Mexico—Five Years after the Crisis

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This article investigates the main factors in the recovery of the Mexican economy after the currency crisis of 1995. It finds that the V-shaped behavior of fixed investment growth is most important in explaining both the economic slowdown during the crisis and the strength of the subsequent recovery. Econometric results show that fixed investment growth fell precipitously in 1995 as a result of the sharp depreciation of the currency—both because of the negative income effect and because of the increase in economic volatility. But after this initial contractionary effect of the depreciation a substitution effect dominated that favored tradable output, which in Mexico has a larger multiplier effect on investment than does nontradable output. One policy implication that emerges from the analysis is that for countries like Mexico currency devaluation, despite its initial contractionary effect, appears to be a reasonable policy response to speculative attacks.

The Mexican economy contracted sharply after the peso devaluation of 22 December 1994, with GDP growth slowing to an annualized rate of −6.2 percent in 1995. Growth became positive again in the first quarter of 1996, and the economy grew at a healthy rate of 5.1 percent that year and 6.8 percent in 1997. Some authors have suggested that the decisive response of fiscal and monetary authorities, supported by the generous financial package announced by Mexican authorities on 9 March 1995, played a crucial role in the rapid recovery, restoring investor confidence, quickly stabilizing the currency, and turning investment and economic activity around.[1] And some claim that the lack of equally forceful responses and equally large financial support packages might explain why a quick recovery from the recent crises in Asia was more elusive.

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Annual World Bank Conference on Development Economics 2000

This assessment of the factors behind Mexico's rapid recovery in 1996–97 after the "tequila crisis" of 1995 aims to contribute to the current debate about appropriate responses to currency crises. We use a simple decomposition analysis to establish the contributions of components of aggregate demand to GDP growth since 1993. We examine the elements behind the increase in export growth during and after the tequila crisis and, using a standard model of investment behavior, the determinants of the growth of fixed investment. Finally, we look at the dynamic relationship between fixed investment and the real exchange rate, and investigate whether real exchange rate variations had short-term substitution effects on the composition of output growth.

Decomposition of Growth

A simple decomposition analysis shows that economic growth in Mexico recovered after the tequila crisis primarily as a result of the behavior of fixed investment. The fixed investment growth rate declined drastically during 1995, the year of the crisis, but subsequently rose above precrisis levels. The growth of exports (in constant pesos) seems to have prevented an even deeper recession in 1995, but its contribution to economic growth declined during the recovery.

The decomposition of GDP growth into the contributions of the components of aggregate demand comes from a transformation of the basic macroeconomic identity $Y = C + I + X - M$, where Y is output, C is the sum of private and public consumption, I is gross investment, X stands for exports, and M for imports. Calculating first differences for each element, dividing by the ex ante level of Y, and performing some simple manipulations makes it possible to decompose the growth of output into the contributions of the growth of each of its components:

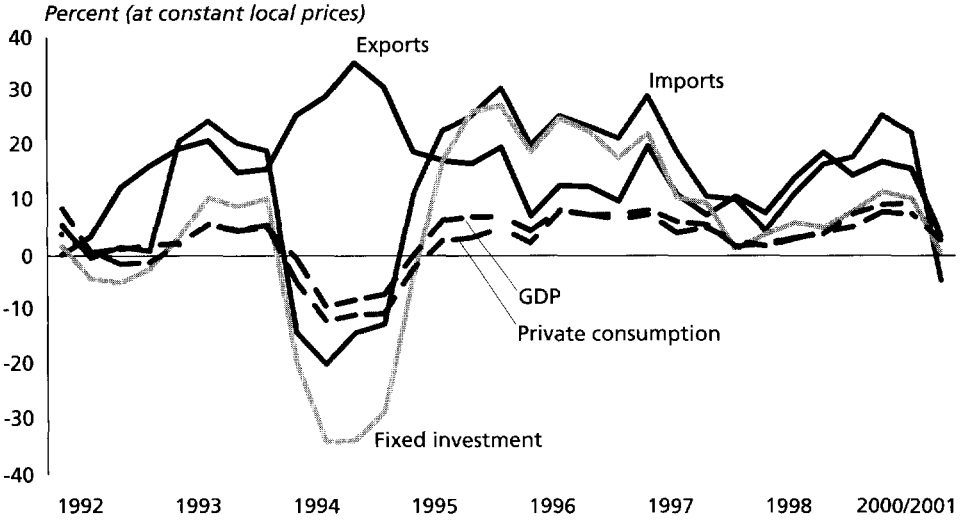
$$(1)\quad \Delta Y/Y_{t-1} = (C_{t-1}/Y_{t-1})(\Delta C/C_{t-1}) + (I_{t-1}/Y_{t-1})(\Delta I/I_{t-1}) + (X_{t-1}/Y_{t-1})(\Delta X/X_{t-1}) - (M_{t-1}/Y_{t-1})(\Delta M/M_{t-1}) .$$

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

In the precrisis period exports and imports were the most dynamic components of GDP (figure 1). Export growth rose gradually from a very low rate of 0.18 percent in the first quarter of 1993 to 20.97 percent in the second quarter of 1994. Import growth accelerated more dramatically, from 0.92 percent in the last quarter of 1993 to 24.60 percent in the second quarter of 1994. This sharp rise in the import growth rate reflects the effect of the real exchange rate appreciation that occurred before the devaluation at the end of 1994.

The tequila crisis was sparked by the announcement of a 15 percent nominal devaluation of the peso in December 1994. By March 1995 there was a 43 percent depreciation of the exchange rate. Between the last quarter of 1994 and the second quarter

Figure 1. Average Quarterly Growth of Components of Demand in Mexico, 1992–2000



Source: Authors' calculations; National Institute of Statistics, Geography, and Information (INEGI), Mexico.

of 1995 there was a rapid reversal in the import growth rate, from 19.17 percent to −19.81 percent. The import growth rate remained negative throughout 1995, even though liberal trade policies remained in place. In contrast, exports continued to grow.[2] These external sector responses to the crisis helped slow the decline of GDP.

By the first quarter of 1996, a year after the crisis began, Mexico's GDP growth rate once again became positive. During the recovery export growth slowed even though exports remained among the most dynamic components of demand. Between 1996 and the third quarter of 1999 export growth averaged 12.99 percent. Meanwhile, imports grew rapidly—by 18.43 percent—surpassing the average growth rates of all other components of demand.

Fixed investment was also dynamic—before, during, and after the tequila crisis. The behavior of fixed investment growth paralleled that of import growth, perhaps because Mexico imports more than 30 percent of its capital goods. During 1994, the year before the crisis, fixed investment growth accelerated from 3.50 percent in the first quarter to 10.43 percent in the last quarter. In 1995, during the crisis, the growth rate of fixed investment dropped more than that of any other component of demand, plummeting to around −30 percent. But fixed investment recovered quickly during the economic recovery, surpassing its precrisis growth rates. Between 1996 and the third quarter of 1999 its growth averaged 14.1 percent.

