Mexico: Five Years after the Crisis

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The World Bank

April 13, 2000

Prepared for presentation at the ABCDE Conference of the World Bank, April 18-19, 2000

Abstract

This study identifies the main factors that explain the recovery of the Mexican economy after the currency crisis of 1995. A growth decomposition exercise shows that export growth mitigated somewhat the effect of the crisis in 1995, but contributed only modestly to the recovery afterwards. The V-shaped behavior of fixed investment was the main factor behind the economic slowdown during the crisis and the strength of the subsequent recovery. Evidence for Indonesia, Korea, and Thailand also show that fixed investment explained a substantial portion of the reduction in economic growth during their recent crises. Econometric results show that fixed investment fell precipitously in 1995 as a result of both the negative income effect and the increase in the cost of capital caused by the sharp depreciation of the currency. However, this initial contractionary effects of the devaluation were followed by the dominance of the substitution effect in favor of tradables output, which, in the Mexican case, has a higher multiplier effect on investment than non-tradable output. We found no evidence of a "confidence" effect associated with hikes in real interest rates (we did find it in the 1982-83 crisis, however). Also, we found support for the view that access to the U.S. financial market was a key feature of the recovery after 1995. A policy implication that emerges from the analysis is that, for countries like Mexico, currency depreciation, in spite of initial contractionary effects, appears as a better policy response to speculative attacks than interest rate defenses of overvalued currency levels.

INTRODUCTION

The Mexican economy experienced a sharp contraction in 1995, after the *Peso* devaluation of December 22, 1994. The GDP growth rate reached an annualized rate of -6.2 percent in 1995, and became positive again during the first quarter of 1996. In 1996 and 1997 the Mexican economy grew at healthy rates of 5.1 percent and 6.8 percent respectively. It has been suggested by some authors that the decisive response of the fiscal and monetary authorities supported by a generous financial package of billions of dollars announced in March 9, 1995, were crucial for a rapid recovery of lost investor confidence. These observers further argue that these policies prompted a rapid stabilization of the currency and a turnaround in investment and economic activity.[1] It is also claimed by some that the lack of equally forceful responses and large enough financial support packages might explain why recovery was more elusive in the recent Asian crises. Thus, assessing the factors behind the fast Mexican recovery of 1996/97 is relevant for current debates about appropriate responses to currency crises.

The aim of this paper is to identify the main factors that explain the recovery of the Mexican economy after the tequila crisis. Section I.A. begins by establishing the contributions of aggregate demand components to the GDP growth rate since 1993. A simple decomposition analysis shows that economic growth in Mexico after the tequila crisis recovered primarily due to the behavior of fixed investment. The fixed investment growth rate declined drastically during the crisis year, 1995, but subsequently rose above pre-crisis levels. The growth of exports (in

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[1] For example, the IMF (1996: 25) wrote that "In Mexico, tight fiscal and monetary policies helped reduce actual and expected inflation in the first half of [1995], contributing to further gains in confidence, declines in interest rates, and the stabilization of the peso."

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*Peso*s) seems to have prevented an even deeper recession during 1995, but its contribution to economic growth declined during the recovery.

Section I.B. evaluates the behavior of both fixed investment and inventories during and after the tequila crisis to conclude that the role of fixed investment was far more relevant for the economic recovery. This section also compares the behavior of these components of investment for some Asian economies during and after their crises of 1997. The aim of this comparison is to see if the conclusion found for the case of Mexico can be extended to the experience of other economies that have also gone through recent periods of crises. The evidence for Indonesia, Korea and Thailand shows that, in times of economic crises a drop in fixed investment does explain more of the reduction in economic growth than does a decrease in inventories. We cannot, however, evaluate the role of these components of investment for periods of recovery, because recovery is just beginning to take place in these economies and any conclusion based upon only a couple observations risks being misleading.

Section I.C. examines the elements behind the increase in export growth during and after the tequila crisis. First, this section finds that the growth of non-oil exports at constant domestic prices was not only due to the real depreciation of the *Peso* but, there was also an increase in the volume of non-oil exports. Second, the Mexican economy showed some gains in competitiveness. During 1993-1999 there was a continuous decrease in unit labor costs in Mexico, even on the eve of the crisis, when there was an appreciation of the real exchange rate. However, the cost of labor measured in US dollars per man/hour increased as the real exchange rate appreciated during 1994, making exports less competitive in the pre-crisis period. Then, as the real exchange rate depreciated, the remuneration in US dollars decreased to the levels of 1993, and remained at that level through the end of the 1990's. Finally, when we compare the

remuneration in US dollars per man/hour in Mexico and Korea, we find that in both countries this indicator followed similar patterns during and after their crises: losing competitiveness on the eve and early parts of the crises and regaining it by the time of the recovery. Additionally, this indicator of competitiveness shows that for those periods when these countries were not facing crises, they had similar levels of international competitiveness. Hence, the Mexican and Korean real depreciations were successful in helping the tradable sectors regain international competitiveness, which had been lost during periods of real appreciation.

Section II focuses on possible determinants of the rate of growth of fixed investment in Mexico. It presents a standard model of investment behavior, with the only addition (to standard models) being that aggregate investment depends differently on the output of tradable and non-tradable goods. A companion paper by Lederman et. al. (2000) presents the theoretical model behind this investment function, which shows that output capital intensities determine the magnitude of the so-called income multiplier effect. Results for the basic investment function indicate that the tradable sector has a higher multiplier effect on Mexican investment than the non-tradable sector; the domestic real interest is a significant determinant of Mexican investment; the relative price of capital and the volatility of the real exchange rate have negative effects on investment. This basic model provides a good explanation of the growth of fixed investment in Mexico, especially in the aftermath of the 1995 crisis. Evidence of this is provided by the out-of-sample forecast of the growth rate of fixed investment. Finally, this section presents estimates of the contribution of tradable and non-tradable out growth and of variations in the relative price of capital goods on the Mexican GDP growth rate during 1995-1999.

Section III examines the role of financial transmission channels. This question is important in the case of Mexico because its financial system went through deep transformations

and crises during the last two decades. After the 1982 debt crisis banks were nationalized. Then, in 1991, they were privatized. On the eve of the tequila crisis, the whole system was, once again, in a very fragile position with a large share of non-performing loans. Conclusions are drawn with the help of results from the aforementioned companion paper by Lederman et.al. (2000). The first conclusion is that the lack of credit availability has a significant and negative effect on the rate of growth of fixed investment. A second conclusion is that it seems that there was no confidence effect during the tequila crisis. i.e., an increase in interest rates does not seem to have encouraged investment during this crisis.[2] Finally, US interest rates negatively affect fixed investment, a result that provides strong evidence in favor of the Kruger-Tornell (1999) hypothesis that access to the U.S. financial market by Mexico's firms operating in the tradable sector was a key feature of the economic recovery after 1995. In fact, when both real interest rates are introduced simultaneously, both maintain their negative and significant coefficients.

Section IV addresses the dynamic relationship between fixed investment and the real exchange-rate. Section V asks if there were short-term substitution effects on the composition of output growth due to variations of the real exchange rate. These two questions are addressed by examining the impulse-response functions (IRFs) of investment and sector outputs to exogenous shocks of the real exchange rate. For example, in order to capture dynamic effects of the real exchange rate on the growth rate of fixed investment, we estimated a Vector Auto-Regressive (VAR) system that included several exogenous variables as well as three endogenous variables (the differenced log of the level of fixed investment, of relative price of capital and the real exchange rate). The results show that a depreciation of the real exchange rate initially has a contractionary effect, but its effect becomes expansionary after about 5 quarters. An appreciation

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[2] It is possible that this conclusion might depend on the frequency of the data used. This model was estimated with

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also seems to have significant short-term substitution effects in favor of the tradable sector. More generally, the story that emerges is that Mexican fixed investment growth declined during 1995 due to the devaluation's impact on the relative price of capital and negative income effect, but the eventual recovery was driven by the high multiplier effect from the tradable sector; declining domestic interest rates and low lending rates in the U.S.

I. Growth Decomposition

A. General decomposition

The decomposition of the GDP growth rate into the contributions of its aggregate demand components comes from a transformation of the basic macroeconomic identity: $Y=C+I+X-M$, where Y is the level of output, C is the sum of private and public consumption, I is the level of gross investment, X stands for exports, and M for imports. By first differencing each element, dividing by the ex-ante level of Y, and some simple manipulations, the growth of output can be decomposed into the contributions of the growth rates of each of its components:

(1) $\Delta Y/Y_{t-1} = (C_{t-1}/Y_{t-1})\bullet\Delta C/C_{t-1} + (I_{t-1}/Y_{t-1})\bullet\Delta I/I_{t-1} + (X_{t-1}/Y_{t-1})\bullet\Delta X/X_{t-1} - (M_{t-1}/Y_{t-1})\bullet \Delta M/M_{t-1}.$

This expression can be easily expanded to include the contribution of more disaggregated demand components. For example, the contribution of gross investment can be further decomposed into the sum of the contribution of fixed investment and inventory accumulation.

Figure 1 shows the growth rates of GDP and the rates of growth of each demand component on the basis of a year-on-year (i.e., seasonally-adjusted and annualized) rate. In the pre-tequila period, imports and exports were the most dynamic components of GDP. The rate of growth of exports rose gradually from a very low rate of 0.18 percent in the first quarter of 1993,

quarterly data.

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to 20.97 percent in the second quarter of 1994. In the case of imports, the acceleration in their growth rate was more dramatic and began a year later. In the final quarter of 1993 the rate of growth of imports was 0.92 percent and by the second quarter of 1994 it reached 24.60 percent. This sharp rise in the growth rate of imports reflects the effect of the appreciation of the real exchange rate that occurred prior to devaluation at the end of 1994.

