00)
Government investment, GI		-0.13 (0.15)	-0.31 (0.01)	-0.27 (0.00)	-0.31 (0.00)	-0.12 (0.09)

[2] At least in terms of the *flow* relationship measured in the equations. The negative cumulative effect of low government investment on the stock of public assets (say, infrastructure) could have a more important, adverse influence on private investment.

Table 3a. Investment determinants, I (Cont.)

Dependent variable: Private investment, PI
Long-run coefficients from error-correction ARDL *models*
OLS *estimation, 1988Q1-2008Q2, 82 observations*

	(1)	*(2)*	*(3)*	*(4)*[a]	*(5)*[a]	*(6)*[a]
Nominal interest rate, NIR				-0.68 (0.00)	-0.57 (0.00)	-0.35 (0.16)
Inflation rate, INF				0.38 (0.00)	0.31 (0.00)	0.28 (0.00)
Manufactured exports, MEX						0.23 (0.08)
USA industrial production, USIPI						-1.31 (0.07)
Linear trend			0.55 (0.02)		0.29 (0.04)	
Adjusted R-sq	0.785	0.886	0.895	0.932	0.936	0.947
Jarque-Bera	0.15 [0.93]	0.06 [0.97]	0.65 [0.72]	1.30 [0.52]	0.57 [0.75]	1.54 [0.46]
Breusch-Godfrey	2.14 [0.09]	1.28 [0.29]	0.28 [0.89]	0.17 [0.95]	0.25 [0.91]	0.98 [0.43]
ARCH	0.12 [0.73]	0.17 [0.68]	1.24 [0.27]	2.15 [0.14]	1.69 [0.20]	0.36 [0.55]
RESET	5.41 [0.02]	0.13 [0.72]	0.01 [0.91]	1.46 [0.23]	1.47 [0.23]	0.89 [0.35]
CUSUM	fails at 5%	ok	ok	ok	ok	ok
CUSUM of squares	ok	ok	ok	ok	ok	ok
Bounds t-stat	-3.35*	-4.27**	-5.02***	-4.90***	-5.15***	-3.48
Bounds F-stat	7.02*** ###	10.18*** ###	6.56*** ##	8.46*** ###	5.14 ** ##	4.56*** ##
Wald NIR=-INF				18.70 [0.00]	12.31 [0.00]	0.98 [0.43]

Source: Author's own calculations. *Notes:* For illustrative purposes, *p*-values for the d_i coefficients from equation (2) (see main text) are shown in parenthesis next to the long-run coefficients. Diagnostics: The null hypotheses are that residuals are normally distributed (Jarque-Bera), and that there is no serial correlation of up to 4th order (Breusch-Godfrey), no ARCH errors, and no mis-specification error (Ramsey's RESET). x^2 (Jarque-Bera) and *F*-statistics with *p*-values in brackets. According to Akaike, all the equations include a constant and three lags in the first-differenced variables. All the equations include a 0-1 dummy for the post-Tequila crisis period (1995Q1-2008Q2). Wald test: The null is the equality of the estimated coefficients. *F*-statistic with *p*-value in brackets. Bounds testing: Test statistic lies above the upper bound at the ***1%; **5%; *10% significance level. Test statistic lies above the small-sample upper critical value computed by Narayan (2005), at the ### 1%; ## 5%; #10% level and for n=80 observations. [a] The underlying ARDL model includes M2 in its short-run segment.

Table 3b. Investment determinants, II

Dependent variable: Private investment, PI
Long-run coefficients from error-correction ARDL models
OLS estimation, 1988Q1-2008Q2, 82 observations

				Without post-1994 crisis dummy	
	(1)	*(2)*	*(3)*	*(4)*	*(5)*
Speed of adjustment, σ	-0.596	-0.758	-0.796	-0.246	-0.236
Lagged real exchange rate, REER	0.30 (0.00)	0.48 (0.00)	0.35 (0.00)	0.88 (0.00)	0.86 (0.00)
Industrial production index, IPI	2.96 (0.00)	1.89 (0.00)	2.24 (0.00)	3.69 (0.01)	3.49 (0.00)
Government investment, GI	-0.21 (0.00)	-0.23 (0.00)	-0.26 (0.00)	-0.01 (0.96)	0.32 (0.02)
Broad money supply, M2		0.78 (0.01)	a	-1.06 (0.40)	a
Nominal interest rate, NIR		-0.43 (0.00)	-0.41 (0.00)	-2.07 (0.00)	-2.57 (0.00)
Inflation rate, INF		0.17 (0.02)	0.20 (0.01)	1.06 (0.00)	1.36 (0.00)
Manufactured exports, MEX		0.19 (0.06)		-0.41 (0.10)	
Linear trend			0.37 (0.00)		-1.38 (0.00)
Adjusted R-sq	0.893	0.954	0.944	0.932	0.903
Jarque-Bera	0.32 [0.85]	0.71 [0.70]	0.11 [0.94]	0.88 [0.64]	0.05 [0.97]
Breusch-Godfrey	1.20 [0.32]	0.57 [0.69]	0.67 [0.62]	0.51 [0.73]	0.24 [0.91]
ARCH	0.58 [0.45]	0.11 [0.75]	0.11 [0.74]	0.02 [0.90]	2.94 [0.09]
RESET	0.36 [0.55]	2.14 [0.15]	4.34 [0.04]	1.93 [0.17]	1.52 [0.22]
CUSUM	ok	ok	ok	ok	ok
CUSUM of squares	ok	ok	ok	ok	ok
Bounds t-stat	-5.17***	-4.42*	-6.08***	-1.49	-1.84

Table 3b. Investment determinants, II (Cont.)