During the crisis there was a reversal in the contribution of imports to GDP growth. While in 1994 the rapid growth of imports slowed GDP growth to 4.45 percent (reducing it by 4.08 percentage points), in 1995 the slowdown in import growth helped limit the decline in GDP to 6.18 percent (reducing it by 3.35 per-

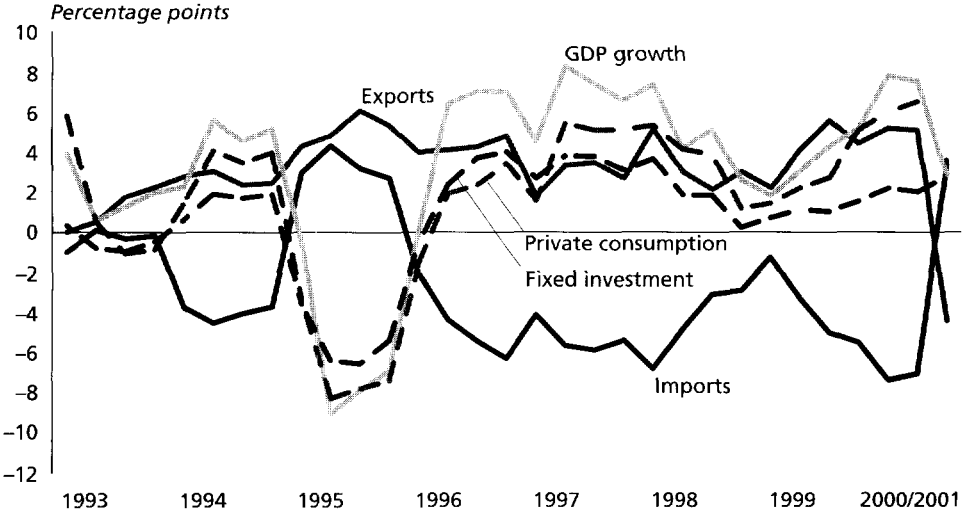
centage points; figure 2). During the recovery import growth rose, once again putting a brake on GDP growth. The contribution of export growth to GDP growth increased remarkably during the crisis, from 2.71 percentage points in 1994 (with GDP growth of 4.45 percent) to 5.19 percentage points in 1995 (with GDP growth of –6.18 percent). During the recovery the role of exports declined: between the first quarter of 1996 and the third quarter of 1999 export growth accounted for 3.42 percentage points of the average GDP growth of 5.13 percent.

In contrast, the contribution of fixed investment fell along with GDP growth in 1995. In that year the decline in fixed investment explained most (5.58 percent) of the 6.18 percent decline in GDP. By 1996 fixed investment had recovered sharply: in the fourth quarter of that year fixed investment growth explained about 60 percent of the GDP growth of 7.11 percent (4.07 percent). Fixed investment growth continued to be important during the postcrisis period, accounting for, on average, 2.27 percentage points of GDP growth, which averaged 5.13 percent.

Export Growth

The external sector has been a key element of the development policies and strategies of the past three Mexican governments. In 1985 the country began a process of trade liberalization by joining the General Agreement on Tariffs and Trade (GATT), the predecessor of the World Trade Organization. In 1991 Mexico entered into negotiations with Canada and the United States over the terms of the North American Free Trade

Figure 2. Average Quarterly Contribution of Growth in Components of Demand to GDP Growth in Mexico, 1992–2000



Note: GDP growth is given as the average quarterly percent change.
Source: Authors' calculations; National Institute of Statistics, Geography, and Information (INEGI), Mexico.

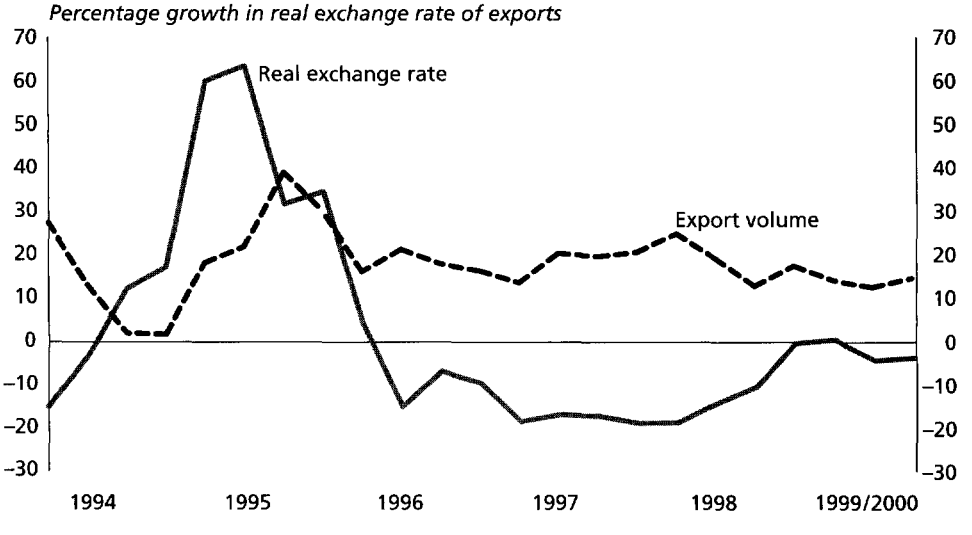
Agreement (NAFTA), which was officially implemented on 1 January 1994. By the onset of the tequila crisis most of the resulting trade reforms had been implemented, and none was reversed as a result of the crisis.[3] In this section we look at the role of export growth by analyzing changes in the volume of non-oil exports, measures of competitiveness, and the real exchange rate of Mexican exports (defined as the ratio of the unit price of exports in pesos divided by the Mexican consumer price index).

As figure 1 shows, the growth of exports (at constant local prices) increased during the tequila crisis, while the growth of imports declined—both tendencies that helped to cushion the fall in GDP in 1995. But this peak in the contribution of net exports to GDP growth was short-lived (see figure 2). After the crisis the contribution of imports diminished substantially, and that of exports also declined.

The rise in export revenue growth during the tequila crisis was not all due to changes in the relative price of exports valued in domestic currency, which could be considered a pure "accounting" effect.[4] It was also due to an increase in the growth of the volume of non-oil exports, which accelerated from 2 percent in the fourth quarter of 1994 to almost 40 percent in 1995 (figure 3). The growth in export volume slowed by the first quarter of 1996, when the economic recovery began, as the real exchange rate of exports began to appreciate. Nevertheless, export volume growth continued to be high, averaging 17.36 percent from the first quarter of 1996 to the third quarter of 1999.