The tequila crisis was sparked by the announcement of a 15 percent nominal devaluation in December 1994, and ended with a depreciation of the exchange rate of 43 percent by March 1995. In that year, there was a rapid reversal in imports, with their rate of growth dropping from 19.17 percent in the last quarter of 1994 to a negative growth of –19.81 in the second quarter of 1995. Imports showed negative rates of growth throughout 1995, even though all trade liberalization policies remained in place. Exports, on the other hand, continued to grow.[3] These responses of the external sector to the crisis helped reduce the overall decline of GDP.

By the first quarter of 1996, a year after the crisis began, Mexico's GDP growth rate became positive once again. During this period of recovery, export growth slowed, even though exports remained among the more dynamic components of demand. Their average rate of growth between 1996 and the third quarter of 1999 was 12.99 percent. Imports, meanwhile, grew rapidly -- by 18.43 percent --, surpassing the average growth rates of all the demand components.

Fixed investment was another demand component with impressive changes in its rate of growth before, during and after the tequila crisis. The behavior of the growth rate of fixed investment parallels that of imports, which may be due to the fact that Mexico imports over 30 percent of its capital goods. During 1994, the year before the crisis, the growth rate of fixed investment accelerated from 3.5 percent in the first quarter, to 10.43 percent in the last quarter. In

1995, during the crisis, the growth rate drop was greater for fixed investment than for any other component of demand. It plummeted to negative rates of growth of around -30 percent. Finally, during the period of economic recovery, the rate of growth of fixed investment recovered quickly, surpassing its pre-crisis rates of growth. Its average rate of growth between 1996 and the third quarter of 1999 was 14.1 percent.

Figure 2 shows the contributions of each component to GDP growth. During the crisis, there was a reversal in the role of imports. While in 1994 imports contributed –4.08 to the GDP growth of 4.45 percent, in 1995 imports contributed 3.35 percent to the GDP growth of –6.18 percent. During the recovery, once again imports contributed negatively to GDP growth. Exports increased remarkably their contribution to GDP growth during the period of crisis. In 1994 exports contributed 2.71 percent to the GDP growth of 4.45 percent. During the year of the crisis, exports contributed 5.19 percent to the GDP growth of –6.18 percent. During the recovery the contribution of exports declined: between 1996:1-1999:3 exports contributed 3.42 percent to an average GDP growth of 5.13 percent.

Contributions of fixed investment, on the other hand, declined along with the fall in GDP growth during 1995. In that year fixed investment contributed –5.58 percent to a GDP growth of –6.18 percent. By 1996, its contribution recovered sharply and by the end of that year it contributed 4.07 percent to a GDP growth of 7.11 percent. Loosely speaking, fixed investment alone explained around 60 percent of the GDP growth in that quarter. The average contribution of fixed investment during the post-crisis period continued to be important, averaging a contribution of 2.27 percent to the GDP growth of 5.13 percent.

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[3] Kruger and Tornell (1999) suggest that this increase of the rate of growth of exports was facilitated by previous structural economic reforms such as privatization, deregulation, removal of trade barriers and the entry into NAFTA.

The following sections analyze in more detail the role of inventories and fixed investment, as well as the driving forces behind the rise in exports during the tequila crisis.

B. Fixed investment and inventories

Inventories are a flexible component of total investment, so their variation should be high in periods of crisis. This section evaluates the role of inventories compared to the contribution of fixed investment to GDP growth during and after the tequila crisis. It also shows the role that these two components of demand played for three Asian economies during and after their respective crises.

Figure 3A shows the growth rates of the components of investment. Clearly, inventories are far more volatile than fixed investment. There are two periods with negative rates of growth in inventories; the first, from the second quarter of 1992 to the first quarter of 1993; and the second, in 1995, the year of the tequila crisis. Both periods were followed by short periods of extremely high rates of growth (above 400 percent in both cases). The rate of growth of fixed investment, on the other hand, oscillated between –30 and 30 percent; it was negative during 1995 and peaked during the period of recovery, as was seen in the last section.

In contrast, Figure 3B shows that the contribution of inventories was less significant for the (fall and) growth of GDP than the contribution of fixed investment, in spite of the dramatic variations in the growth of inventories. The simple explanation of this observation is that inventory accumulation covers a very small share of GDP: 2.5 percent on average for 1993-99, compared to 17.9 percent of GDP for fixed investment. During the crisis in 1995, fixed investment contributed –5.58 percent to a GDP growth of –6.18 percent, while the contribution

of inventories was –2.16 percent. During the post-crisis period, the average contribution of fixed investment continued to be more important than that of inventories. Fixed investment averaged a contribution of 2.27 percent to the average GDP growth of 5.13 percent, while inventories contributed only 0.70 percent.

Finally, figure 3C shows the absolute value of the difference between GDP growth and each one of the components of investment. This difference reflects the contribution to GDP growth of the rest of the aggregate demand components; the closer this difference is to zero, the less important the contribution of the remaining components. Except for a few quarters, the difference for fixed investment is closer to zero. For the period 1992-1999, the average absolute value of the contribution to GDP growth from all demand components different from fixed investment was barely 2.58 percent, while for the same period, the corresponding contribution from all demand components different from inventories was 3.81 percent. During 1995, the average contribution to GDP growth from all demand components different from fixed investment was 2.20 percent, while for the same period, the contribution from all demand components different from inventories was 4.12 percent. During 1996-99, the average absolute value of the contribution to GDP growth from all demand components different from fixed investment was 2.86 percent, while for the same period, the contribution from all demand components different from inventories was 4.48 percent. Therefore, the contribution of fixed investment to GDP growth was more relevant than that of inventories, especially during and after the Mexican crisis.

The final aim of this section is to compare the role of inventories and fixed investment in three Asian economies; namely Indonesia, Korea and Thailand. These three economies went through a period of deep and long economic crises that began in mid-1997, and now show strong

signs of economic recovery. This section evaluates whether fixed investment has also played a predominant role in the performance of these economies.[4]

Figures 4 A to C show the absolute value of the difference between GDP growth and each one of the components of investment for Indonesia, Korea and Thailand. The vertical line shows the quarter in 1997 when the crises began in each of these countries. In the case of Indonesia, (Figure 4A), during the years of the crisis (1997:Q2-1999:Q1), the absolute value of the difference between GDP growth and the contribution of fixed investment was closer to zero (2.81 percent), than the difference with inventories (7.84 percent). Thus, more of the fall of GDP is explained by the contribution of fixed investment than by the contribution of inventories. The last two observations, which correspond to the recovery period, however, show that the contribution of inventories surpassed that of fixed investment.[5]

In the case of Korea (Figure 4B), the contribution of fixed investment was also more relevant for GDP rate of growth than inventories during the period of crisis (1997:Q3-1998:Q4), even though the contribution of inventories was closer to that of fixed investment than in the case of Indonesia. The average absolute value of the difference between GDP growth and the contribution of fixed investment was 3.17 percent and that difference with inventories was 4.40 percent. As in the case of Indonesia, the last two observations that correspond to the period of economic recovery, show higher contributions from inventories than from fixed investment.

In Thailand, the contribution of inventories was more relevant for GDP growth before and during the onset of the crisis than the contribution of fixed investment. This trend was reversed by the first quarter of 1998, when the contribution of fixed investment became stronger.

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[4] We thank an anonymous reviewer for suggesting this comparison on the role of fixed investment and inventories between Mexico and some Asian economies.

During the crisis (1997:Q2-1998:Q4), the average absolute value of the difference between GDP growth and the contribution of fixed investment was 3.21 percent and that difference with inventories was 6.00 percent. By the time of the recovery, the contribution of inventories to GDP growth became as important as that of fixed investment.

To summarize, in times of crises, more of the fall of GDP is explained by the contribution of fixed investment than by the contribution of inventories. This applies to the cases of Mexico, Indonesia, Korea, and Thailand. We cannot evaluate the role of these components of investment for periods of recovery in Asia, however, because recovery is just beginning to take place in the Asian economies and any conclusion based on only a couple of observations risks being misleading.

C. Export Growth

The external sector has been a key element in the development policies and strategies of the last three Mexican governments. In 1985, the country began a process of trade liberalization by joining the General Agreement of Tariffs and Trade (GATT), the predecessor of the World Trade Organization (WTO). In 1991, Mexico, the U.S. and Canada launched the negotiations over the terms of the North American Free Trade Agreement (NAFTA). The NAFTA was officially implemented beginning in January 1, 1994. By the time of the onset of the tequila crisis, most of these trade reforms had been implemented, and none were reversed as a result of the crisis. This section addresses the role of export growth by analyzing changes in the volume of non-oil exports, measures of competitiveness and the real exchange rate of Mexican exports,

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[5] Recovery is defined by those quarters for which the rate of growth on a year-on-year basis is positive. In Indonesia the recovery began in the second quarter of 1999, while in Korea and Thailand it began in the first quarter of 1999.

which is defined as the ratio of the unit price of exports in *Peso*s divided by the Mexican consumer price index.

In the previous section on the growth decomposition, Figure 1 showed that during the tequila crisis there was an increase in the growth rate of exports (at constant local prices), accompanied by a decrease in imports. Both tendencies certainly helped to cushion the fall of GDP in 1995. Nonetheless, Figure 2 showed that this peak in the contribution of net-exports to the growth of GDP was short-lived. After the crisis, the contribution of imports diminished substantially and the contribution of exports also declined.

