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ABSTRACT

Chile and Mexico experienced severe economic crises in the early 1980s. This paper analyzes four possible explanations for why Chile recovered much faster than did Mexico. Comparing data from the two countries allows us to rule out a monetarist explanation, an explanation based on falls in real wages and real exchange rates, and a debt overhang explanation. Using growth accounting, a calibrated growth model, and economic theory, we conclude that the crucial difference between the two countries was the earlier policy reforms in Chile that generated faster productivity growth. The most crucial of these reforms were in banking and bankruptcy procedures.

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1. INTRODUCTION

Chile and Mexico, like most of the other countries in Latin America, experienced severe economic crises in the early 1980s that led to large drops in output. The paths of recovery from these crises differed markedly. Figure 1 shows that output per working-age (15-64) person[1] in Chile returned to trend within a decade and since then has grown even faster than trend.[2] In contrast, output in Mexico never fully recovered and even two decades later is still 30 percent below trend. For Mexico, like much of the rest of Latin America, the 1980s were a "lost decade" — while for Chile they were a decade in which the economy began to grow spectacularly.

This paper analyzes four possible explanations for the different paths of recovery in the two countries:

The first explanation is the standard monetarist story that, short of inducing a hyperinflation, the more rapidly a country in a severe recession expands its money supply, the faster it will recover. Although this story is not often proposed for the cases of Mexico and Chile, we examine it because it probably is the most common story for both the severity of and the slow recovery from depressions like that of the 1930s in the United States.

The second explanation is Corbo and Fischer's (1994) story for rapid recovery. After the crisis, the Chilean government reversed its previous policy of wage indexation and allowed real wages to fall sharply. Corbo and Fischer argue that this policy, together with policies that produced a rapid depreciation of the real exchange rate, fueled an export boom that was the principal cause of the rapid recovery.

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[1] Throughout we focus on output per working-age person — which is appropriate for our growth accounting and our model — rather than output per capita — which is not appropriate. Since both Mexico and Chile went through demographic transitions during 1960-2000 in which population growth rates fell sharply, the percentage of working-age persons in the total population changed, and these two measures of output do not move proportionately.

[2] To detrend the GDP data in figure 1, we use a common, 2 percent growth rate, which comes close to matching both Mexico's and Chile's average annual growth rates over our entire sample, 1960-2000.

The third explanation is Sachs's (1989) story for Mexico's slow recovery. Sachs argues that Mexico's large external debt led new investors to fear that most of the returns on any new investment would be taxed to pay off old loans. Hence, new investors were discouraged from investing, and both investment and output remained low.

The fourth explanation is a story based on the timing of structural reforms. Chile had undertaken a series of structural reforms in the 1970s that set the stage for the successful performance of the 1980s. In contrast, Mexico undertook these reforms only in the mid-1980s or later. We examine reforms in a number of areas: trade policy, fiscal policy, privatization, banking, and bankruptcy laws.

For each explanation we ask: Can it explain the different paths of recoveries in Chile and Mexico? We find that, although each of the first three explanations has some merit, none can account for the different paths of recovery: The standard monetarist story implies that Chile should have recovered more slowly than Mexico. The real wages and real exchange rate depreciation story implies that exports should have boomed even more in Mexico than in Chile — and they did — but Mexico stagnated while Chile grew. The debt overhang story implies that Chile should have stagnated even more than Mexico.

A comparison of data from Chile and Mexico allows us to rule out only one part of the structural reforms story — trade reforms. The timing of reforms is crucial if they are to drive the differences in economic performance of the two countries. During the decade following the crisis, Mexico's trade grew faster than Chile's, partly because Mexico was engaged in vigorous trade reform while Chile had already done so (and, in fact, backtracked until the early 1990s). By the mid-1990s, Mexico was just as open as Chile.

To shed light on the ability of the other reforms to account for the different paths, we turn to a growth accounting exercise. We ask: Were the differences in recoveries due mostly to differences in paths for factor inputs, like capital and labor, or were they due to differences in productivity? We find that nearly all of the differences in the recoveries resulted from different paths of productivity.

From our growth accounting exercise, we conclude that the only reforms that are promising as explanations are those that economic theory dictates would show up primarily as differences in productivity, not those that would show up as differences in factor inputs. We use this implication to rule out fiscal reforms. These reforms primarily affect the incentives to accumulate capital and to work, not productivity. Moreover, the timing is not right for the fiscal reforms explanation: both countries reformed their tax systems by the mid-1980s, so these cannot account for the different paths.

We do find that fiscal reforms are important in explaining some features of the recoveries, just not the differences. In particular, when we use a calibrated growth model to quantitatively account for the recovery paths for Chile and Mexico, we find that a numerical experiment that incorporates the different paths for productivity but leaves out the fiscal reforms misses badly. In the same model, however, a numerical experiment that keeps the different paths for productivity and adds an identical fiscal reform in both countries fares much better.