Dependent variable: Private investment, PI
Long-run coefficients from error-correction ARDL models
OLS estimation, 1988Q1-2008Q2, 82 observations

				Without post-1994 crisis dummy	
	(1)	*(2)*	*(3)*	*(4)*	*(5)*
Bounds F-stat	15.93*** ###	8.31*** ###	8.91*** ###	4.20** ##	3.25
Wald NIR=-INF		18.64 [0.00]	11.21 [0.00]	22.96 [0.00]	23.20 [0.00]

Source: Author's own calculations. *Notes:* For illustrative purposes, *p*-values for the d_i coefficients from equation (2) (see main text) are shown in parenthesis next to the long-run coefficients. Diagnostics: The null hypotheses are that residuals are normally distributed (Jarque-Bera), and that there is no serial correlation of up to 4th order (Breusch-Godfrey), no ARCH errors, and no mis-specification error (Ramsey's RESET). x^2 (Jarque-Bera) and *F*-statistics with *p*-values in brackets. According to Akaike, all the equations include a constant and three lags in the first-differenced variables. All the equations include a 0-1 dummy for the post-Tequila crisis period (1995Q1-2008Q2). Wald test: The null is the equality of the estimated coefficients. *F*-statistic with *p*-value in brackets. Bounds testing: Test statistic lies above the upper bound at the ***1%; **5%; *10% significance level. Test statistic lies above the small-sample upper critical value computed by Narayan (2005), at the ### 1%; ## 5%; #10% level and for n=80 observations. [a] The underlying ARDL model includes M2 in its short-run segment.

III.1. Capital Flows and Real Exchange Rate

Having identified the main macroeconomic determinants of private investment in Mexico, we turn to an analysis of the role of capital flows. We begin by including the financial account balance, without disaggregating it, as a possible additional determinant. Tables 4a and b present the estimation results. The initial columns in table 4a show relatively simple specifications, where investment is posited as a function of the financial account balance plus the industrial production index and government investment. Column (1) presents seemingly satisfactory results, with the bounds tests supporting the existence of a long-run relationship, a large speed of adjustment coefficient, and very significant long-run coefficients. The results are somewhat surprising, however, in that capital flows have a relatively large, statistically significant, but negative effect on investment. The negative effect remains if a linear trend is added to the equation (column 2) or if the estimation period is extended to include the debt crisis years of 1983 to 1987 (although in this case the coefficient is not statistically sig-

nificant —more on this below). Given the macroeconomic turbulence of the latter period in Mexico, perhaps it is not surprising that the latter equation shows evidence of parameter instability.

What is the explanation for the counter-intuitive negative effect of capital flows on investment? A possible one is related to the behavior of the real exchange rate. As was shown in figure 1, in Mexico there has been a close correlation between capital flows and the real exchange rate: as capital flows in, the peso appreciates. But as we saw in the previous section, an appreciation of the peso lowers private investment. Thus, the negative effect of capital inflows on investment could be explained by the parallel appreciation of the currency produced by the inflows themselves.

To explore the empirical relevance of the previous explanation, the real exchange rate was reintroduced in the investment equation (see columns 4 to 7 in table 4a). To obtain better results, the real exchange rate was lagged one year. As in previous estimations, the coefficient on the real exchange rate is positive and highly significant. Importantly, once the effect of the real exchange rate is controlled for, the coefficient on the financial account balance remains statistically significant, but in addition its sign shifts from negative to positive. The results obtain whether the real exchange rate is introduced in the original equation (column 4), with a linear trend (column 5), or in current rather than lagged value (column 6). Qualitatively the same results obtain if the sample is extended back to 1983, but in that case the real exchange rate coefficient becomes much smaller and the coefficient on capital flows becomes non-significant (column 7). The fall in significance could be related to the fact that from 1983 to 1987 capital inflows were quite small (averaging 0.4 per cent of GDP only). Moreover, portfolio investment was null until 1989, while FDI was quite stable at about 1 per cent of GDP.

To further explore the role of the real exchange rate, table 4b reintroduces simultaneously all the previously identified determinants of investment. In addition, the equations include the accumulation of international reserves by the central bank. The transfer of capital flows to the current account deficit rests on the assumption that the inflows are not accumulated as reserves, as otherwise their link with the current account, and therefore with investment, may be weakened or severed altogether. Given that the Bank of Mexico typically leans against capital inflows (Ibarra, 2011), variations in the pace of reserve accumulation could explain why capital flows do not affect investment positively. Since reserve accumulation reduces the amount of foreign saving available to finance domestic spending, it is expected to have a negative effect on investment.

Column (1) includes all the determinants of investment except the real exchange rate. As immediately seen, the equation is not entirely satisfactory: the F-test only weakly supports the existence of a long-run relationship, while the t-test rejects it altogether. There is evidence of parameter instability, and reserve accumulation shows a counter-intuitive positive coefficient. More importantly for our purposes, the coefficient on the financial account balance is highly significant, but again negatively signed. The anomalous result is not removed by including a linear trend in the equation (column 2).