What explains the increase in the growth of export volume? In 1993–99 unit labor costs in Mexican manufacturing fell steadily; before the crisis this occurred even as the real exchange rate was appreciating (figure 4). But the manufacturing remunera-

Figure 3. Average Quarterly Growth in Volume of Non-Oil Exports and Real Exchange Rate of Exports from Mexico, 1994–99



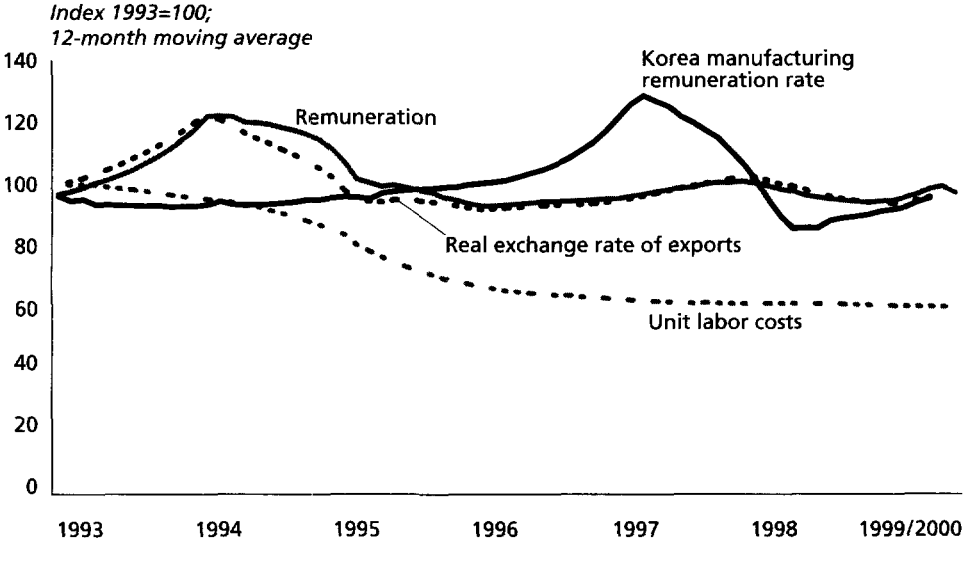
Note: Positive variations of the real exchange rate = depreciations.
Source: Authors' calculations; National Institute of Statistics, Geography, and Information (INEGI), Mexico.

tion rate in U.S. dollars rose before the crisis. This represented a loss in competitiveness for Mexican exports, associated with the appreciation of the real exchange rate of exports in the same period. In 1995, the year of the crisis, the remuneration rate fell 20 percent as the real exchange rate depreciated. In 1996 both indicators of international competitiveness returned to levels recorded in 1993. We can infer that the gain in competitiveness reflected in the depreciation of the real exchange rate and the decline of the remuneration rate was an important factor in the growth of the volume of non-oil exports in 1995.

In Korea during 1997, before the crisis, the remuneration rate in manufacturing in U.S. dollars increased by 30 percent. It fell through 1998, returning to its precrisis level by the end of 1999. Thus the Mexican and Korean remuneration rates behaved in remarkably similar ways—increasing before the onset of the crisis and returning to their precrisis level the year after the crisis. According to the remuneration indicator, Mexican exports lost competitiveness relative to Korean exports the year before and regained competitiveness the year after the tequila crisis. In 1996 the two countries had similar remuneration rates. By the end of that year Korean exports began to lose competitiveness relative to Mexican exports. By 1999 the countries once again had similar remuneration rates.

In sum, the increase in the growth of Mexican exports observed during and after the tequila crisis was probably driven by an increase in the volume of non-oil

Figure 4. Remuneration in U.S. Dollars and Unit Labor Costs in Manufacturing in Mexico, 1994–99



Note: Data refer to Mexico unless otherwise specified.
Source: Authors' calculations. For remuneration and unit labor costs, National Institute of Statistics, Geography, and Information (INEGI), Mexico. For real exchange rates, International Monetary Fund, various years, *International Financial Statistics.*

exports, which in turn was stimulated by a sustained reduction in unit labor costs and a transitory improvement (or correction) in the international competitiveness of Mexico's industrial sector. That increased competitiveness seems to have been associated with the real depreciation of the peso.

A Mexican Investment Function

The growth decomposition exercise indicates that fixed capital formation was at the heart of the economic recovery in Mexico after 1995. Evidence also suggests that investment in Mexico may be linked to the performance of the tradable sector (Krueger and Tornell 1999). Thus 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 the tradable and nontradable sectors (table 1 lists the variables and their sources), where we expect to find different sector multiplier effects:[5]

$$\frac{I}{GDP} = \bar{I} + Y_T^{m_T} + Y_{NT}^{m_{NT}} + I(RIR, p_K, \sigma_{RER}) \tag{2}$$

where *I/GDP* is the level of private fixed investment to GDP ratio at constant prices, $\bar{I}$ is a constant, minimum level of private fixed investment, and m is the multiplier of the corresponding sector: tradable (T) and nontradable (NT). The last term on the right-hand side of the equation 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 that we identify as the volatility of the real exchange rate (σ_{RER}). This simple model is broadly consistent with standard empirical models of investment behavior in developing countries (see Rama 1993), except for the assumption that tradable and nontradable output growth have different multiplier effects on investment.

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 important in explaining the fall in investment in Mexico during 1995 and even during the debt crisis of 1982–83. Moreover, the consideration of real exchange rate uncertainty is consistent with two plausible assumptions. First, domestic investors can be risk averse, so uncertainty may adversely affect private investment. Second, it is also possible that at least portions of private investment are irreversible and contribute to sunk costs. Under these circumstances macroeconomic uncertainty can be associated with swings in the value of private firms, hampering firms' productive investment (Pindyck 1988). If the tradable sector has a large multiplier effect on private investment, real exchange rate uncertainty could also have an indirect effect on investment through its effect on the output of tradables. As Maloney and Acevedo (1995) argue, uncertainty about the expected relative returns of producing for domestic and export markets will affect the composition of output.