Figure 5 shows the growth rate of the volume of non-oil exports and the real exchange rate of Mexican exports. This figure shows that the rise in export value growth seen in Figure 1 during the tequila crisis was not all due to changes in the aforementioned relative price, which could be considered to be a purely "accounting" effect.[6] This rise in export revenues was also due to an increase in the rate of growth of the volume of non-oil exports, which accelerated in this period from two percent in 1994:4 to almost 40 percent in 1995. The rate of growth of the volume of exports declined by the first quarter of 1996, when the economic recovery began, as the real exchange rate of exporters began a slow appreciation process. Nevertheless, the average rate of growth of the volume of non-oil exports continued to be high (17.36 percent) from the first quarter of 1996 to the third quarter of 1999.

Figure 6 shows the unit labor costs, the remuneration in US dollars per man/hour in the manufacturing industries in Mexico and Korea, as well as the Mexican exports real exchange rate. From 1993 to 1999, the unit labor costs decreased steadily, even as the real exchange rate

was appreciating before the crisis. On the other hand, remuneration per man/hour increased before the crisis. This represents a loss in competitiveness for Mexican exports. This loss in competitiveness was associated with the appreciation of the real exchange rate in the same period. In 1995, the year of the crisis, the remuneration decreased 20 percent as the real exchange rate depreciated. From 1996 onwards, both indicators of international competitiveness returned to levels recorded in 1993. We can only infer that the gain in competitiveness, expressed by the depreciation of the real exchange rate and the decrease in US dollars paid per man/hour, was an important factor behind the increase in the volume of non-oil exports in 1995.

Finally, Figure 6 also shows the remuneration in US dollars per man/hour in Korea. It shows that during 1997, prior to the crisis, remuneration increased by 30 percent. Through 1998, remuneration per man/hour decreased and recovered its pre-crisis level by the end of 1999. Thus, the behavior of remuneration around the Mexican and Korean crises was remarkably similar: there was an increase of this indicator prior to the onset of the crisis and then, the year after the crisis, it returns to the pre-crisis level. According to these indicators, Mexican exports lost international competitiveness with respect to Korea the year before and the year after the tequila crisis. Then, in 1996, both countries had similar levels of remuneration per man/hour. By the end of that year, Korea began to lose competitiveness with respect to Mexico, and by 1999, both countries had once again similar levels of remuneration per man/hour in dollars.

In sum, the growth of exports observed during and after the tequila crisis was probably driven by an increase in the volume of non-oil exports, which was, in turn, stimulated by a sustained reduction in unit labor costs and a transitory improvement (or correction) in the

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[6] The rate of change of export revenues measured at constant local prices can be decomposed into a relative price or

international competitiveness of Mexico's industrial sector. The latter seems to have been associated with the real devaluation of the *Peso*.

II. A Mexican Investment Function

The growth decomposition exercise presented above indicated that fixed capital formation was at the heart of the economic recovery in Mexico after 1995. Also, there seems to be some evidence that Mexican investment may be linked to the performance of the tradable sector (Krueger and Tornell 1999). Hence it is important to study more carefully the determinants of investment and its links with the tradable sector.

We can model Mexican investment as a function of the output of tradables and non-tradables, where we expect to find different sector multiplier effects:[7]

$$(2) \qquad I = \bar{I} + m_T \bullet Y_T + m_{NT} \bullet Y_{NT} + I\left(RIR, p_K, s_{RER}\right)$$

where I is the (log of the) level of private fixed investment at constant prices; $\bar{I}$ is a constant, minimum level; and the m's are the corresponding sector multipliers. The last term on the right-hand side is the portion of the investment function that is determined by "cost factors," including the real interest rate (RIR), the relative price of capital goods (p_K) and an uncertainty variable, which we identify with the volatility of the real exchange rate (s_{RER}). This simple model is

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"accounting" effect and a volume effect: $\dot{x} = \dot{RER} + \dot{Q}_X$.

[7] The appendix in Lederman et. al. (2000) presents a model of optimal investment rules which gives theoretical grounds for this assumption. In brief, m(t)>m(nt) due to higher capital intensity of production in the tradables sector.

broadly consistent with standard empirical models of investment behavior in developing

countries (see Rama 1993), except for the assumption regarding the two sectors' multipliers.

Servén (1998) finds a strong negative effect of real exchange-rate uncertainty on investment-

output ratios in a cross-country panel framework. This effect could be an important explanation

of the fall of investment during 1995 in Mexico, and even of the downfall of investment during

the debt crisis of 1982-1983.

Moreover, the consideration of real exchange rate uncertainty is consistent with two

plausible assumptions. First, domestic investors can be risk-averse, thus uncertainty may

adversely affect private investment. Second, it is also possible that at least portions of private

investments are irreversible and contribute to sunk costs. Under these circumstances,

macroeconomic uncertainty can be associated with swings in the value of private firms, thus

hampering productive investment by firms (Pyndick 1988). If the tradables sector has a high

multiplier effect on private investment, then the uncertainty of the real exchange rate could also

have an indirect effect on investment through its effect on the output of tradables. As argued by

Maloney and Azevedo (1995), uncertainty about expected returns of producing for domestic

versus export markets will affect the composition of output.

If the output multipliers are constant over time, then in terms of growth rates, or in

differences of the logs, the investment function can be re-written as follows:

(3) $g_I = m_T \bullet g_T + m_{NT} \bullet g_{NT} + g\left(RIR, g_{pK}, \boldsymbol{s}_{RER}\right)$

where the g's denote growth rates of the corresponding variables. In this specification, the multipliers are analogous to the standard income accelerators that are standard in empirical investment functions (Rama 1993, Servén 1998).

A companion paper by Lederman, et.al.(2000) estimates the investment function described in equation (3). We will refer to our main findings of that paper where appropriate throughout this paper.[8] This basic investment function has as the dependent variable the growth of Mexican fixed investment. The explanatory variables include the growth of the sectoral GDPs, the domestic real interest rate, real exchange rate volatility, variations in the relative price of capital, and the lagged dependent variable. This function is estimated for the whole sample (1980-1999:Q3) and for a restricted sample (1980-1994) used to conduct an out-of-sample forecast.[9]

The first column of Table 1 presents the results for the basic investment function. According to the statistic for the J-test (last row) the model is well instrumented, i.e., the instrumental variables are not correlated with the error term, and therefore we can interpret the coefficients as being the impact from the explanatory variables to the dependent variable. A second element to notice is that the Q-statistic shows no sign of serial correlation and therefore supports the model specification.

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[8] These empirical analyses rely purely on publicly available data, primarily from the Mexican statistical agency (INEGI) and the International Monetary Fund. A description of the variables (and their sources) is presented in Table 1 of Lederman et.al. (2000). All the data has a quarterly frequency and covers the period between 1980 and the third quarter of 1999. The econometric models were estimated using the General Method of Moments (GMM) estimator which controls for the joint endogeneity of the explanatory variables.

[9] The basic model is extended in Lederman, et. al. (2000) along four dimensions: first, the inflation differential between tradable and non-tradable goods is added to the set of explanatory variables; second, the US real interest rate is introduced; third, two measures of credit availability (the growth rates of total domestic credit and credit to the private sector issued by commercial banks) are included; and, finally, the authors test the stability of the coefficient on the domestic real interest rate during periods of crisis.

The results show that an increase of one percent in the output of tradables "causes" an increase of 1.16 percent in the growth of fixed investment, while an equal increase in non-tradables would "cause" an increase of 0.80 percent in the growth of fixed investment. Thus, the multiplier effect of the tradable sector on investment clearly surpasses that of the non-tradable sector.[10] The volatility of the real exchange rate has a negative coefficient, but the magnitude of this effect is not significantly different from zero. The relative price of capital (e.g., the ratio of the price index of capital goods over the CPI) has a negative sign and is significant at the 5 percent level. The coefficient implies that an increase of one percent in the growth rate of this relative price "causes" a reduction of 0.33 percent in the growth of fixed investment. The coefficient of the domestic real interest rate has the expected negative sign in the estimation of the investment function, and it is statistically different from zero. The estimated coefficient implies that a one percentage point increase in the real interest rate leads to a 0.08 percentage points decline in the growth rate of fixed investment.

Table 2 shows the contributions of the growth rate of tradable and non-tradable sectors during 1996-99, based on the results presented in the first column of Table 1. In 1996, fixed investment grew 14.9 percent; 10 percent of this growth was associated with the contribution of tradables and 6.2 percent to the contribution of non-tradables.[11] This relative importance of the contribution of tradables is maintained through 1999. In contrast, the contribution of variations in the relative price of capital seem to have been quite modest during the five years. [12] Interestingly enough, the rate of growth of non-tradables fell by 18.9 percent during 1995, while the one for

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[10] Moreover, the p-value of the F-statistic for the null hypothesis that the two multipliers are equal is 0.01.
[11] The sum of these contributions is larger than the growth of fixed investment because there are other determinants of investment.
[12] These simulations presume that the actual variations in these explanatory variables were exogenous.

tradables fell only by 3.6 percent. Later in this paper we analyze the effect of real exchange rate variations on the sectoral growth rates.

The second column of Table 1 shows results for the same basic regression estimated for the 1980-1994 period. The results are quite similar to those reported for the full sample. An important difference, however, is that the estimated negative coefficient of the real interest rate is larger than the one reported in the first column. Another notable difference is that the estimation with the restricted sample shows a Wald test that does not reject the null hypothesis that the sectoral multipliers are equal -- its p-value is now 0.44.

To provide a visual illustration of the capacity of this basic model to explain the behavior of Mexican investment during and after the 1995 crisis, Figure 7 presents the forecasted and actual values for the year-on-year growth rate of Mexican fixed investment. The forecast presented here uses the dynamic approach to forecasting which calculates multi-step forecasts starting from the first period in the forecast sample (first quarter of 1995).[13] It shows that this naïve model quite successfully explains the behavior of Mexican fixed investment, especially after 1995. The Theil inequality coefficient comparing the forecast with the actual observations is relatively low at 0.17 (a zero would indicate a perfect fit). More importantly, almost 80 percent of this inequality is due to the covariance between forecast and actual errors (or deviations from the corresponding means). This means that the lion's share of the inequality between the forecast and the actual observations is due to unsystematic error covariance.