Table 4a. Investment and capital flows, I

Dependent variable: Private investment, PI
Long-run coefficients from error-correction ARDL *models*
OLS *estimation, 1988Q1-2008Q2, 82 observations*

	(1)	*(2)*	*(3)*[a]	*(4)*	*(5)*	*(6) with current* REER	*(7)*[a]
Speed of adjustment, σ	-0.669	-0.732	-0.681	-0.657	-0.776	-0.728	-0.691
Lagged real exchange rate, REER				0.46 (0.00)	0.44 (0.00)	0.71 (0.04)	0.13 (0.08)
Financial account balance, FAB	-0.69 (0.02)	-0.33 (0.06)	-0.19 (0.57)	0.94 (0.03)	0.98 (0.00)	0.38 (0.00)	0.10 (0.66)
Industrial production index, IPI	2.63 (0.00)	2.09 (0.00)	2.46 (0.00)	2.82 (0.00)	2.15 (0.00)	2.20 (0.00)	2.50 (0.00)
Government investment, GI	-0.28 (0.00)	-0.40 (0.00)	-0.10 (0.10)	-0.07 (0.40)	-0.22 (0.00)	-0.25 (0.00)	-0.06 (0.32)
Linear trend		0.55 (0.01)			0.60 (0.00)	0.58 (0.00)	
Adjusted R-sq	0.853	0.863	0.899	0.892	0.905	0.898	0.907
Jarque-Bera	0.02 [0.99]	0.48 [0.79]	0.74 [0.69]	0.65 [0.72]	1.14 [0.57]	2.55 [0.28]	0.46 [0.79]
Breusch-Godfrey	2.03 [0.10]	1.30 [0.28]	1.47 [0.22]	0.84 [0.51]	0.89 [0.47]	0.62 [0.65]	1.32 [0.27]
ARCH	0.11 [0.75]	0.08 [0.78]	0.04 [0.84]	0.01 [0.93]	0.04 [0.84]	0.23 [0.64]	3.25 [0.07]
RESET	0.46 [0.50]	0.01 [0.93]	0.54 [0.46]	0.35 [0.55]	0.44 [0.51]	0.02 [0.90]	0.37 [0.54]
CUSUM	ok	ok	fails at 5%	ok	ok	ok	fails at 5%

Table 4a. Investment and capital flows, I (Cont.)

Dependent variable: Private investment, PI
Long-run coefficients from error-correction ARDL models
OLS estimation, 1988Q1-2008Q2, 82 observations

	(1)	*(2)*	*(3)* [a]	*(4)*	*(5)*	*(6) with current REER*	*(7)* [a]
CUSUM of squares	ok	ok	fails at 5%	ok	ok	fails at 5%	ok
Bounds t-stat	-4.67***	-5.23***	-5.40***	-5.42***	-6.31***	-5.13***	-5.07***
Bounds F-stat	8.87*** ###	7.50*** ###	11.02*** ###	12.49*** ###	11.49*** ###	6.02*** ###	9.06*** ###

Source: Author's own calculations. *Notes:* For illustrative purposes, p-values for the d_i coefficients from equation (2) (see main text) are shown in parenthesis next to the long-run coefficients. Diagnostics: The null hypotheses are that residuals are normally distributed (Jarque-Bera), and that there is no serial correlation of up to 4th order (Breusch-Godfrey), no ARCH errors, and no mis-specification error (Ramsey's RESET). x^2 (Jarque-Bera) and F-statistics with p-values in brackets. According to Akaike, all the equations include a constant and three lags in the first-differenced variables. All the equations include a 0-1 dummy for the post-Tequila crisis period (1995Q1-2008Q2). Wald test: The null is the equality of the estimated coefficients. F-statistic with p-value in brackets. Bounds testing: Test statistic lies above the upper bound at the ***1%; **5%; *10% significance level. Test statistic lies above the small-sample upper critical value computed by Narayan (2005), at the ### 1%; ## 5%; #10% level and for n=80 observations. [a] Sample: 1983Q1 2008Q2, n=102.

Table 4b. Investment and capital flows, II

Dependent variable: Private investment, PI
Long-run coefficients from error-correction ARDL models
OLS estimation, 1988Q1-2008Q2, 82 observations

	(1)	*(2)*	*(3)*	*(4)* [a]	*(5)*
Speed of adjustment, σ	-0.562	-0.603	-0.963	-1.002	-0.976
Lagged real exchange rate, REER			0.40 (0.00)	0.39 (0.00)	0.34 (0.00)
Financial account balance, FAB	-1.74 (0.01)	-1.41 (0.01)	0.41 (0.12)	0.19 (0.08)	0.20 (0.24)
Industrial production index, IPI	2.56 (0.00)	2.38 (0.00)	2.17 (0.00)	2.17 (0.00)	2.13 (0.00)
Government investment, GI	-0.42 (0.00)	-0.39 (0.00)	-0.24 (0.00)	-0.23 (0.00)	-0.25 (0.00)
Nominal interest rate, NIR	-0.61 (0.02)	-0.60 (0.01)	-0.36 (0.01)	-0.39 (0.00)	-0.33 (0.01)

Table 4b. Investment and capital flows, II (Cont.)

Dependent variable: Private investment, PI
Long-run coefficients from error-correction ARDL *models*
OLS estimation, 1988Q1-2008Q2, 82 observations

	(1)	*(2)*	*(3)*	*(4)* [a]	*(5)*
Inflation rate, INF	0.33 (0.02)	0.34 (0.01)	0.19 (0.01)	0.22 (0.00)	0.17 (0.02)
Broad money supply, M2	0.23 (0.69)	-1.44 (0.08)	1.15 (0.00)	1.11 (0.00)	0.26 (0.58)
Reserve accumulation, RAC	0.90 (0.17)	0.58 (0.10)	-0.82 (0.03)	-0.37 (0.02)	-0.58 (0.07)
Linear trend		0.73 (0.03)			0.35 (0.07)
Adjusted R-sq	0.919	0.921	0.947	0.947	0.950
Jarque-Bera	3.11 [0.21]	0.01 [0.99]	0.19 [0.91]	0.08 [0.96]	0.18 [0.91]
Breusch-Godfrey	0.38 [0.82]	0.25 [0.91]	0.29 [0.88]	0.30 [0.88]	0.56 [0.69]
ARCH	0.12 [0.73]	0.42 [0.52]	0.03 [0.86]	0.03 [0.87]	0.34 [0.56]
RESET	0.70 [0.41]	0.77 [0.39]	2.88 [0.10]	3.35 [0.07]	2.96 [0.09]
CUSUM	ok	ok	fails at 5%	fails at 5%	ok
CUSUM of squares	fails at 5%	fails at 5%	ok	ok	ok
Bounds t-stat	-2.87	-3.18	-4.90**	-4.56*	-5.14**
Bounds F-stat	3.33* #	2.50	5.67*** ###	5.57*** ###	4.61*** ##