Table 1. Variable Descriptions

Variable	*Mean*[a]	*Description*
Investment share (*I/GDP*)	0.007	Share of gross (total) fixed investment in total GDP at 1993 constant prices
GDP tradable goods	0.027	GDP of manufactures and agriculture at 1993 constant prices
GDP nontradable goods	0.018	GDP of construction, electricity, gas and water at 1993 constant prices
Relative price of capital goods	–0.026	Ratio of price index of capital goods over the consumer price index (1993 = 100)
Real interest rate (RIR)	0.004	$((1+i)\ (1-\pi)\text{^}4)-1$
Domestic nominal interest rate (*i*)		Money market rate (annualized quarterly). Period average
Inflation (π)		Rate of growth of quarterly CPI (1993 = 100; quarter on quarter
U.S. real interest rate	–0.002	$[(1+USi)\ (1-m)]-1$
U.S. nominal interest rates (USi)		Prime bank lending rate (annualized)
Rate of growth of the import unit value index (*m*)		Rate of growth of the import unit value index (average quarterly)
Real exchange rate (RER)	–0.001	Real effective exchange rate
Credit to the private sector	0.013	Credit to private sector by deposit money banks and other banking institutions.
Volatility of the real	0.030	Conditional variance of the Garch(1,1) of the *International Financial Statistics* quarterly real effective exchange rate.
U.S. gross domestic product	0.032	U.S. GDP in billions of chained 1996 dollars
Terms of trade	–0.034	Ratio of Mexico's export and import price indexes (1993=100)
1982 dummy crisis		Dummy variable designed to capture the effect of financial crisis in the Mexican economy. The periods selected correspond to the quarters for which there was a negative rate of growth (*y* on *y*). The 1982 crisis covers from 1982:3 to 1983:4, the 1995 crisis from 1995:1 to 1995:4.
1995 dummy crisis		
1982 and 1995 dummy crises		

a. Mean of the rate of growth for all the variables included in regressions, except U.S. and Mexican interest rates (nominal and real), which are in levels.
Note: The dependent variable is the ratio of growth rate of investment to GDP.
Source: National Institute of Statistics, Geography, and Information (INEGI), Mexico; International Monetary Fund, various years, *International Financial Statistics;* Economagic.com [http://www.economagic.com/]; HAVER-Emergela; authors' calculations.

If the output multipliers are constant over time, the investment function can be rewritten in terms of growth rates, or in differences of the logs, as follows:

$$g_{I/GDP} = m_T g_T + m_{NT} g_{NT} + g(RIR, g_{p_k}, \sigma_{RER} \tag{3}$$

where g denotes the growth rate of the corresponding variable. In this specification the multipliers are analogous to the income accelerators that are standard in empirical investment functions (Rama 1993; Servén 1998).

In a related paper we estimate the investment function described in equation 3 (Lederman and others 2001).[6] This investment function has as the dependent variable the growth of fixed investment to GDP ratio. The explanatory variables include the growth of tradable and nontradable output, the domestic real interest rate, real exchange rate volatility, variation in the relative price of capital, and the lagged dependent variable.

This basic model was expanded by adding dummy variables for the crises of 1982 and 1995, as well as a term that interacts each crisis with the domestic real interest rate. The aim is to determine whether there is any evidence of "confidence" effects

during crises. A confidence effect would be present in times when increases in interest rates are associated with increases in the growth rate of investment. This phenomenon can theoretically arise when high interest rates signal that the monetary authorities are willing to defend the value of the currency, thus protecting the net worth of firms with liabilities denominated in foreign currency.

Mexican Investment Function and "Confidence" Effects

Results are presented in the first column of table 2. According to the statistic for the *J*-test, the model is well instrumented: the instrumental variables are not correlated with the error term and we can therefore interpret the coefficients as being the impact of the explanatory variables on the dependent variable. In addition, the *Q*-statistics (reported for the first and fourth lags) show no sign of serial correlation and therefore support the model specification.

The results show that a 1 percentage point increase in the growth of tradable output "causes" a 0.96 percentage point increase in the growth of fixed investment to GDP ratio, while an equal increase in the growth of nontradable output would "cause" a 0.30 percentage point increase in the growth of fixed investment to GDP ratio. Thus the multiplier effect of the tradable sector on investment clearly surpasses that of the nontradable sector. Moreover, the *p*-value of the *F*-statistic for the null hypothesis that the two multipliers are equal is 0.01.

The volatility of the real exchange rate has a negative coefficient significant at 5 percent. This coefficient implies that an increase of 1 percent in the volatility growth rate "causes" a reduction of 0.02 percent in the growth of the investment share. Also, the domestic real interest rate has a negative coefficient significant at 5 percent. The estimated coefficient implies that a 1 percentage point increase in the real interest rate leads to a 0.06 percent decline in the growth of investment relative to GDP. The relative price of capital (that is, the ratio of the price index of capital goods over the consumer price index) is not significantly different from zero in this model specification.

The coefficient for the interacted 1982 crisis dummy shows a positive sign but is only significant at 15 percent. The coefficient implies that the overall effect of increases in the real interest rate was positive during this crisis. That is, there is only weak evidence of a confidence effect. The coefficient for the interacted 1995 crisis dummy shows a negative and significant sign. This suggests that there was no confidence effect during this second crisis.

The main conclusion is that we cannot reject the hypothesis of the presence of a structural break in the interest rate coefficient during the 1995 crisis. The coefficients for the 1982 interacted dummy crisis weakly support the existence of a confidence effect.[7] On the other hand, the 1995 interacted dummy crisis supports the opposite hypothesis, that in this case higher interest rates reduced even more the growth of the investment to GDP ratio.[8]

The model was also extended to explore whether the recovery of Mexican fixed investment growth was due to the financial links with the United States, as argued by Krueger and Tornell (1999), and whether there is an effect of credit availability on

Table 2. Determinants of the Growth Rate of Fixed Investment over GDP in Mexico, 1980–2000

Explanatory variables	*Regression 1: Basic model*	*Regression 2a: With credit rationing*	*Regression 2b For 1981–94 only*
Constant	–0.03 **	–0.02 **	0.07 **
	(0.01)	(0.01)	(0.01)
Lagged investment	0.35 **	0.34 **	0.26 **
	(0.04)	(0.03)	(0.08)
GDP nontradables	0.30 **	0.13	0.66 **
	(0.12)	(0.10)	(0.21)
GDP tradables	0.96 **	1.00 **	0.88 **
	(0.14)	(0.17)	(0.27)
Volatility real exchange rate	–0.02 **	–0.03 **	0.00
	(0.00)	(0.00)	(0.01)
Relative price of capital	0.04	0.09	–0.43 *
	(0.14)	(0.13)	(0.25)
Domestic real interest rate	–0.06 *	–0.09 **	–0.12 **
	(0.03)	(0.03)	(0.05)
Dummy for crises	–0.05 **	–0.08 **	0.04
	(0.02)	(0.02)	(0.05)
Crisis 1982*domestic real interest rate	0.13	0.13 *	0.46 **
	(0.09)	(0.07)	(0.15)
Crisis 1995*domestic real interest rate	–0.29 **	–0.22 **	
	(0.14)	(0.10)	
U.S. real interest rate		–0.00	
		(0.03)	
Credit to private sector		0.05 **	
		(0.01)	
Number of observations	70	70	50
Adjusted R2	0.88	0.84	0.87
R2 standard error of regression	0.04	0.05	0.05
Q-stat at lag 1, p-value	0.64	0.79	0.32
Q-stat at lag 4, p-value	0.51	0.34	0.22
Wald test, p-value	0.01	0.00	0.63
J-test, p-value	0.91	0.90	0.45

** Significant at 5 percent.
* Significant at 10 percent.
Note: The dependent variable is the growth of the ratio of the investment over GDP. Coefficients are from a regression using a generalized method of moments estimator. Variables are the year-on-year differences of their logs, except for the Mexican and U.S. real interest rates, which are in levels. For the first two columns, exogenous variables are U.S. real interest rates, U.S. GDP, terms of trade, four lags of endogenous variables, and seasonal dummy variables. The last column has the same exogenous variables but only two lags of endogenous variables.
Source: National Institute of Statistics, Geography, and Information (INEGI), Mexico.

the rate of growth of the investment share. More specifically, the model explores whether the hypothesis of credit rationing applies to the Mexican experience. Under credit rationing investment could be driven by credit availability for any level of real interest rates (Stiglitz and Weiss 1981). These two questions are explored further in the next section.