The companion paper by Lederman et. al. explores in more depth the investment function of the Mexican economy. In particular, it evaluates whether there was any structural break in the estimated coefficient on the interest rate during the periods of crisis. It also controls for credit

availability and evaluates the importance of the US interest rate. Two important findings are: i) The hypothesis of a structural break of the interest rates during the 1982-1983 debt crisis cannot be rejected. That is, higher interest rates were related with higher growth in investment during this period. For the tequila crisis, on the other hand, the results reject the hypothesis that the coefficient on the real interest rate was positive during 1995. ii) The second important finding is that US interest rates played an important role in the Mexican investment function. These results provide strong evidence in favor of the Kruger-Tornell hypothesis that access to the U.S. financial market was a key feature of the recovery after 1995. However, the inclusion of U.S. rates did not dilute the negative coefficient on the domestic real interest rate. This last result suggests the existence of some form of financial market segmentation, whereby some firms tap the domestic credit market while others rely on the U.S. market.

III. The Role of Financial Transmission Channels

The Mexican financial sector had serious difficulties during the last decades. In 1982, after the debt crisis, Mexico nationalized the banking system, only to privatize it again after 1991. By December 1994, the system was fragile once again, with 35% of total loans non-performing. A third of the loans were denominated in foreign currency and most of them extended to firms without sources of foreign income. The *Peso*-based loans also suffered from the rise in interest rates during 1994 that was generalized as most credits had interest rates tied to

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[13] This method is less 'accurate' than the static approach, which calculates a sequence of one-step-ahead forecasts using actual, rather than forecasted values for the lagged values of fixed investment growth.

the one-month Cetes. Finally, some of the loans allocated during the credit expansion of the early

90's went to risky ventures.[14]

These circumstances question the relevance of interest rates and the role of credit

availability as determinants of investment. To assess these questions, we must analyze the

evolution of credit in Mexico.

Figure 8 shows how credit has grown. The most noticeable feature of the evolution of

credit is the acceleration in the growth of credit offered to the private sector by non-money banks

in 1989, coinciding with a decrease in credit to the private sector by the deposit money banks.

The second feature is that during the crises of 1982-1983 and 1995 there was an overall decline

in credit. After the debt crisis, the recovery of credit from banking institutions different from

deposit money banks was quicker and stronger than other types of credit, even though credit from

deposit money banks followed closely. In 1996, after the tequila crisis, credit from banking

institutions different from deposit money banks, recovered partially but never attained its pre-

crisis share of total credit. Another important difference in the behavior of credit during the

tequila crisis was the strong recovery of credit from monetary authorities.

Under credit rationing, investment could be driven by credit availability and not by real

interest rates (Stiglitz and Weiss 1981). Lederman et. al. (2000) show that once total credit or

credit to the private sector were added to the basic investment function, there was high serial

correlation and the model was no longer well specified. Therefore we were unable to confirm or

reject the hypothesis that Mexico has suffered from credit rationing. On the other hand, when

these authors include credit availability instead of real interest rates to the core model, serial

correlation disappears and the coefficient for credit is positive and significant. Credit availability

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[14] For an extensive description of the role of the banking system in the recovery of the Mexican economy see

could be considered an important determinant of fixed investment in Mexico and the decrease in its availability during the crises negatively affected the growth of fixed investment. But we cannot distinguish between the negative effects of high real interest rates and low credit availability.

Figure 9 shows the behavior of domestic and foreign real interest rates. Domestic rates were calculated using the money market nominal interest rate deflated by the consumer price index. The foreign interest rate was calculated using the US prime lending rate deflated by the import unit value of the USA. This last interest rate should reflect the relative cost faced by domestic producers of tradable goods and thus the import unit value is one possible proxy deflator.

First, Figure 9 shows a long period (1981-1987) of negative domestic real interest rates. The average real interest rate in Mexico between the debt crisis (1982:Q1) and the second quarter of 1988 was –23.1 percent. In that period there was a big gap between domestic and US real interest rates; the average U.S. real interest rate was 10.25 percent. Then, from 1988:Q3 to 1994:Q4, the domestic real interest rate decreased to an average of 9.92 percent. In the year of the crisis this rate fell to an average of 3.85 percent, and during the recovery years (1996:Q1 to 1999:Q3) it increased again to an average of 5.2 percent. The gap with the US real interest rate narrowed and became negative; between 1995 and 1999, the average U.S. real interest rate was 8.05 percent.

Thus, for the period under study, there is a clear "break" in the series of domestic real interest rates. During and after the debt crisis, domestic real interest rates plummeted for a long time, but during the tequila crisis, the drop was both less dramatic and of shorter duration.

Krueger and Tornell (1999).

Lederman et. al. tests the hypothesis of how fixed investment was affected by the fact that real interest rates behaved differently during each of these crises. The authors conclude that there was indeed a structural break in the estimated coefficient of the domestic real interest rate during the debt crisis. In other words, during the debt crisis, an increase in interest rates was related to an increase in fixed investment. This result can be interpreted as evidence that increases in interest rates generated confidence in the economy, although there are other plausible explanations.[15] Nevertheless, this empirical conclusion cannot be extended to the tequila crisis.

We have mentioned that during the 1990s domestic and US real interest rates floated around the same levels, and that capital markets were greatly transformed and liberalized since the late 1980s. These facts open the question of the role played by the US credit market during this last decade. As mentioned, Lederman et. al. find that US real interest rates do matter in the Mexican investment function. In fact, when the US real interest rate is added to set of explanatory variables in the basic investment function, it presents a significant negative coefficient, while the relevance of domestic real interest rates is also maintained. This result provides some evidence in favor of the hypothesis that some sectors of the Mexican economy are tightly integrated with the U.S. financial markets while others are not.

IV. What was the dynamic short-term relationship between the real exchange-rate and investment growth?

Our previous model does not examine the direct relationship between the real exchange rate and fixed investment, because the real exchange rate is expected to affect investment only indirectly, through its effects on the relative price of capital and the composition of output. Here

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[15] During this period, Mexican banks were nationalized and interest-rate controls were imposed. Therefore, it is not

we use the impulse-response function (IRF) derived from Vector Auto-Regressions (VAR) to study the relationship between fixed investment and the real exchange rate. We ran a VAR with the growth rates of fixed investment, the relative price of capital goods, and the real exchange rate as endogenous variables. The choice of these variables is inspired by existing evidence for Mexico indicating that the relative price of capital may be an important channel through which variations in the real exchange rate (and its determinants, such terms of trade) affect domestic investment (Warner 1994).[16] We also included the following exogenous variables that are likely to affect the three variables mentioned above: the growth of U.S. GDP, variations in public consumption, variations in the terms of trade, the U.S. real prime lending rate, the OPEN and NAFTA dummy variables, and a constant. Figure 10 shows the corresponding IRF assuming that the real exchange-rate is more exogenous than the relative price of capital which, in turn, is assumed to be more exogenous than fixed investment. Twelve lags of the endogenous variables were included in the VAR, because the Akaike, Scwartz and Log Likelihood tests all indicated that this was the best distributed lag specification, when compared to 1, 4 and 8 lags. The IRF illustrates the effect on investment of a one standard deviation innovation in the real exchange rate. The results show that the response of investment to an *appreciation* of the real exchange rate is positive at first but becomes negative and significant during the second year, after approximately five quarters.[17]

The finding that an *appreciation* of the real exchange rate in Mexico is associated with an expansion of the economy in the short run, is consistent with the conclusions of other recent empirical studies. For example, Kamin and Rogers (1998) also find that appreciations

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surprising that we found a structural break during that time.

[16] The RER used here is the IMF's real effective exchange rate.

(depreciations) have positive (negative) effects on output, but these authors argue that there are multiple channels through which this effect takes place, including its effect on government spending, monetary aggregates, and capital flows. In fact, Kamin and Rogers only tentatively reject the hypothesis that the channel is the inflation rate. Four quarters after the simulated appreciation the growth of fixed investment tends to decline. A plausible interpretation of these dynamic effects is that an appreciation has an initially positive effect that could be due to income effects (or positive net worth effects) and the reduction of the relative price of capital. Later, as a substitution effect takes hold (see below), investment growth declines as a consequence of the real appreciation of the currency.

V. Were there short-term substitution effects of real exchange rate variations?

Based on pairwise VARs, the impulse-response functions presented in Figures 11A-C look at the effect of the real exchange rate on the relative growth of the non-tradable and tradable sectors. The model was estimated with 1, 4, 8 and 12 lags, but Figures 11A through C show the IRF based on the lag specification supported by the Akaike criteria.[18] The endogenous variables are the rate of growth of either tradables, non-tradables or the ratio of tradables/non-tradables and the real exchange rate, being this latter one the more exogenous. As exogenous variables we included US GDP, US real interest rate, public consumption, terms of trade and dummy variables for openness and NAFTA. The first two IRFs show that an appreciation of the real exchange rate tends to raise the growth rate in the non-tradables and the tradables sectors in the short run,

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[17] The VAR results show that, among the exogenous variables, the growth of US GDP has a positive and significant coefficient (6.2; t-stat of 2.4). The US real interest rate is also significant (-0.4; t-stat of -2.6).
[18] The Schwartz and log-likelihood criteria supported different distributed lag specifications.

lasting between 4 and 5 quarters. But this effect is larger for the non-tradables sector.[19] The

finding that an appreciation of the real exchange rate in Mexico is associated with a transitory

expansion of the economy is consistent with the conclusions of other empirical studies. As

mentioned earlier, Kamin and Rogers (1998) also find that appreciations (depreciations) have

positive (negative) effects on output. On the other hand, Figure 11C provides evidence that

variations in the real exchange rate have significant substitution effects in the sense that it affects

the composition of output: an appreciation decreases the rate of growth of tradables over non-

tradables. This effect is also clear from Figure 12. This figure shows how the ratio of the rate of

growth of tradables over non-tradables accelerated after the depreciations of the debt and the

tequila crises. In other words, while the depreciation of the real exchange rate tends to have a

short-run negative income effect associated with a decline in the growth rates of tradable and

non-tradable output, this effect is larger for non-tradables. We interpret this differential effects as

evidence of transitory substitution effects. This temporary substitution effect implies a permanent

change in the composition of the level of Mexican output in favor of tradables.