Our analysis suggests that it is differences in the timing of reforms in the other three areas — privatization, banking, and bankruptcy laws — that can account for the differences in economic performance between the two countries. Once again, however, the matter of timing is crucial: reforms in privatization were probably less important than those in banking and bankruptcy law precisely because Chile had already reaped the benefits of these reforms while Mexico was doing so during the period in which Mexico was stagnating and Chile was growing. The crucial differences between Mexico and Chile were in banking and bankruptcy laws: Chile was willing to pay the costs of reforming its banking system and of letting inefficient firms go bankrupt; Mexico was not. This is not to say that the reforms in Mexican trade policy, fiscal policy, and privatization were not important. The long period of crisis and stagnation that afflicted Mexico from 1982 through 1995 would have been far worse without them.

Two good general references for Mexico during the 1980s and 1990s are Aspe (1993) and Lustig (1998); good general references for Chile are Bosworth, Dornbusch, and Labán (1994), Corbo (1985), and Edwards and Edwards (1991). Edwards (1996) provides an interesting comparison of the 1981-1983 crisis in Chile with the 1994-1995 crisis in Mexico.

2. DIFFERENT REACTIONS TO SIMILAR INITIAL CONDITIONS

What is striking about the economic performances of Mexico and Chile depicted in Figure 1 is not so much the initial downturn in the early 1980s, but the markedly different paths of recovery from these crises. In Chile, output returned to trend within a decade and since then has grown even faster than trend. In Mexico, output never recovered and after almost two decades, in 2000, it was still more than 30 percent below trend.

Figure 1 uses indices of real GDP and is useful when thinking about movements in output relative to a base year. It is not useful in comparing levels of GDPs across countries. To do that, Figure 2 plots levels of real GDP per working-age person in common units of 1985 dollars using purchasing power parity adjustments. (Appendix A provides descriptions and sources for the data used in this paper.) As the figure makes clear, in 1980 Mexico had a level of average income almost twice that of Chile. Over the next two decades Chile erased this gap.

In the early 1980s, both countries faced fairly similar conditions, at least on the macroeconomic level: Both countries had sizeable foreign debts, appreciating real exchange rates, large current account deficits, and weaknesses in the banking sector. Both countries were also hit by similar external shocks. These shocks consisted of a jump in world interest rates, plummeting prices of their primary exports, and a cutoff of foreign lending.

Some simple data provide a feel for the initial conditions: Like many developing countries, Mexico and Chile took advantage of low world interest rates in the late 1970s to build up large levels of foreign debt. Total external debt in Mexico in 1982, which had grown by 140 percent in U.S. dollars since 1978, was 53 percent of GDP. In Chile, total external debt had grown by 134 percent in U.S. dollars since 1978 and was 71 percent of GDP. The real exchange rate against the U.S. dollar — and the United States was by far both Mexico's and Chile's largest trading partner – had appreciated by 27 percent in Mexico between 1978 and 1981 and by 26 percent in Chile. The current account deficit in Mexico in 1981 was 5.8 percent of GDP, while in Chile it reached 14.5 percent. By the end of 1982, foreigners stopped financing new capital inflows, and the current account deficits disappeared. The banking sectors in Mexico and Chile were so vulnerable to the shocks that buffeted their economies that, in each case, the government found it necessary to take over private banks: In Mexico the government nationalized all the banks, and in Chile the government took over distressed banks and nonbank financial institutions (*financieras*) that held more than 55 percent of the assets in the financial sector.

The following data provide a feel for the magnitude of the shocks: Loans to Mexico and Chile were offered at a spread over the London Inter Bank Offer Rate (LIBOR).

Between 1978 and 1981, in response to contractionary U.S. monetary policy, the three-month U.S. dollar LIBOR jumped from 8.8 percent to 16.8 percent per year. In the early 1980s, Mexico was heavily dependent on its exports of crude petroleum, which accounted for 52 percent of total exports in 1980. Chile was similarly heavily dependent on its exports of copper, which accounted for 48 percent of its total exports in 1980. Figure 3 plots the prices of crude petroleum and copper relative to the U.S. Producer Price Index. The relative price of crude petroleum fell 21 percent from 1980 to 1982, while that of copper fell 39 percent. By the end of 1982, following Mexico's default, essentially no new private foreign loans were granted to Mexico or Chile until the end of the decade: although Mexico's total external debt increased by 25 percent in U.S. dollars between 1981 and 1987 and Chile's increased by 23 percent, almost all of the increases can be accounted for by loans from the International Monetary Fund and, in the case of Mexico, accumulation of unpaid interest.