Mexican Investment Function and Market Imperfections

To test the hypothesis of credit rationing, we include as an explanatory variable the amount of credit provided to the private sector by financial and nonfinancial

institutions. This variable controls for the quantity of credit but could also reflect variations in supply or demand. To test the Krueger and Tornell effect of financial links between Mexico and the United States we include the U.S. real interest rate.

The results are in the second column of table 2. This model passes the specification tests. The domestic interest rate retains its significant and negative sign even after controlling for credit availability and the U.S. real interest rate. The coefficient for credit to the private sector is also significant and implies that an increase of 1 percent in the growth rate of private credit leads to an increase of 0.05 percent in the growth of the fixed investment share. These results provide evidence of rationing: for a given real interest rate, an increase in credit leads to an increase in the growth of investment to GDP ratio.

As we mentioned above, the domestic real interest rate maintains its significance even after controlling for the U.S. real interest rate (that is, the prime lending rate deflated by the inflation of U.S. import prices). The results show that even though the coefficient for the U.S. real interest rate is negative, it is significant only at 14 percent. Thus there is only weak evidence that access to the U.S. financial market by Mexico's firms operating in the tradable sector was a key feature of the Mexican growth of investment to GDP ratio.

Regarding the other explanatory variables, the multiplier from the tradable sector remains significantly higher than that of the nontradable sector, and the volatility of the real exchange rate presents negative coefficients significantly different from zero. The relative price of capital, on the other hand, has a positive coefficient but is not significant. The coefficient for the interacted term of interest rates with the 1982–83 dummy crisis becomes significant in this specification at 10 percent, thus strengthening the hypothesis that there was a confidence effect during this crisis.

Forecasting the Tequila Crisis and Its Aftermath

The aim of this section is to evaluate the stability of the basic model used to test the existence of a confidence effect by looking at the results for the same regression estimated only for 1981–94. We were unable to test the complete model reported in the second column of table 2 for this sample because of the reduced number of observations. The results are presented in the third column of table 2. This model uses a reduced number of instrumental variables also because of a reduced sample size. Some differences between this and the full sample results: the coefficient for relative price of capital as well as the coefficient for the interacted 1982–83 crisis dummy have the expected sign and are significantly different from zero. Interestingly, the estimated negative coefficient of the real interest rate is larger than the one reported in the first column for results with the full sample. Real exchange rate volatility is not significant and neither is the mean-shifter dummy for the 1982–83 crisis. All the other coefficients retain their expected signs. This specification passes the test for serial correlation and the *J*-test shows that the instrumental variables are not correlated with the error term. The Wald test shows that the coefficient for tradables is not statistically different from that of nontrad-

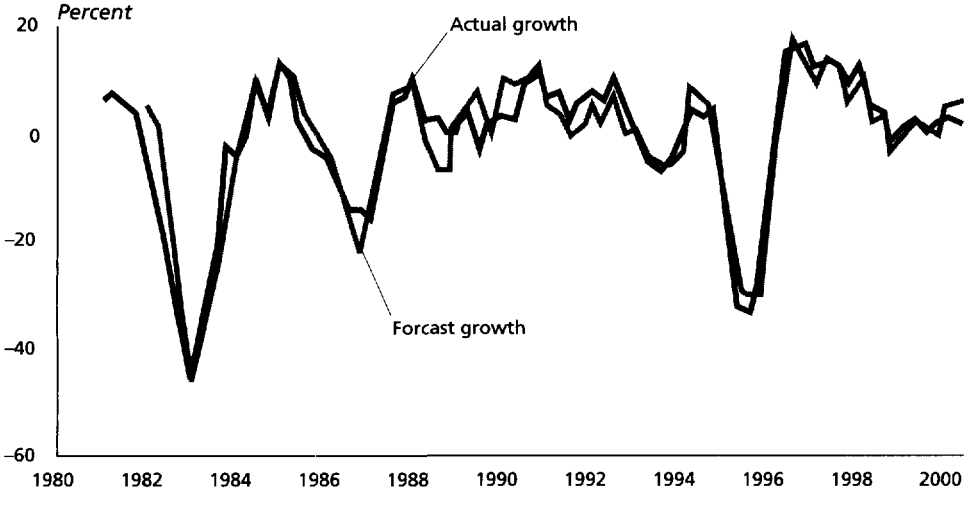
ables for this shorter time period. Hence we conclude that the higher tradables multiplier was present mostly after 1994.

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 5 presents the forecasted and actual values for the year-on-year growth rate of Mexican fixed investment to GDP ratio. This figure shows that this naïve model quite successfully explains the behavior of Mexican fixed investment. The Theil inequality coefficient comparing the forecast with the actual observations is very low—0.16 (zero indicates a perfect fit). More important, 99 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.

Contributions of Explanatory Variables to the Growth of Investment Share

Table 3 shows the contributions of the growth rate of all the significant explanatory variables to the growth rate of investment to GDP ratio during 1995–2000. This exercise is based on the coefficients presented in the second column of table 2 and the growth of the exogenous component of each explanatory variable. The exogenous component of each explanatory variable was derived from the fitted value of each explanatory variable after regressing each one of them on the entire set of instrumental (contemporaneously exogenous) variables used for the generalized method of moments regressions. Adjusted R squares reported in the table show that the fitted vari-

Figure 5. Out-of-Sample Forecast of the Recovery of Mexican Investment Growth, 1980–2000



Source: Authors' calculations; National Institute of Statistics, Geography, and Information (INEGI), Mexico; International Monetary Fund, various years, *International Financial Statistics.*

ables are good predictors of the explanatory variables. This estimation strategy avoids the problem of endogeneity of the explanatory variables in the simulation exercise.