CONCLUSIONS

Since the eruption of the so-called tequila crisis of 1995, and after the Asian crises of

1997, much has been written about the causes of financial crises in developing countries. Yet

much less attention has been given to the evolution of the productive economy after these

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[19] Of the exogenous variables, only the terms of trade has a significant coefficient in the regression for the growth of tradable output. The US GDP growth rate has a positive coefficient (0.8) but its t-statistic is low (1.4). None of the exogenous variables were significant in the determination of non-tradable output growth.

crises.[20] This study provides an analysis of the macroeconomic variables behind the recovery of the Mexican economy. The growth decomposition exercise showed that during the crisis, there was an increase in exports growth and a reduction in imports growth, that played a crucial role in cushioning the fall in GDP. During the period of recovery, imports contributed negatively to GDP growth and exports contribution, though still relevant, was smaller than during the crisis.

The rate of growth of fixed investment, on the other hand, plummeted during the Mexico tequila crisis but recovered sharply in 1996, attaining rates of growth higher than those observed during the pre-crisis period. Hence the contribution of fixed investment was a critical element in the post-crisis period. Inventories, on the other hand, were not as important. As in the case of Mexico, the growth of fixed investment and its contribution to GDP growth fell in Indonesia, Korea, and Thailand during times of crises. It is not possible to come to a conclusion for the post-crises periods in the Asian economies because of the lack of sufficient observations.

The rise in the growth of export revenues measured in constant pesos during and after the crisis was not all due to the "accounting" effect of the real exchange rate.[21] It was also because the rate of growth of the volume of non-oil exports accelerated in this period. Furthermore, as the real exchange rate depreciated, remuneration in US dollars decreased, and remained at that low level during 1995-1999, thus improving the competitiveness of the tradable sector. Finally, since 1994, unit labor costs have tended to decrease, even when the real exchange rate appreciated.

The empirical implementation of the fixed investment function for Mexico follows the principles of basic economics. It only adds to basic investment models the assumption that tradable and non-tradable output growth have different multiplier effects on investment. The

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[20] See Perry and Lederman (1999) for a comparison of the aftermath of Latin American and Asian Crises in the 1990s.

main finding is that the basic model does quite well in predicting the recovery of investment during 1996-1999. Also, the tradable sector has a higher multiplier effect than non-tradables, while naïve measures of real exchange-rate uncertainty are not robust determinants of Mexican fixed capital formation.

The section on the role of financial transmission channels concludes that both the amount of credit and real interest rates seem to be important determinants of fixed investment and we could not distinguish between their effects. It also finds that US real interest rates are significant determinants (with a negative sign) of the growth of fixed investment in Mexico. Thus, there is evidence in favor of the Kruger-Tornell (1999) hypothesis that access to the U.S. financial market by Mexican firms operating in the tradable sector was a key feature of the economic recovery after 1995.

The paper also finds that the impact of variations of the real exchange rate on fixed investment seems to be dominated by income effects initially. Substitution effects were also present in the sense that a depreciation of the real exchange rate seems to produce a larger decline in the growth of non-tradable output than of tradable output. Therefore, a depreciation of the real exchange rate, such as that of 1995, has a negative income effect associated with a decline in the growth rates of tradable and non-tradable output in the short-run. Nevertheless, there is a substitution effect which makes this negative effect larger for non-tradables and therefore, the rate of growth of tradables over non-tradables accelerated after the depreciation. The story that emerges is that Mexican investment growth declined during 1995 due to the currency depreciation's impact on the relative price of capital goods and the income effect, but

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[21] This "accounting" effect is given by the fact that a real depreciation raises the value of exports in domestic currency relative to the general consumer price level.

eventually the recovery was driven by the high multiplier effect from the growth of tradable output.

Some of the most relevant empirical conclusions which can be drawn from this paper are:

- The decline and subsequent rise in the GDP growth rate were primarily due to the behavior of fixed investment.

- Fixed investment growth was negative during the crisis because the real depreciation of the exchange rate raised the relative price of capital. Besides, the real depreciation had a negative income effect that affected investment decisions.

- The recovery of fixed investment observed during the year after the crisis was linked to the substitution effect of the real devaluation in favor of the tradable sector. Indeed, the real devaluation produced a notable improvement in the competitiveness of Mexican manufactures, which was reflected in an increase in the growth of the volume of non-oil exports. This may explain why the growth of tradables declined less than the growth of non-tradables in 1995.

- The international comparisons based on the growth decomposition show that in the cases of currency crises in Indonesia, Korea, and Thailand, fixed investment was also an important driving force behind the fall in GDP growth.

- There is strong evidence in favor of the hypothesis that financial links with the U.S. economy were important factors that helped in the recovery of Mexican investment.

As a policy implication we can say that during currency crises there are tradeoffs related to interest rate defenses of the currency. High nominal interest rates used to contain inflation are associated with higher real interest rates, which then contribute to the downfall of investment. On the other hand, the depreciation of the currency can have negative consequences on investment in

the short-run as a result of its effects on the relative price of capital and its negative income effect. However, a real depreciation is healthy in the medium term because it stimulates export growth and increases the share of tradables in total output, which then has a large multiplier effect on investment. At the very least, this paper has shown that in the case of the Mexican recovery there is no evidence in favor of blind defenses of the currency during and after a speculative attack.

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Table 1. GMM Regression Results

Dependent Variable ------------ Explanatory Variables	Growth of Investment (a)	Growth of Investment (restricted sample) (a)
Constant	-0.04** (0.00)	-0.04** (0.01)
Lagged Investment	0.26** (0.03)	0 43** (0.07)
GDP non-Tradables	0.80** (0.08)	1.19** (0.18)
GDP Tradables	1.16** (0.08)	0.90** (0.22)
Volatility RER	-0.00 (0.00)	-0.02** (0.01)
Relative Price of Capital	-0.33** (0.09)	-0.52** (0.24)
Real Interest Rates	-0.08** (0.02)	-0.13** (0.06)
US GDP		
N	67	50
Adjusted R^2	0.92	0.88
S.E. of Regresion	0.05	0.05
Q-stat for lag 4, p-value	0.98	0.42
Wald test, p-value	0.01	0.44
J-test, p-value	0.85	0.50

*Significant at 10%, ** Significant at 5%. NOTES: All variables are included in year-on year differences of their logs, except for Mexican and US Real Interest Rates which are in levels. (a)Exogenous variables: US Real Interest Rates, US GDP and Terms of Trade. 4 lags of endogenous variables and seasonal dummy variables.

Table 2: Contributions to Investment Growth*
(Actual growth rates in parenthesis)

Year	Investment Growth	Contribution of Non-Tradables	Contribution of Tradables	Contribution of Relative Price of Capital
1995	-34.44%	-15.1%	-4.2%	-0.7%
		(-18.9%)	(-3.6%)	(2.2%)
1996	14.9%	6.2%	10.0%	1.6%
		(7.7%)	(8.6%)	(-4.8%)
1997	19.2%	6.3%	8.5%	0.9%
		(7.8%)	(7.3%)	(-2.7%)
1998	10.6%	3.7%	6.7%	-0.10%
		(4.6%)	(5.7%)	(0.4%)
1999	4.6%	3.1%	4.4%	0.30%
		(3.9%)	(3.8%)	(-1.2%)

Note: The contribution = estimated coefficient (Table 1, column 1) * actual growth rate

Figure 1. Mexico: Growth Rates of Demand Components
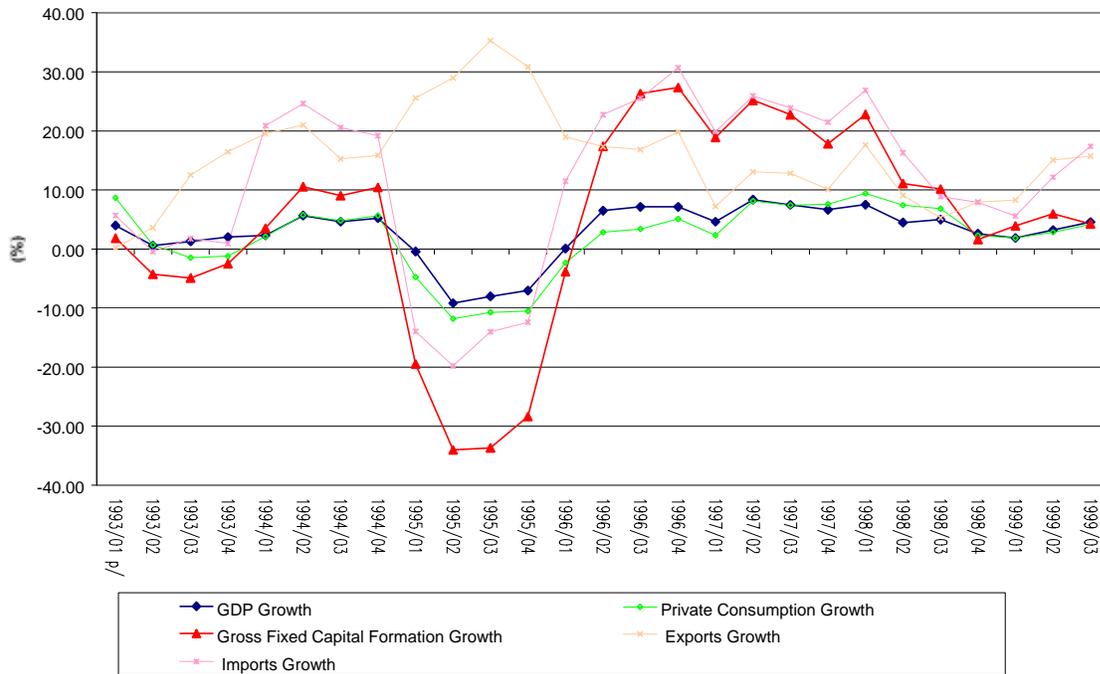
Figure 2. Mexico: Contribution of Demand Components to GDP Growth