3. DIFFERENT STORIES FOR DIFFERENT RECOVERIES

Despite the similarities in their initial conditions, Mexico and Chile experienced very different recoveries from their crises. In this section, we consider four potential explanations for these different recoveries. Comparing the case of Mexico with that of Chile allows us to rule out three of these explanations: although a story may have some merit when applied to one of the countries in isolation, we rule it out if it is incapable of explaining the differences between the experiences of the two countries.

Standard Monetarist Story

Crudely stated, the standard monetarist story is that, short of inducing a hyperinflation, the more rapidly a country in a severe recession expands its money supply, the faster it recovers. We include this story, not because it has been proposed as a serious explanation of these episodes, but rather because it is probably the most common story for recovery from crisis. Even though we have oversimplified the story, the basic theme can be found in Friedman and Schwartz's (1963) analysis of the Great Depression in the United States and is pervasive in the literature (see, for example, Lucas (2001)).

In Table I , we consider some simple statistics for 1983-1987, the crucial period in which Chile began to recover while Mexico was still mired in crisis. We see that the annual growth rate of the money supply was substantially higher in Mexico than in Chile. This higher growth of money was associated with a faster growth of prices in Mexico than in Chile. It does not show up, however, in a faster growth of output for Mexico. Indeed, output per working-age person contracted in Mexico while it grew in Chile. Of course, even the most avid proponents of the monetarist story do not claim that monetary forces can account for a decade of growth. Nevertheless, it is interesting that these forces seem incapable of explaining even a single year or two of the path of output following the crisis.

Table I

Annual growth rates of output, money, and prices

1983-1987

	Mexico	**Chile**
GDP per working-age person	-2.20	3.27
money (M1)	66.45	22.39
prices (CPI)	83.24	27.05

While the monetary story seems unable to account for the different paths of recovery, part of the downturn may well be associated with monetary factors. The jump in world interest rates that adversely affected Mexico and Chile was clearly associated with a monetary contraction in the United States. Moreover, in a failed effort to defend its nominal exchange rate, Chile contracted its money supply during the first three quarters of 1982, and this policy may have deepened and prolonged its crisis. Of course, this argument begs the question of why Chile recovered so rapidly while Mexico, which had no contraction, did not.

Although we have treated the monetarist story in a superficial manner, at first blush it does not seem to be a promising route to follow. More generally, in most Latin American countries, high inflation is often associated with large drops in output, not with substantial recoveries. It may be that this pattern for Latin America is quite different from the patterns in the United States and Europe in which large drops in output are associated with deflations, not inflations. If so, this is an area that warrants further study.

Real Wages and Real Exchange Rate Depreciation Story

In an influential article, Corbo and Fischer (1994) argue that one of the principal causes of Chile's crisis in the early 1980s was the government's policy of fixing the nominal exchange rate for the four years before the crisis, while at the same time mandating that wages be adjusted at least one-for-one with past inflation. Given the high inflation the country had already experienced, these policies led to a continuation of past inflation, an appreciation of the real exchange rate, and a sharp increase in real wages. After the crisis, the government reversed its position. It undid its wage indexation policies and allowed the real exchange rate to depreciate. Figure 4 shows that real wages in manufacturing declined by 15 percent in the two years after 1982. Furthermore, as shown in Figure 5, between 1982 and 1987, Chile's real exchange rate against the U.S. dollar depreciated by 124 percent. This decline in wages, together with the depreciation of the real exchange rate, according to Corbo and Fischer (1994), generated an export boom (as shown in Figure 6) that was the principal cause of Chile's rapid recovery.

The story of declining real wages and a depreciating real exchange rate generating an export boom that spurred the recovery sounds convincing for Chile. But can it explain the differences in the economic performances of Mexico and Chile? Probably not. The fall in real wages was substantially greater in Mexico than in Chile: in the two years following the crisis, real wages fell by almost 30 percent, compared with 15 percent in Chile. Furthermore, between 1981 and 1987, the Mexican peso depreciated by 95 percent against the U.S. dollar, compared with 124 percent in Chile. As Figure 6 shows, exports boomed in Mexico as well as in Chile as a percent of GDP.

The data in Figure 6, which express exports as a percent of GDP, can be misleading as indicators of the movements in value of exports when there are substantial fluctuations in GDP and in the real exchange rate. Looking at the value of exports in U.S. dollars deflated by the U.S. Producer Price Index in Figure 7, we see that the value of Chile's exports actually fell after 1981 while that of Mexico's exports rose, falling below its 1981 level only briefly in 1986. Much of the movement in the dollar value of Mexico and Chile's exports should come as no surprise, given the data on commodity prices in Figure 3. What is surprising is that, even though the price of copper recovered in the late 1980s and early 1990s and the price of crude petroleum did not, the dollar value of Mexico's exports grew faster during this period than did Chile's. By 2000, Mexico was exporting

427 percent more than it had in 1981, measured in terms of deflated U.S. dollars, while Chile was only exporting 250 percent more. Moreover, returning to Figure 6, we see that, by 2000, Mexico's trade as a percent of GDP exceeded Chile's, even though Mexico's economy was seven times larger.