In 1995 the fixed investment to GDP ratio dropped by 28 percent. The contribution of tradables was –1.7 percent while the contribution of nontradables was –2.0 percent. Note that even though the accelerator effect for tradables is bigger than for nontradables, the contribution of tradables to the fall of the growth of investment to GDP ratio was smaller. The reason behind this smaller negative effect of tradables can be explained by the considerable increase of exports during this crisis. An important 6.3 percent of the fall was due to the effect of real exchange rate volatility, while other variables had minor effects.[9] In 1996 the fixed investment to GDP ratio increased by 9.9 percent. About 6 percent of this growth was due to the reduction in the volatility of the real exchange rate; 7.3 percent to the contribution of tradables; 1 percent to the contribution of nontradables; and 2 percent to credit availability. The relative importance of the contribution of tradables is maintained during 1997–2000. The contribution of real exchange rate volatility was around 1.3 percent (in absolute values), which is not negligible, especially for the observed growth of investment to GDP ratio in the past couple years (3 percent average between 1998–2000), and the contribution of credit availability and domestic interest rates were also important. In contrast, the contribution of variations in the U.S. real interest rates seem to have been quite modest during the past five years.[10]

What Was the Dynamic Short-Term Relationship between the Real Exchange Rate and Investment Growth?

Our earlier model does not examine the direct relationship between the real exchange rate and fixed investment growth, because the real exchange rate is

Table 3. Contributions of Selected Variables to the Growth of the Ratio of Fixed Investment to GDP in Mexico, 1995–2000
(percent)

Variable	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*
Growth of share of fixed investment in GDP	–28.0	9.9	12.6	5.4	2.0	3.0
Contribution of nontradables	–2.0	1.0	0.9	0.3	0.5	0.9
Adjusted R^2 = 0.80	(–15.3)	(7.6)	(6.9)	(2.4)	(3.6)	(6.9)
Contribution of tradables	–1.7	7.3	7.1	5.3	4.5	6.8
Adjusted R^2 = 0.75	(–1.7)	(7.3)	(7.1)	(5.3)	(4.5)	(6.8)
Contribution real exchange rate volatility	–6.3	6.3	1.5	–1.6	1.4	–0.5
Adjusted R^2 = 0.80	(211.4)	(–210.9)	(–51.1)	(54.3)	(–47.1)	(16.2)
Contribution of domestic real interest rate	–0.6	0.1	–0.2	–1.0	–1.4	–0.5
Adjusted R^2 = 0.76	(1.8)	(–0.6)	(2.4)	(10.8)	(15.4)	(5.0)
Contribution of U.S. real interest rate (exogenous variable)	0.0 (6.3)	0.0 (6.5)	0.1 (13.2)	0.1 (15.6)	0.0 (2.5)	–0.0 (–4.9)
Contribution of credit	–0.7	–2.0	0.6	0.5	–0.4	–0.8
Adjusted R^2 = 0.93	(–14.0)	(–40.0)	(1.2)	(10.5)	(–7.9)	(–16.2)

Note: The numbers in parentheses are the growth rates of the exogenous component. The contributions are calculated as the estimated coefficient (from the second column of table 2) times the growth rate of the exogenous component of each variable. The adjusted R^2 corresponds to the regression of each explanatory variable on the set of instruments used in the generalized method of moments estimation.
Source: National Institute of Statistics, Geography, and Information (INEGI), Mexico.

expected to affect investment only indirectly, through its effects on the relative price of capital, the composition of output, and economic volatility. Here we use the impulse response function derived from vector autoregressions to study the relationship between fixed investment growth and the real exchange rate.

We ran a vector autoregression with the growth rates of fixed investment, the relative price of capital, and the real exchange rate as endogenous variables. The choice of these variables was inspired by evidence for Mexico that the relative price of capital may be an important channel through which variation in the real exchange rate (and its determinants, such as terms of trade) affect domestic investment (Warner 1994), although our previous results do not support this conclusion.[11] We also included the following exogenous variables likely to affect the three endogenous variables: the growth of U.S. GDP, variation in public consumption, variation in the terms of trade, the U.S. real prime lending rate, dummy variables for openness and NAFTA, and a constant.

The corresponding impulse response function assumes that the real exchange rate is more exogenous than the relative price of capital, which is assumed to be more exogenous than fixed investment. Twelve lags of the endogenous variables were included in the vector autoregression, because the Akaike, Schwartz, and log likelihood tests all indicated that this was the best distributed lag specification when compared with one, four, and eight lags. The impulse response function illustrates the effect on investment growth of a one standard deviation innovation in the real exchange rate. The results show that the response of investment growth to an appreciation of the real exchange rate is positive at first but becomes negative and significant during the second year, after about five quarters (figure 6).[12]

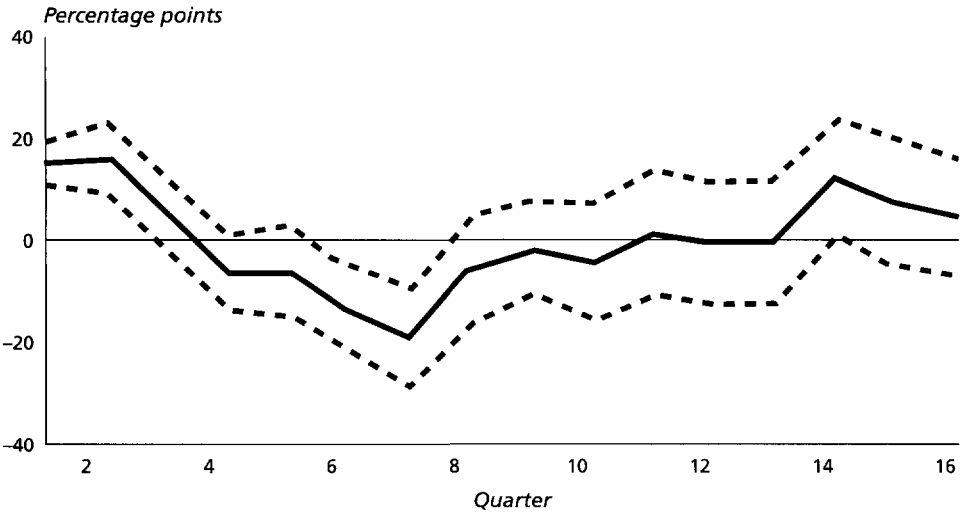
The finding that an appreciation of the real exchange rate in Mexico is associated with economic expansion in the short run is consistent with the conclusions of other recent empirical studies. Kamin and Rogers (1998), for example, also find that appreciation has a positive effect on output—and depreciation a negative effect. But they argue that there are multiple channels through which this effect takes place, including its impact 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 becomes negative. A plausible interpretation of these dynamic effects is that 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 result of the real appreciation of the currency.

Did Real Exchange Rate Variation Have Short-Term Substitution Effects?