34
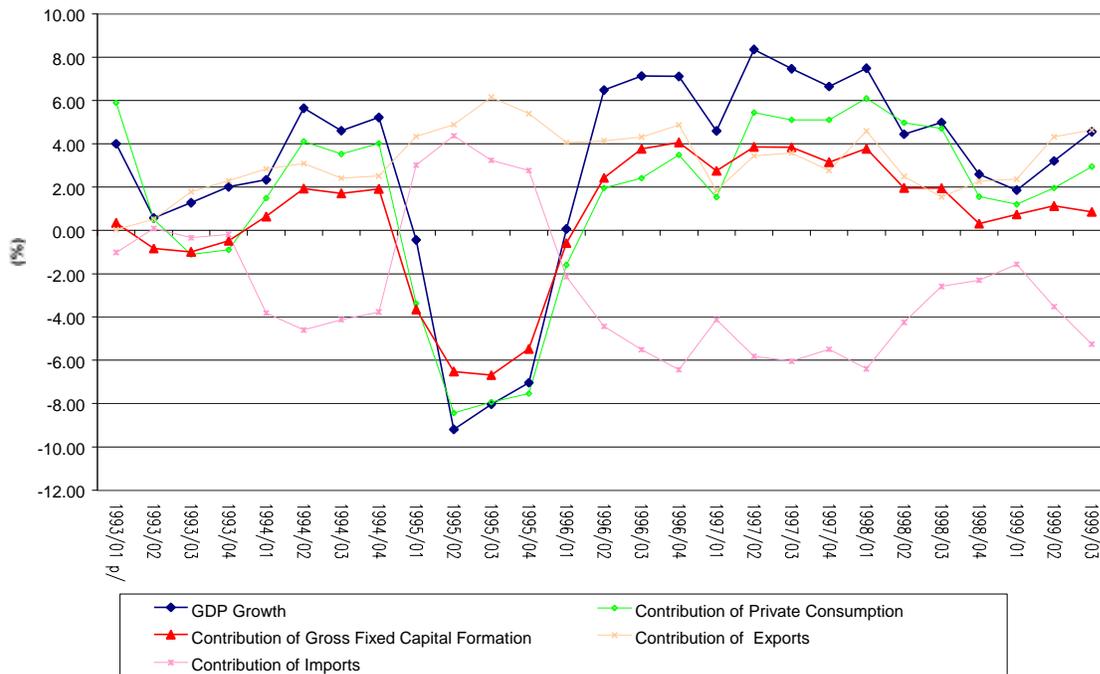
Figure 3A. Mexico: Growth Rates of Investment Components

Legend: Gross Fixed Capital Formation Growth — Inventories Growth — GDP Growth
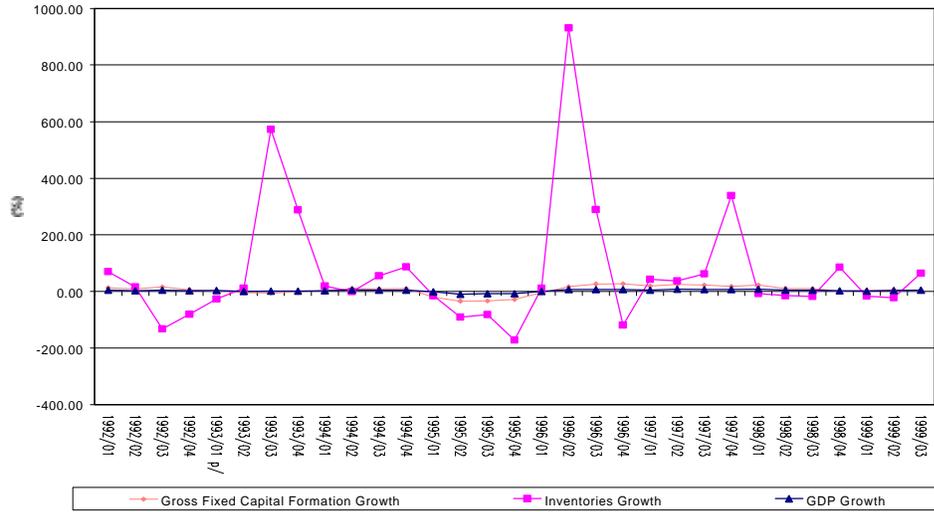
Figure 3B. Mexico: Contribution of Fixed Investment and Inventories to GDP Growth

Legend: Contribution of Gross Fixed Capital Formation — Contribution of Changes in Inventories — GDP Growth
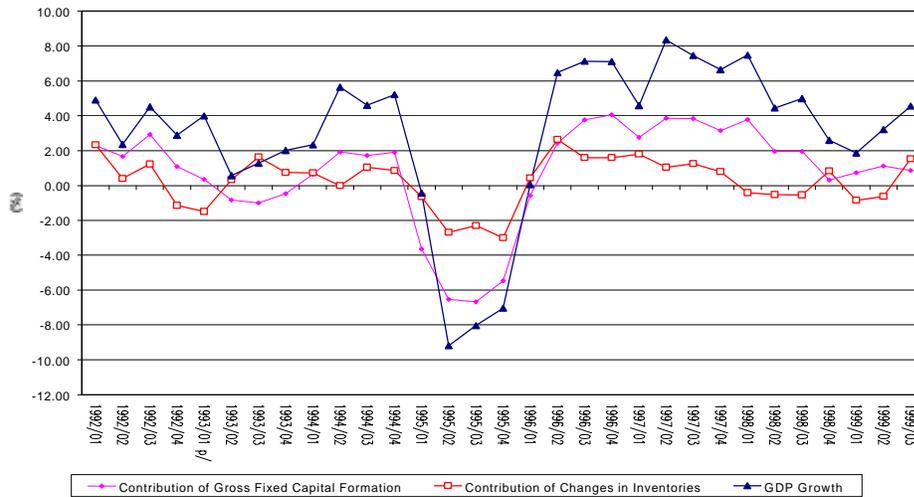
Figure 3C. Mexico: Relative Importance of Inventories and Fixed Investment

Legend: GDP Growth - Gross Fixed Capital Formation — GDP Growth - Change in Inventories

35
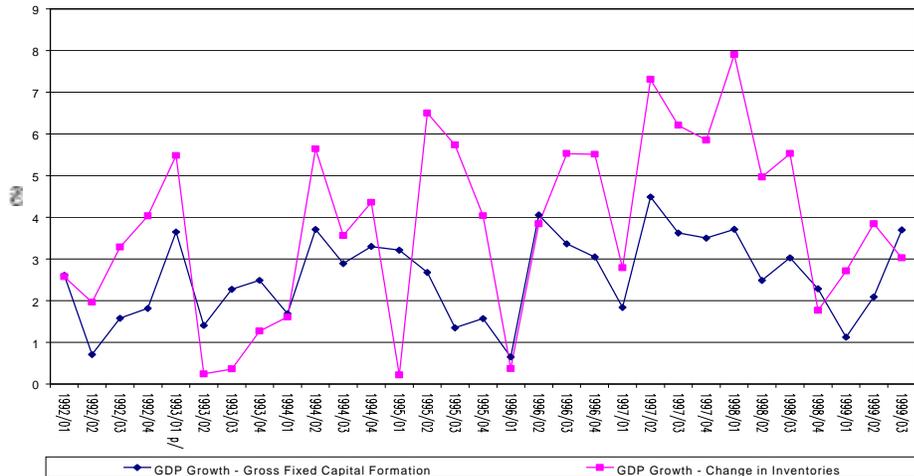
Figure 4. Asia: Relative Importance of Fixed Investment and Inventories to GDP Growth