Source: Author's own calculations. *Notes:* For illustrative purposes, *p*-values for the d_i coefficients from equation (2) (see main text) are shown in parenthesis next to the long-run coefficients. Diagnostics: The null hypotheses are that residuals are normally distributed (Jarque-Bera), and that there is no serial correlation of up to 4th order (Breusch-Godfrey), no ARCH errors, and no mis-specification error (Ramsey's RESET). x^2 (Jarque-Bera) and *F*-statistics with *p*-values in brackets. According to Akaike, all the equations include a constant and three lags in the first-differenced variables. All the equations include a 0-1 dummy for the post-Tequila crisis period (1995Q1-2008Q2). Wald test: The null is the equality of the estimated coefficients. *F*-statistic with *p*-value in brackets. Bounds testing: Test statistic lies above the upper bound at the ***1%; **5%; *10% significance level. Test statistic lies above the small-sample upper critical value computed by Narayan (2005), at the ### 1%; ## 5%; #10% level and for n=80 observations. The small-sample critical values for the *F*-test in columns (4) and (5) assume k=7 regressors (the maximum reported by Narayan 2005). [a] With FAB and RAC measured as % of M3.

Column (3) shows what happens when the (lagged value of the) real exchange rate is reintroduced in the investment equation. There is a clear improvement in the estimation results: the existence of a long-run relationship is amply accepted, and all the long-run coefficients are statistically significant and have the expected sign, including that on reserve accumulation. Importantly, once the real exchange rate is included in the equation, the coefficient on the financial account balance becomes positive again. The same result obtains when capital flows are measured as a percentage of M3 instead of GDP (column 4), and when a linear trend is allowed for in the equation (column 5). As perhaps is natural, the estimated coefficient on capital flows is now smaller than in the simpler specifications of table 4a. This is consistent with the idea that capital inflows are transmitted to domestic investment by channels such as credit and the real interest rate. Once the effect of the latter variables is controlled for, the estimated effect of capital flows on investment necessarily falls. Thus, in table 4b, column 3, the coefficient on the financial account balance has an estimated value of 0.41, in contrast with more than 0.9 in table 4a, columns (4) and (5).

Although the present paper is concerned with the study of persistent, "level" effects, we close this part with a brief exploration of short-run effects with the help of a series of Granger causality tests (table 5). The tests are based on an error correction model of the form,

$$\Delta PI_t = \sigma LRE_{t-1} + \Sigma_{i=1}^{k} \Sigma_{j=1}^{3} c_{i,j} \Delta Z_{i,t-j} + \Sigma_{j=1}^{3} h_j \Delta PI_{t-j} \qquad (3)$$

where the long run error (LRE) is derived from the long-run equation (6) in table 4a, σ is again the speed of adjustment coefficient (or the coefficient on the error correction term), and the Z regressors consist of the industrial production index, government investment, the real exchange rate, and the financial account balance.

As shown in the table, the hypothesis that government investment, the industrial production index, and the real exchange rate individually do not cause private investment can be amply rejected. The hypothesis that the financial account balance does not cause private investment, in contrast, cannot be rejected, showing a probability of 0.20. Moreover, the opposite hypothesis, that private investment does not cause capital inflows, cannot be rejected with an even higher probability of 0.87.

Thus, the Granger causality tests fail to provide evidence of a short-run effect of capital inflows on investment (or the other way around). On

Table 5. Granger causality tests

Sample: 1988Q1 to 2008Q2, n=82.		
Null hypothesis:	*F-stat*	*Prob.*
IPI does not cause PI	3.69	0.02
GI does not cause PI	9.58	0.00
REER does not cause PI	11.87	0.00
FAB does not cause PI	1.58	0.20
PI does not cause FAB[a]	0.24	0.87
	Coefficient	*Prob.*
Error correction term	-0.847	0.00
Diagnostics of the Error Correction Model (ECM):		
Adjusted R-sq	0.779	
Jarque-Bera	0.23 (0.89)	
Breusch-Godfrey	0.31 (0.87)	
ARCH	0.17 (0.69)	
RESET	13.3 (0.00)	

Source: Author's own calculations. *Notes:* The tests are based on the ECM described by eq. (3) in the text, where the dependent variable is private investment (PI), and the RHS variables consist of the first three lags of PI, the industrial production index (IPI), government investment (GI), the real exchange rate (REER), and the financial account balance (FAB), plus the long-run error derived from eq. (6) in table 4a. All the variables are measured in first difference. [a] From an error correction model where the dependent variable is FAB.

the other hand, the coefficient on the error correction term (-0.847) is negative, as expected, large, and very significant in statistical terms. This confirms that there is a long-run effect of the different variables included in the estimation, including capital inflows, on investment.