Based on pairwise vector autoregressions, the impulse response functions presented in figure 7 look at the effect of the real exchange rate on the relative growth of the

Figure 6. Response of Fixed Investment to a One Standard Deviation Innovation in the Real Exchange Rate

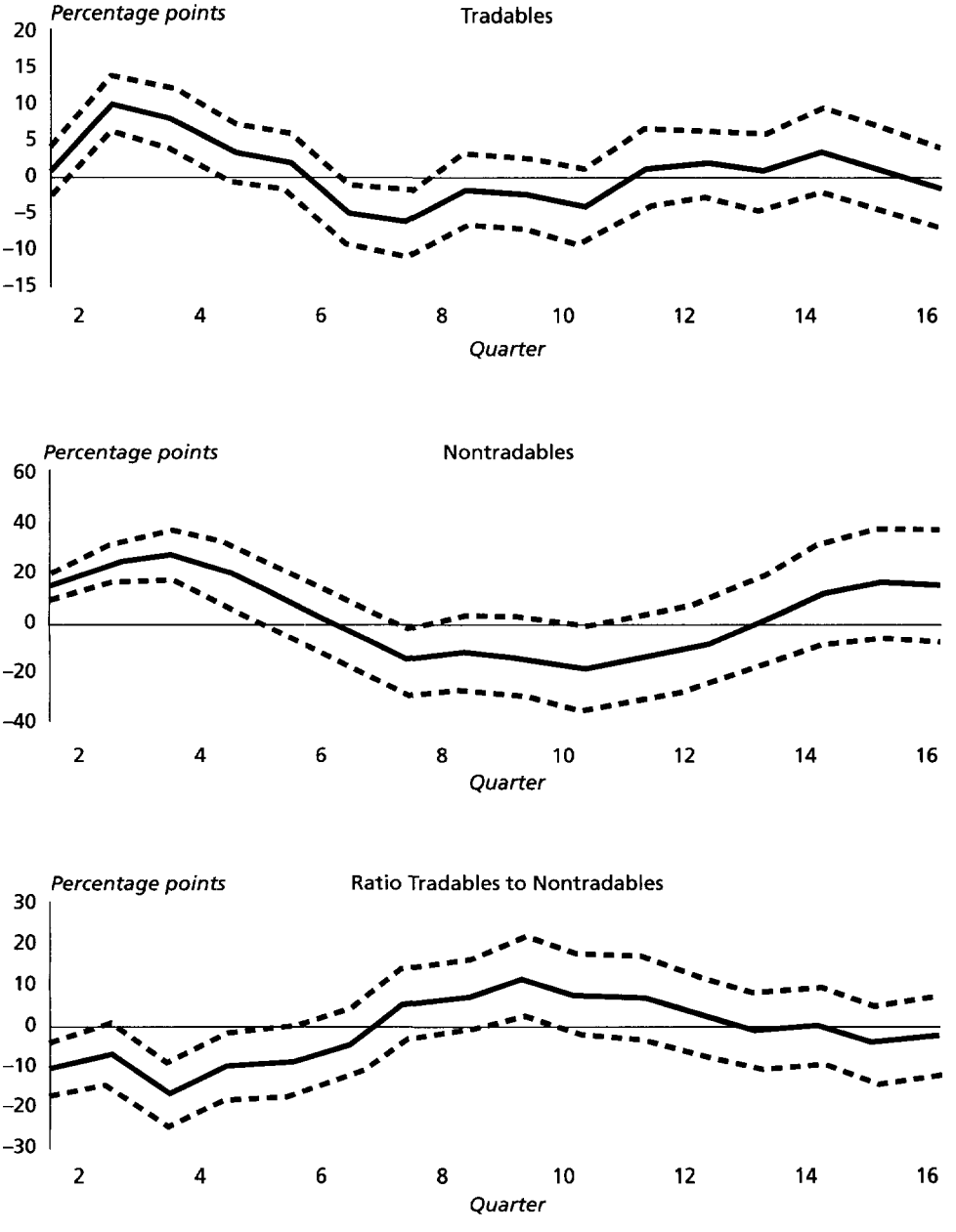


Note: Variables are in the year-on-year differences of the logs. The vector autoregression includes as endogenous variables the real exchange rate, relative price of capital, and fixed investment. The exogenous variables are U.S. GDP, the U.S. real interest rate, public consumption, dummy variables for openness and Nafta, terms of trade, and a constant.
Source: Authors' calculations; National Institute of Statistics, Geography, and Information (INEGI), Mexico; International Monetary Fund, various years, *International Financial Statistics.*

tradable and nontradable sectors. The model was estimated with 1, 4, 8, and 12 lags, but the figure shows the impulse response functions based on the lag specification supported by the Akaike criterion. The endogenous variables are the real exchange rate and the growth rate of tradables, of nontradables, or of the ratio of tradables to nontradables; the real exchange rate is the more exogenous. The exogenous variables are U.S. GDP, the U.S. real interest rate, public consumption, terms of trade (all the variables are the first difference of their logs), and dummy variables for openness and NAFTA .

The first two impulse response functions show that real exchange rate appreciation tends to raise the growth rate in the tradable and nontradable sectors in the short run, an effect lasting a few quarters. This effect is larger for the nontradable sector.[13] The third impulse response function provides evidence that real exchange rate variation has significant substitution effects: an appreciation slows the growth in the ratio of tradables to nontradables. This effect is also clear from figure 8, which shows the growth in the ratio of tradable to nontradable output accelerating after the depreciations during the debt and tequila crises. In other words, while real exchange rate depreciation tends to have a short-run negative income effect associated with a decline in the growth rates of tradable and nontradable output, this effect is larger for nontradables. We interpret this difference in the size of the effect as evidence of a temporary substitution effect. And this effect implies a permanent change in the composition of Mexican output in favor of tradables.

Figure 7. Response of Growth in Tradables, Nontradables, and the Ratio of Tradables to Nontradables in Mexico to a One Standard Deviation Innovation in the Real Exchange Rate



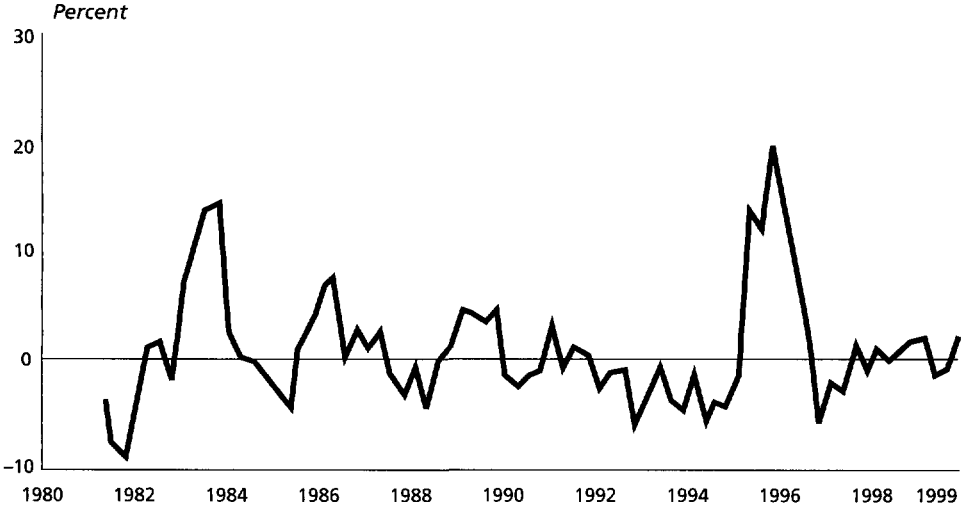
Note: Variables are in the year-on-year differences of the logs. The exogenous variables are U.S. GDP, the U.S. real interest rate, public consumption, dummy variables for openness and Nafta, terms of trade, and a constant.
Source: Authors' calculations; National Institute of Statistics, Geography, and Information (INEGI), Mexico; International Monetary Fund, various years, *International Financial Statistics.*