Indonesia

Korea

Thailand

Legend: GDP Growth - Contribution of Gross Fixed Investment — GDP Growth - Contribution of Inventories
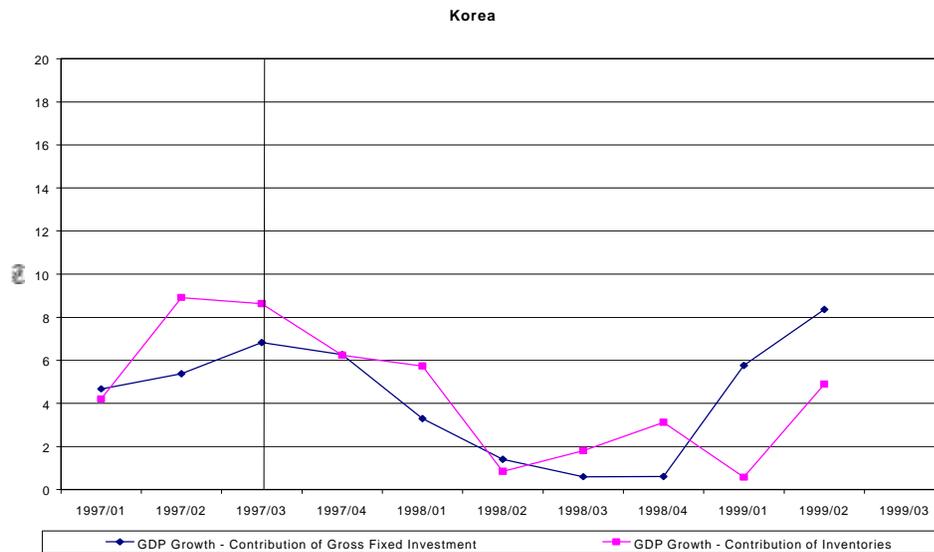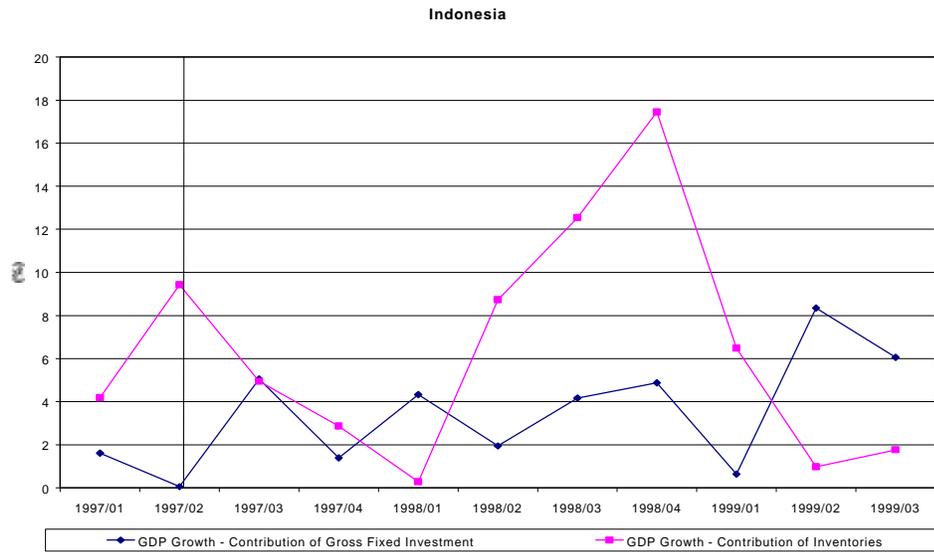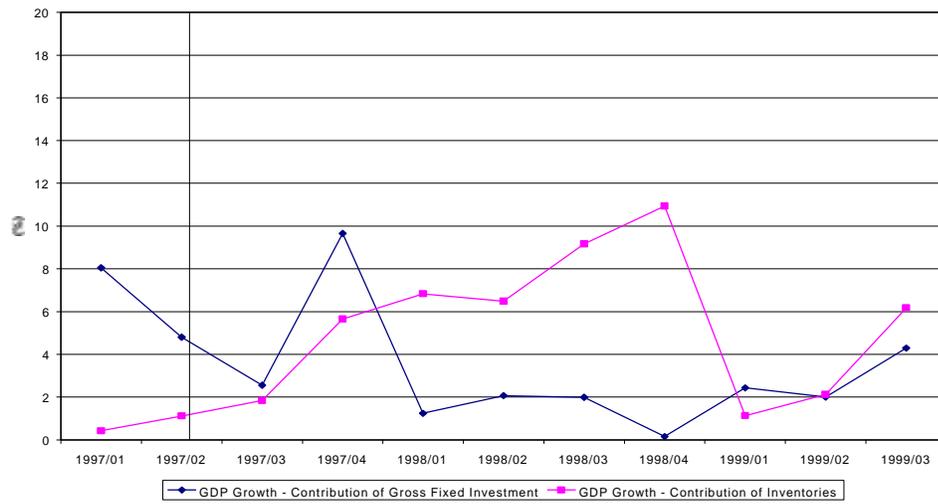
Figure 5. Mexico: Growth of Exports Volume
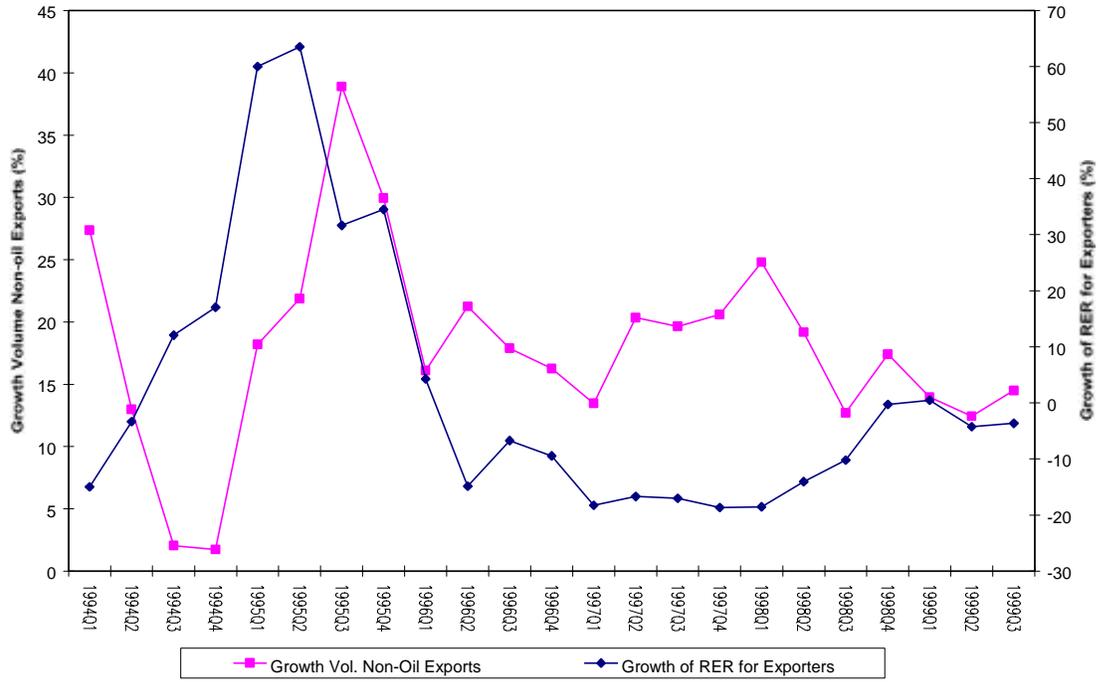
Figure 6. Mexico: Remuneration in US Dollars per Man Hour and Unit Labor Costs, 1994-1999

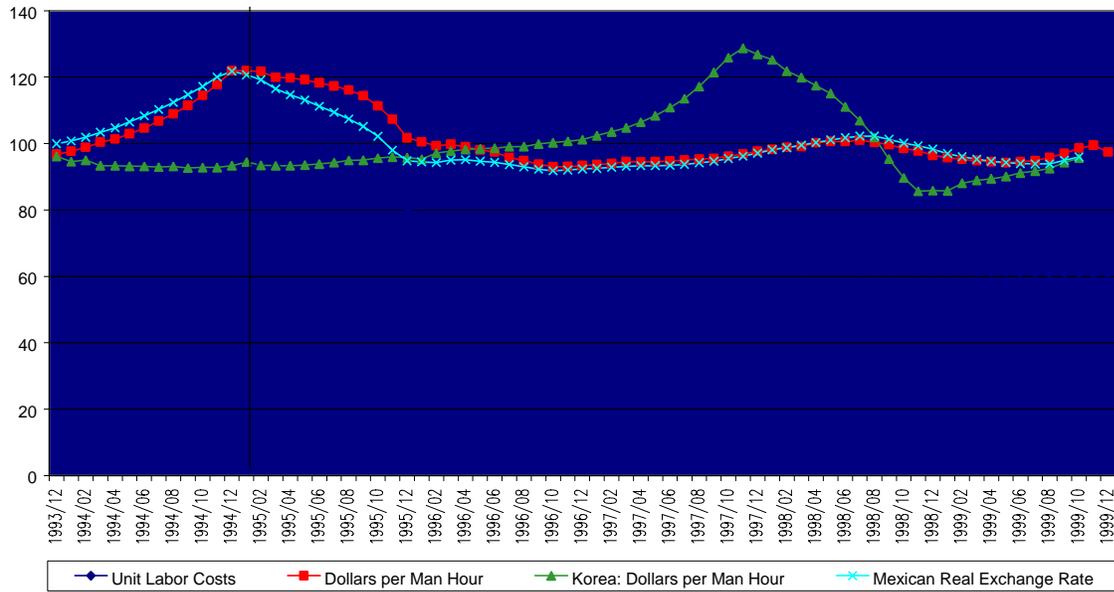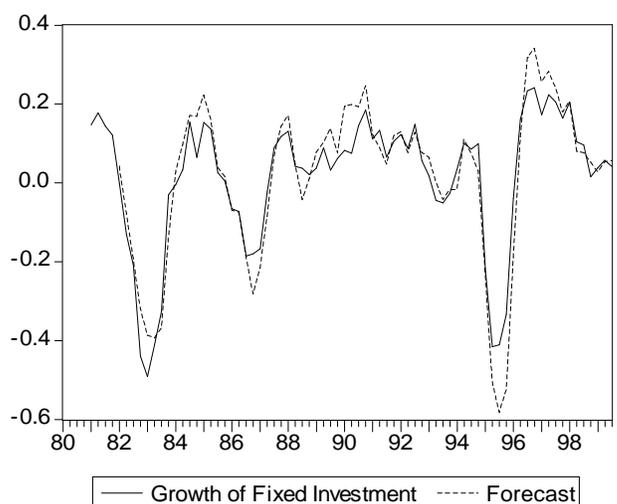(In manufacturing industries; 12-month moving average; 1993=100)