In summary, the results in this part of the paper indicate that to capture in the estimations the *potentially* positive effect of capital flows on private investment, it is important to control for the influence of the real exchange rate. More importantly, they indicate that the transfer of capital flows to investment may be thwarted by the simultaneous tendency of the currency to appreciate as capital flows in. In the case of Mexico, this contributes to explaining the relatively small transfer of capital flows to investment observed during the recent episodes of capital surge. For a given level of the real exchange rate, higher capital inflows tend to increase in-

vestment; allowing the real exchange rate to move (that is, not controlling for the real exchange rate in the estimations) shows that, in practice, the positive effect of capital flows on investment may be weakened, or even reversed, because of the simultaneous appreciation of the currency.

III.2. FDI Versus Portfolio Capital Flows

A frequent finding in the literature is that, besides possible differences in their degree of volatility, FDI affects developing economies more favorably than portfolio investments do. According to some studies, for example, FDI appreciates the currency weakly, non-significantly, or even depreciates it (Athukorala and Rajapatirana, 2003; Bakardzhieva *et al*., 2010; Saborowski, 2010). But the evidence is not conclusive; Lartey (2007), for example, shows that FDI caused heavy currency appreciation in a sample of Sub-Saharan countries. Similarly, FDI in Mexico appears to have a stronger appreciation effect compared with portfolio investments (Ibarra, 2011).

In the same vein, recent multi-country studies show that FDI may increase domestic capital formation by more than portfolio investments do (Bosworth and Collins, 1999; Mody and Murshid, 2005; Mileva, 2008; Aizenman *et al*., 2011). Previous studies of Mexico, however, cast some doubt about the positive influence of FDI on domestic investment (Blecker, 2009). The following estimations contribute to this literature by disaggregating capital flows as possible determinants of private investment in Mexico. The purpose is to determine whether the individual types of capital flows have a significant effect on investment generally, and specifically whether the effect from FDI is stronger than that from portfolio investments.

Capital flows were disaggregated into FDI, portfolio investments, bank loans, and domestic capital outflows. In addition, the equations include government investment, the industrial production index, and the real exchange rate. The estimations, presented in table 6, yielded mixed results. On one side, both FDI and portfolio investments accelerate capital formation, as expected; on the other, however, domestic capital outflows are not statistically significant (and thus were removed from the equations), while bank loans lower investment (see column 1).[3]

[3] Although the negative coefficient on loans may seem anomalous, it has antecedents in the literature. Reisen and Soto (2001), for example, present econometric evidence of a negative ef-

Table 6. Investment and disaggregated capital flows

Dependent variable: Private investment, PI
Long-run coefficients from error-correction ARDL models
OLS estimation, 1988Q1-2008Q2, 82 observations

				With lagged REER		
	(1)	*(2)*[a]	*(3)*[a]	*(4)*	*(5)*	*(6)*
Speed of adjustment, σ	-0.901	-0.911	-0.989	-0.764	-0.775	-0.820
Real exchange rate, REER	0.46 (0.00)	0.45 (0.00)	0.43 (0.00)	0.33 (0.00)	0.33 (0.00)	0.32 (0.00)
Industrial production index, IPI	2.68 (0.00)	2.66 (0.00)	2.44 (0.00)	2.54 (0.00)	2.54 (0.00)	2.34 (0.00)
Government investment, GI	-0.16 (0.00)	-0.12 (0.04)	-0.21 (0.01)	-0.10 (0.07)	-0.09 (0.09)	-0.18 (0.04)
Foreign portfolio investment, FPI	2.68 (0.00)	1.04 (0.00)	0.88 (0.00)	2.42 (0.00)	2.36 (0.00)	2.00 (0.00)
Foreign direct investment, FDI	1.22 (0.07)	0.51 (0.10)	0.48 (0.09)	0.73 (0.26)	0.91 (0.15)	0.83 (0.16)
Foreign bank loans, LOANS	-0.30 (0.06)	-0.10 (0.07)	-0.10 (0.06)	-0.22 (0.21)		
Linear trend			0.28 (0.08)			0.25 (0.19)
Adjusted R-sq	0.907	0.909	0.913	0.909	0.908	0.909
Jarque-Bera	0.04 [0.98]	0.29 [0.87]	1.65 [0.44]	1.29 [0.53]	2.06 [0.36]	2.91 [0.23]
Breusch-Godfrey	0.27 [0.90]	0.40 [0.81]	0.16 [0.96]	0.55 [0.70]	0.95 [0.44]	0.78 [0.54]
ARCH	4.79 [0.03]	7.35 [0.01]	6.87 [0.01]	1.54 [0.22]	1.19 [0.28]	1.63 [0.21]
RESET	2.26 [0.14]	2.05 [0.16]	1.77 [0.19]	1.16 [0.29]	0.69 [0.41]	0.58 [0.45]
CUSUM	ok	ok	ok	ok	ok	ok
CUSUM of squares	ok	ok	ok	ok	ok	fails at 5%

Table 6. Investment and disaggregated capital flows (Cont.)

Dependent variable: Private investment, PI
Long-run coefficients from error-correction ARDL models
OLS estimation, 1988Q1-2008Q2, 82 observations

				With lagged REER		
	(1)	*(2)* [a]	*(3)* [a]	*(4)*	*(5)*	*(6)*
Bounds t-stat	-5.71***	-5.36***	-5.68***	-4.78**	-5.05***	-5.29***
Bounds F-stat	8.71*** ###	8.48 *** ###	5.48 *** ###	8.34 *** ###	10.94 *** ###	8.31 *** ###
Wald FDI=FPI	4.15 [0.05]	2.80 [0.10]	1.89 [0.18]	3.34 [0.07]	2.60 [0.11]	1.84 [0.18]