Conclusion

Since the eruption of the Mexican tequila crisis of 1995 and the Asian crises of 1997, much has been written about what causes financial crises in developing countries. Much less attention has been given to what happens in the productive economy after these crises.[14] This analysis has identified the main macroeconomic factors behind the recovery of the Mexican economy following the 1995 crisis:

- An increase in export growth and a decline in import growth during the crisis played a crucial role in cushioning the fall in GDP. During the recovery import growth rose, slowing GDP growth, and export growth, though still important, contributed less to GDP growth than during the crisis.
- Export revenues (in constant pesos) grew more rapidly during and after the crisis. The rise in growth was not all due to the "accounting" effect of the real exchange rate. It was also due to the acceleration in the growth of the volume of non-oil exports in this period. The competitiveness of the tradable sector improved: as the real exchange rate depreciated, the manufacturing remuneration rate in U.S. dollars fell, remaining at that low level during 1995–99. Since 1994 unit labor costs have also tended to fall, even when the real exchange rate appreciated.
- Fixed investment growth plummeted during the crisis but recovered sharply in 1996, reaching rates higher than those during the precrisis period. The contribution of fixed investment was thus critical in the postcrisis period.

Figure 8. Average Quarterly Growth in the Ratio of Tradable to Nontradable Output in Mexico, 1980–99



Source: Authors' calculations; National Institute of Statistics, Geography, and Information (INEGI), Mexico; International Monetary Fund, various years, *International Financial Statistics.*

- A basic investment model, differing from the standard model only by the assumption that tradable and nontradable output growth have different multiplier effects on investment, does quite well in predicting the recovery of investment in 1996–2000.
- The model for the whole period finds that the tradable sector has a larger multiplier effect than the nontradable sector. Real exchange rate uncertainty was also a significant determinant of fixed investment.
- Both the amount of credit and the real interest rate seem to be important determinants of the growth of fixed investment to GDP ratio. These results provide evidence of rationing: for a given real interest rate, an increase in credit leads to an increase in the growth of investment to GDP ratio.The impact of real exchange rate variation on fixed investment was initially dominated by income effects, but substitution effects were also present, with real exchange rate depreciation producing a larger decline in the growth of nontradable output than in that of tradable output. Thus the real exchange rate depreciation in 1995 had a negative income effect associated with a decline in the growth of tradable and nontradable output in the short run. But because of the substitution effect the decline was larger for nontradables, and the growth of tradables relative to nontradables accelerated after the depreciation.

From these findings emerge several important empirical conclusions: The decline and subsequent rise in GDP growth were primarily due to the behavior of fixed investment. Fixed investment growth was negative during the crisis because the short-lived hike in interest rates did not positively affect investment—there was no confidence effect. Also, investment declined because of the negative effect of higher volatility in the real exchange rate. The real depreciation also had a negative income effect that influenced investment decisions. The recovery of fixed investment observed during the year after the crisis was linked to the substitution effect of the real depreciation in favor of the tradable sector. In turn, the growth in the tradable sector, with its relatively large multiplier effect, drove the recovery of investment. Indeed, the real depreciation produced a notable improvement in the competitiveness of Mexican manufactures, reflected in the increase in the growth of the volume of non-oil exports. This may explain why growth in tradables declined less than growth in nontradables in 1995.

The findings also point to a policy implication: 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 a downturn in investment. But depreciation of the currency can have adverse consequences for investment in the short run as a result of its effects on economic uncertainty and its negative income effect. In the medium term, however, a real depreciation is healthy because it stimulates growth in exports and increases the share of output from the tradable sector, which then has a large multiplier effect on investment. At the very least, we have shown that the Mexican currency crisis of 1995 is not a case in which high real interest rates benefited the economy.

Notes

1. For example, an IMF report (1996) states 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" (p. 25).

2. Krueger and Tornell (1999) suggest that the increase in export growth was facilitated by previous structural economic reforms, such as privatization, deregulation, removal of trade barriers, and the entry into the North American Free Trade Agreement (NAFTA).

3. Any increase in trade barriers to diminish negative short-term growth effects during the crisis would have negatively affected Mexico's partnership in NAFTA.

4. The rate of change in export revenues measured at constant local prices can be decomposed into a relative price or "accounting" effect and a volume effect: $\dot{x} = R\dot{E}R + \dot{Q}_X$. The accounting effect refers to the fact that a real depreciation raises the value of exports in domestic currency relative to the general consumer price level.

5. See section II in Lederman and others (2001) for a model of optimal investment rules that gives theoretical grounds for this assumption. In brief, $m_T > m_{NT}$ because of the higher capital intensity of production in the tradable sector.

6. We refer to the main findings of Lederman and others (2001) where appropriate. The empirical analyses in that paper rely on publicly available data, primarily from the Mexican statistical agency (INEGI) and the International Monetary Fund. The data have a quarterly frequency and cover the period from 1980 through the second quarter of 2000. The econometric models were estimated using the generalized method of moments estimator, which controls for the joint endogeneity of the explanatory variables.

7. However, we acknowledge that this break may be due to other effects that are not really "confidence" effects. For example, the banking system was nationalized during that time, and the change in the coefficient's sign during that crisis may be due to interest-rate controls.

8. We also acknowledge that we cannot test for "confidence" effects with a duration of less than one quarter, given the frequency of the available data.

9. The sum of the contributions from all the variables reported does not equal the growth of fixed investment because there are other (omitted) determinants of investment.

10. The table does not include contributions of relative price of capital because this variable was statistically zero in this model.

11. The real exchange rate used here is the International Monetary Fund's real effective exchange rate.

12. Among the exogenous variables, the growth of U.S. GDP has a positive and significant coefficient (6.2; t-statistic of 2.4). The U.S. real interest rate is also significant (–0.4; t-statistic of –2.6).

13. Among the exogenous variables, only the terms of trade has a significant coefficient in the regression for the growth of tradable output. The U.S. GDP growth rate has a positive coefficient (0.8), but its t-statistic is low (1.4). None of the exogenous variables was a significant determinant of nontradable output growth.

14. See Perry and Lederman (1999) for a comparison of the aftermath of the Latin American and Asian crises in the 1990s.

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