Legend: Unit Labor Costs — Dollars per Man Hour — Korea: Dollars per Man Hour — Mexican Real Exchange Rate

Figure 7. Out-of-Sample Forecast of the Recovery of Mexican Investment Growth, 1995-1998

Theil Inequality Coefficient	0.17
Bias Proportion	0.01
Variance Proportion	0.19
Covariance Proportion	0.79

Figure 8. Mexico: Growth of Credit

Legend:
- Total Domestic Credit
- Credit from monetary authorities and deposit money banks
- Credit to the private sector by other banking institutions
- Credit to the private sector by deposit money banks
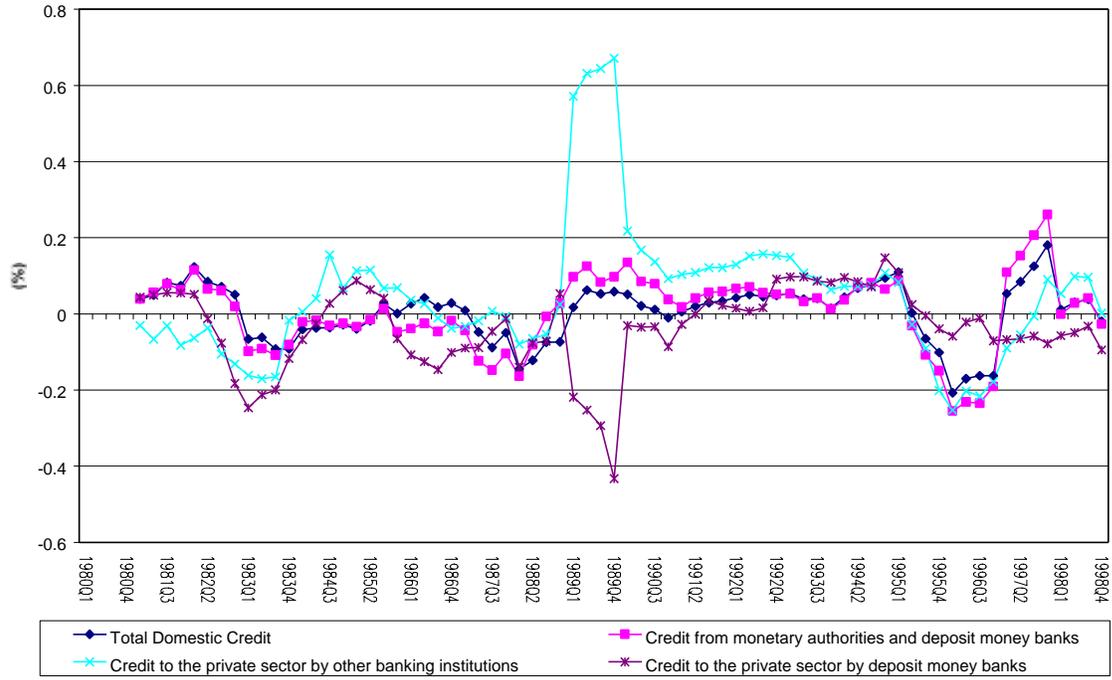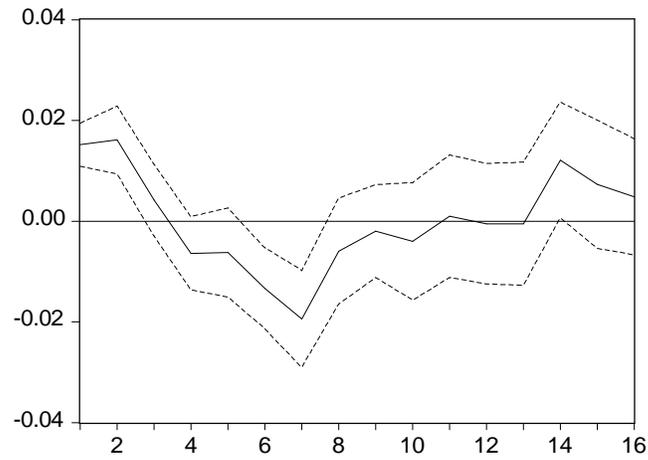
Figure 9. Mexico and US: Real Interest Rates
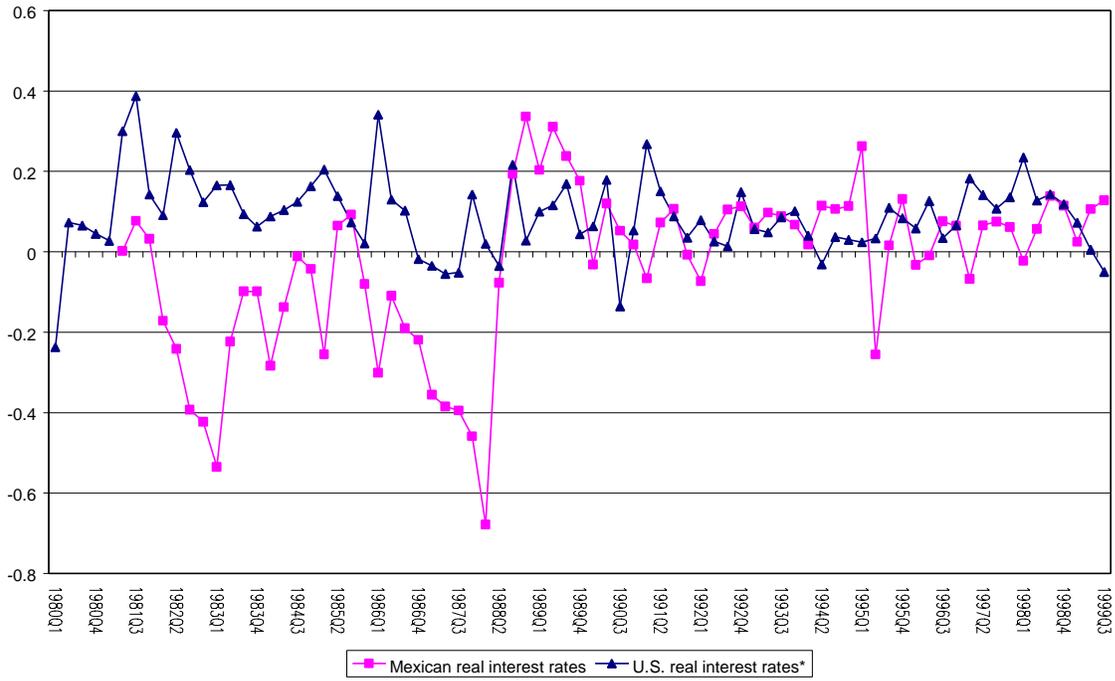
Figure 10. Response of Fixed Investment to One S.D. Innovation to RER*

*Variables are in the year-on-year differences of the logs. VAR: RER, Relative Price of Capital and Fixed Investment

Exogenous variables: USGDP, USRIR, Public Consumption, Openness, Nafta, Terms of Trade and a Constant

Lags:12; AIC:-12.19; SWZ:-7.20; Log Likelihood:479.

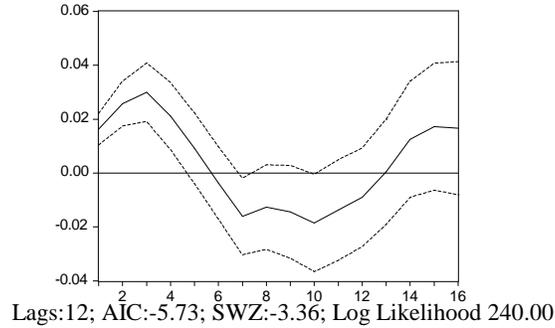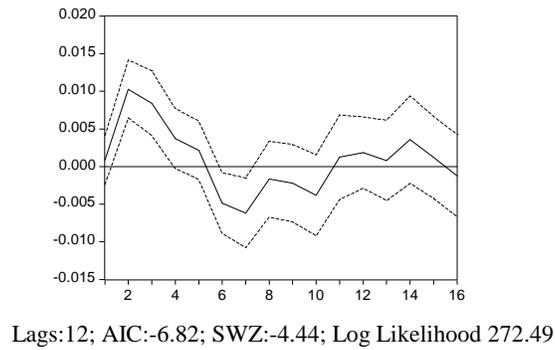**Figure 11A. Response of Non-Tradables to One S.D. Innovation to the RER***

Lags:12; AIC:-5.73; SWZ:-3.36; Log Likelihood 240.00

Figure 11B. Response of Tradables to One S.D. Innovation to the RER*

Lags:12; AIC:-6.82; SWZ:-4.44; Log Likelihood 272.49

Figure 11C. Response of Tradables/Non-Tradables to One S.D. Innovation to the RER*

Lags:8; AIC:-5.52; SWZ:-3.76; Log Likelihood 228.5.
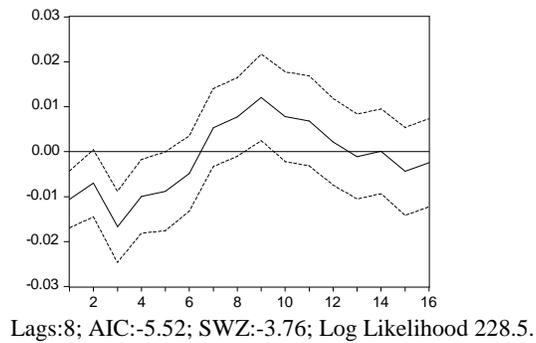
*Variables are in the year-on-year differences of the logs. VAR: RER, Non-Tradables.

Exogenous variables: USGDP, USRIR, Public Consumption, Openness, Nafta, Terms of Trade and a Constant

Figure 12. Rate of Growth of the Ratio Tradables/Non-Tradables