Source: Author's own calculations. *Notes:* For illustrative purposes, *p*-values for the d_i coefficients from equation (2) (see main text) are shown in parenthesis next to the long-run coefficients. Diagnostics: The null hypotheses are that residuals are normally distributed (Jarque-Bera), and that there is no serial correlation of up to 4th order (Breusch-Godfrey), no ARCH errors, and no mis-specification error (Ramsey's RESET). x^2 (Jarque-Bera) and *F*-statistics with *p*-values in brackets. According to Akaike, all the equations include a constant and three lags in the first-differenced variables. All the equations include a 0-1 dummy for the post-Tequila crisis period (1995Q1-2008Q2). Wald test: The null is the equality of the estimated coefficients. *F*-statistic with *p*-value in brackets. Bounds testing: Test statistic lies above the upper bound at the ***1%; **5%; *10% significance level. Test statistic lies above the small-sample upper critical value computed by Narayan (2005), at the ### 1%; ## 5%; #10% level and for n=80 observations. [a] With capital flows measured as % of M3.

In contrast with the evidence provided by recent multi-country studies, the estimated effect of FDI on private capital formation is notably smaller than that of portfolio investments. In column (1), for example, the respective long-run coefficients are 1.2 and 2.7, which are statistically different according to a Wald test. The difference in the estimated effects remains if capital flows are measured as a percentage of M3 instead of GDP, with or without a trend (columns 2 and 3), or if the real exchange rate is lagged one year (columns 4 to 6). In the latter case, in fact, not only does the difference between the estimated coefficients become larger (for example, 2.4 versus 0.9 in column 5), but the FDI coefficient loses statistical significance.

Before considering possible explanations for the above result, we may note that the estimated transfer of capital flows to domestic investment is relatively small —even in the case of portfolio investments, and after con-

fect of bank loans on per capita GDP growth in a sample of developing countries during the period 1986-1997.

trolling for the real exchange rate. The largest estimated coefficient indicates that an increase of one percent of GDP in portfolio investments tends to increase capital formation by 2.7 percent (see column 1). Since the latter represented about 15 per cent of GDP during the period under analysis, the 2.7 percent increase in capital formation is equivalent to an increase of about 0.40 percent as a proportion of GDP.

How can the difference in the effect of FDI versus portfolio investments be explained? While it is beyond the scope of this paper to offer a full explanation, we may briefly consider some possibilities. According to the literature on growth diagnostics (Hausmann *et al*., 2007, 2008), the disparity in the effect of the individual types of capital flows may result from their loosening, with different intensity, the constraints specifically affecting investment in Mexico. Since they must be intermediated by the domestic financial sector, portfolio investments may have a multiplier effect on domestic credit; FDI, in contrast, must not (Calvo *et al*., 1994). But it is well known that, relative to its level of economic development, Mexico has an underdeveloped financial sector. To the extent that the cost and availability of credit is a binding constraint on investment, we may expect portfolio investments to have a greater effect on capital formation than FDI does.

A second possible factor is the large and increasing share of mergers and acquisitions (M&A's) in FDI in Mexico (Ernst, 2005; Cuevas *et al*., 2002). In contrast to greenfield FDI, M&A's have no direct positive effect on domestic capital formation; in addition, they do not necessarily increase the availability of domestic credit, as they may involve an exchange of equity with local owners. Finally, FDI may be crowding out investment previously carried out by domestic firms; indeed, under full crowding out the expected value of the FDI coefficient would be zero, which may explain why in some of the regressions the estimated coefficient on FDI is not statistically significant (Wang, 2011 for multi-country results in this direction).

IV. Conclusions

The paper studied the determination of private investment in Mexico, with particular attention given to the role of capital flows and the real exchange rate. Relying on the bounds testing approach of Pesaran *et al*. (2001), the study focused on the estimation of level —or "long-run"— effects on investment. The estimations used series from the first quarter of 1988 to the second quarter of 2008, thus encompassing the post-liberalization period in Mexico but leaving out for future research the influence of

the Lesser Depression. For comparative purposes, in some of the equations the sample was extended back to 1983.

The equations showed that private investment in Mexico responds to standard macroeconomic determinants like government investment, the industrial production index (as an activity indicator), the components of the real interest rate, and credit levels as approximated by M2; interestingly, they showed that, for given levels of manufactured exports and industrial production in Mexico, the USA industrial production index has a negative effect on investment, an unexpected result that may reflect the high degree of capital mobility that exists between the two countries. Importantly, the estimations showed that a real appreciation of the peso lowers private investment. Since the estimations controlled for other possible channels like manufactured exports and industrial production, the estimated coefficient on the real exchange rate may be capturing the latter's profitability effect on investment, as recently discussed in the literature.

The real exchange rate is central to understanding the effects of capital flows on investment. If the real exchange rate is omitted from the investment equations, then capital inflows appear to *reduce* private investment. The unexpected result obtains from the simplest specification, for example one including only the industrial production index and government investment, to the fullest one controlling for credit, reserve accumulation, and the components of the real interest rate. It is only when the real exchange rate is introduced in the equations that the expected positive effect of capital flows on investment arises. One interpretation is that, during the period under analysis, foreign capital tended to decrease private investment because, as capital flowed in, the currency appreciated. Given its adverse effect on profitability, the appreciated value of the peso contributes to explaining the low "transfer" of capital flows to investment observed in Mexico.

When capital flows are disaggregated into their main types, both FDI and portfolio investments accelerate capital formation. A perhaps surprising result, however, is that the effect from FDI is notably weaker. While a full analysis of this difference is beyond the scope of the paper, it may be speculated that the relatively strong effect of portfolio investments comes from their favorable influence on the cost and availability of domestic credit —which FDI lacks— while the weak effect from FDI could be explained by the crowding out of investment previously carried out by local firms and by the high share of mergers and acquisitions in FDI in Mexico.

The results presented in the paper may have implications for the outlook not only of the Mexican economy, but of developing economies more

generally. For a slowly-growing country like Mexico, international capital inflows represent an opportunity to raise investment levels and achieve faster rates of economic growth. The current outlook in the developed economies —characterized by sluggish growth and low interest rates— suggests that capital may keep flowing into developing countries for a relatively long time. But the transfer of resources allowed by capital inflows, which shows up as a deficit in the current account, may result in different combinations of higher investment and consumption levels. Capital flows will improve the growth record mainly to the extent that they increase investment.

Presumably, the effect of capital flows will depend on the profitability of domestic investment. With low profitability, investment is unlikely to rise, even if foreign resources are available. In that case, the rise in the current account deficit accompanying the inflows of capital will have as counterpart higher consumption levels. If profitability is high, in contrast, investment may be actually constrained by the external sector, and capital flows will be more likely to increase it. Given the real exchange rate's profitability effect, the previous reasoning shows the importance of the level the real exchange rate has *before* capital flows in. An uncompetitive real exchange rate level increases the chances that capital flows will be reflected in higher consumption rather than investment levels.

Thus, an appreciated level of the real exchange rate will bias resources toward consumption but, for a given level of capital inflows, the bias toward consumption in turn will reinforce the appreciation of the currency. The reason is the high share of non-tradable goods in consumption compared with investment. Because of the high share of non-tradables, the necessary increase in imports and the current account deficit —the mirror image of the capital inflows— may require a stronger appreciation if a consumption rather than investment boom takes place. Fed by capital inflows, Mexico and other countries could be trapped in a vicious circle of depressed investment levels and real currency appreciation, with negative consequences for economic growth.

References

Aizenman, J., Y. Jinjarak and D. Park (2011), "Capital Flows and Economic Growth in the Era of Financial Integration and Crisis, 1990-2010", NBER Working Paper, 17502, October.

Athukorala, P. C. and S. Rajapatirana (2003), "Capital Inflows and the

Real Exchange Rate: A Comparative Study of Asia and Latin America", *The World Economy,* 26 (4), pp. 613-637.

Bahmani-Oskooee, M. and M. Hajilee (2010), "On the Relation between Currency Depreciation and Domestic Investment", *Journal of Post Keynesian Economics,* 32 (4), pp. 645-660.

Bakardzhieva, D., S. B. Naceur and B. Kamar (2010), "The Impact of Capital and Foreign Exchange Flows on the Competitiveness of Developing Countries", IMF Working Paper, 10/154, July.

Blecker, R. A. (2009), "External Shocks, Structural Change, and Economic Growth in Mexico, 1979–2007", *World Development,* 37 (7), pp. 1274-1284.

Bosworth, B. P. and S. M. Collins (1999), "Capital Flows to Developing Economies: Implications for Saving and Investment", *Brookings Papers on Economic Activity,* 1, pp. 143-180.

Calvo, G., L. Leiderman and C. Reinhart (1994), "The Capital Inflows Problem: Concepts and Issues", *Contemporary Economic Policy,* 12 (3), pp. 54-66.

Cuevas, A., M. Messmacher and A. Werner (2002), "Changes in the Patterns of External Financing in Mexico Since the Approval of NAFTA", Bank of Mexico Working Paper, July.

Ernst, C. (2005), "The FDI–Employment Link in a Globalizing World: the Case of Argentina, Brazil and Mexico", Employment Strategy Papers, 17, International Labor Office.

Frenkel, R. and J. Ros (2006), "Unemployment and the Real Exchange Rate in Latin America", *World Development,* 34 (4), pp. 631-646.

Gala, P. (2008), "Real Exchange Rate Levels and Economic Development: Theoretical Analysis and Econometric Evidence", *Cambridge Journal of Economics,* 32 (2), pp. 273-288.

Hausmann, R., B. Klinger and R. Wagner (2008), "Doing Growth Diagnostics in Practice: A 'Mindbook'", Center for International Development Working Paper 177, Harvard University, September.

Hausmann, R., D. Rodrik and A. Velasco (2007), "Growth Diagnostics", in D. Rodrik, *One Economics, Many Recipes*, Princeton, Princeton University Press, pp. 56-84.

Ibarra, C. A. (2008), "Mexico's Slow-Growth Paradox", *CEPAL Review*, 95, pp. 83-102.

_____ (2011), "Capital Flows and Real Exchange Rate Appreciation in Mexico", *World Development,* 39 (12), pp. 2080-2090.

Kouri, P. J. K. (1978), "Profitability and Growth in a Small Open Econo-

my", Cowles Foundation Discussion Paper 490, April.
Lartey, E. K. K. (2007), "Capital Inflows and the Real Exchange Rate: An Empirical Study of Sub-Saharan Africa", *Journal of International Trade and Economic Development,* 16 (3), pp. 337-357.
Lederman D., A. M. Menéndez, G. Perry and J. Stiglitz (2003), "Mexican Investment After the Tequila Crisis: Basic Economics, 'Confidence' Effects or Market Imperfections?", *Journal of International Money and Finance,* 22, pp. 131-151.
Mileva, E. (2008), "The Impact of Capital Flows on Domestic Investment in Transition Economies", European Central Bank Working Paper 871, February.
Mody, A. and A. P. Murshid (2005), "Growing up with Capital Flows", *Journal of International Economics,* 65 (1), pp. 249-266.
Narayan, P. K. (2005), "The Saving and Investment Nexus for China: Evidence from Cointegration Tests", *Applied Economics*, 37 (17), pp. 1979-1990.
Peltonen, T. A., R. M. Sousa and I. S. Vansteenkiste (2011), "Investment in Emerging Market Economies", *Empirical Economics*, doi: 10.1007/s00181-011-0457-0, March.
Pérez, A. (2004), "Un modelo de pronósticos de la formación bruta de capital privada en México", Bank of Mexico Working Paper 2004-04, September.
Pesaran, M. H. and Y. Shin (1998), "An Autoregressive Distributed-lag Approach to Cointegration Analysis", in S. Strom (ed.), *Econometrics and Economic Theory in the 20th Century: The Ragnar Frisch Centennial Symposium*, New York, Cambridge University Press, pp. 371-413.
Pesaran, M. H., Y. Shin and R. J. Smith (2001), "Bounds Testing Approaches to the Analysis of Level Relationships", *Journal of Applied Econometrics*, 16 (3), pp. 289-326.
Prasad, E. S., R. G. Rajan and A. Subramanian (2007), "Foreign Capital and Economic Growth", *Brookings Papers on Economic Activity,* 1, pp. 153-209.
Ramírez, M. D. (1994), "Public and Private Investment in Mexico, 1950-1990: An Empirical Analysis," *Southern Economic Journal,* 61 (1), pp. 1-17.
Razmi, A., M. Rapetti and P. Skott (2009), "The Real Exchange Rate as an Instrument of Development Policy", Department of Economics Working Paper, 07, University of Massachusetts at Amherst, July.
Reinhart, C. M. and V. R. Reinhart (1998), "Some Lessons for Policymakers

who Deal with the Mixed Blessing of Capital Inflows", in M. Kahler (ed.), *Capital Flows and Financial Crises*, Cornell University Press, pp. 93-127.

Reisen, H. and M. Soto (2001), "Which Types of Capital Inflows Foster Developing-country Growth?", *International Finance,* 4 (1), pp. 1-14.

Ros, J. and P. Skott (1998), "Dynamic Effects of Trade Liberalization and Currency Overvaluation under Conditions of Increasing Returns", *The Manchester School,* 66 (4), pp. 466-489.

Saborowski, C. (2010), "Can Financial Development Cure the Dutch Disease?", *International Journal of Finance and Economics*, doi:10.1002/ijfe.419.

Trigueros, I. (1998), "Capital Inflows and Investment Performance: Mexico", in R. Ffrench-Davis and H. Reisen (eds.), *Capital Flows and Investment Performance: Lessons from Latin America*, ECLAC and OECD, pp. 193-213.

Wang, M. (2011), "FDI and Domestic Investment in the Host Country: Evidence from Panel Study", *Applied Economics,* 42 (29), pp. 3711-3721.

Appendix. Data sources and definitions

Domestic capital outflow (DCO): Percentage ratio of the net outflow of domestic (Mexican) capital, in current USA dollars, to quarterly dollar GDP or the financial aggregate M3. See FAB below for source and further explanation.

Financial account balance (FAB): Percentage ratio of the financial account balance, in current USA dollars, to quarterly GDP. GDP corresponds to the nominal GDP in pesos, divided by the nominal exchange rate calculated at purchasing power parity (PPP). In some equations, the financial account balance and its components are measured as a percentage of the financial aggregate M3 (Bank of Mexico's definition) transformed to dollars also at PPP. Source: Bank of Mexico (BOM) for balance of payments data; Mexico's National Institute of Statistics (INEGI) for nominal GDP; and author's calculations of the PPP exchange rate.

Foreign direct [portfolio] investment (FDI, [FPI]): Percentage ratio of the net inflow of foreign direct [portfolio] investment, in current USA dollars, to quarterly dollar GDP or M3. Portfolio investment includes investment in the money and stock markets. See FAB above for source and further explanation.

Government investment (GI): Natural log (times 100) of government investment (gross fixed capital formation), in real pesos. Source: National Accounting data from INEGI.

Inflation rate (INF): Annual variation of the consumer price index, in percentage. The quarterly CPI series corresponds to the average of the original monthly series. Source: BOM.

Industrial production index (IPI): Natural log (times 100) of the industrial production index. The quarterly series corresponds to the average of the original seasonally-adjusted monthly series. Source: INEGI.

Foreign loans (LOANS): Percentage ratio of the net inflow of foreign bank loans and securities issued abroad, in current USA dollars, to quarterly dollar GDP or M3. See FAB above for source and further explanation.

Manufactured exports (MEX): Natural log (times 100) of manufactured exports, originally in current USA dollars and deflated by the USA PPI. Source: Balance of Payments data from BOM.

Broad money supply (M2): Percentage ratio of nominal M2, BOM's definition, to the annualized nominal GDP. Nominal M2 corresponds to the quarterly average of the original end-of-month series. Source: BOM and INEGI.

Nominal interest rate (NIR): Quarterly average of the monthly series of the annualized nominal interest rate on 91-day Mexican Treasury bills (Cetes), in percentage. Source: BOM.

Private investment (PI): Natural log (times 100) of private investment (gross fixed capital formation), in real pesos. Source: National Accounting data from INEGI.

Reserve accumulation (RAC): Percentage ratio of the quarterly accumulation of international reserves, in current USA dollars, to quarterly dollar GDP or M3. See FAB above for source and further explanation.

Real exchange rate (REER): Natural log (times 100) of the CPI-based, real effective exchange rate index calculated by Bank of Mexico. A rise in the index indicates a real depreciation of the Mexican peso. The quarterly series corresponds to the average of the original monthly series. Source: BOM.

USA industrial production index (USIPI): Natural log (times 100) of the seasonally-adjusted USA industrial production index. Source: USA Federal Reserve.