If declining real wages and a depreciating real exchange rate generated an export boom in Chile, they had even more pronounced effects in Mexico.[3] Yet, after 1983, Chile's economy recovered rapidly while Mexico's stagnated. Consequently, we need to look elsewhere for an explanation of the differences in the recoveries.

Debt Overhang Story

A hypothesis often associated with Sachs (1989) for Mexico's slow recovery is the debt overhang story. The idea is that Mexico's large external debt led to fears by potential new investors that most of the returns on any new investment would be used to pay down old loans. Potential new investors viewed the outstanding debt as leading to future (implicit or explicit) taxes on the returns to their new investments. Hence, these investors were discouraged from making new investments, and private incentives were distorted towards consuming rather than investing. The larger the outstanding debt, the higher the implicit tax on new investment, and the lower the actual investment.

To analyze this story, we plot the ratio of foreign debt to output in Mexico and Chile in Figure 8, and we plot the investment rate in these two countries in Figure 9. It is clear that, both during and after the crisis, Mexico had an increasing ratio of debt to output and that, during the same period, Mexico's investment-output ratio fell below its pre-crisis level. So, at least for Mexico, the pattern is not inconsistent with Sachs's story.

Can Sachs's story explain the difference between Mexico's slow recovery and Chile's fast recovery? As Figure 8 makes clear, both during and after the crisis, Chile had a much higher debt-output ratio than Mexico. Furthermore, in Figure 9, we see that Chile's investment rate fell more abruptly than Mexico's and only caught up and passed it in 1989. Looking at macroeconomic aggregates like investment rates, we do not see how debt overhang can explain the different recoveries of Mexico and Chile.

[3] This was especially true during and after the 1994-1995 crisis.

Before leaving the debt overhang story, it is worth making two comments. First, it could be argued that Chile's debts were somehow different from Mexico's because a large portion had been privately contracted: in 1981 only 35.6 percent of Chile's debt was public or publicly guaranteed, while 80.8 percent of Mexico's were. Following the bailout of Chile's banking system, however, the portion of debt in Chile that was public or publicly guaranteed shot up, reaching 86.3 percent in 1987, compared to 85.6 percent in Mexico. If the crucial factor in the debt overhang story is the level of public debt, Chile had more debt overhang during the crucial period when it was recovering and Mexico was not. Second, comparing Figure 8 with Figure 5, we see that most of the fluctuations of both counties' ratios of debt to output were due to depreciation of the domestic currency. This depreciation increased the relative value of debt, which was mostly denominated in U.S. dollars. This suggests that Corbo and Fischer's story for Chile's recovery, which says that depreciation is good because it drives up exports, conflicts with Sachs's story for Mexico's stagnation, which says that depreciation is bad because it drives up the relative value of foreign debt. Neither story is capable of explaining the differences between the economic performances of Mexico and Chile.

Structural Reforms Story

A promising explanation of the different recovery patterns is that in the 1970s Chile had undertaken structural reforms that set the stage for successful performance of the economy in the 1980s. These reforms covered trade policy, fiscal policy, privatization, banking, and bankruptcy. In contrast, Mexico only undertook such reforms in the 1980s or later. Could the different timing of the reforms have determined the different recovery patterns? Here we argue that neither trade policy reforms nor fiscal reforms can explain the differences. Privatization, banking, and bankruptcy reforms, however, may well be able to.

Consider first the differences in trade policy. By 1979 Chile had eliminated all quantitative restrictions on imports and imposed a uniform tariff of 10 percent. The uniform tariff was increased to 20 percent in 1983 and to 35 percent in 1984 and then gradually lowered until it fell below its original level in 1991 (see De la Cuadra and Hachette (1991)). In Mexico in 1985, there was massive protection: in addition to tariffs, import licenses protected 100 percent of domestic production, and there were numerous other nontariff barriers and a system of dual exchange rates that gave preferred treatment to industries favored by the government. Starting in the mid-1980s, however, Mexico embarked on a massive liberalization of trade policy that culminated in the implementation of the North American Free Trade Agreement in 1994 (see, for example, Kehoe (1995)). Trade liberalization, like real exchange rate depreciation, generated exports in both Mexico and Chile, but it is hard to see how differences in the timing determined the different recoveries. As we have seen in Figures 6 and 7, trade grew more in Mexico during the crucial period of the late 1980s and early 1990s than it did in Chile, partly because Mexico was more closed than Chile to start with.

Consider next differences in fiscal policy. In Chile, there was a major tax reform in 1975, a major social security reform in 1980, and another major tax reform in 1984. In Mexico, there were major tax reforms in 1980 and in 1985. Corporate tax policy in Mexico was reformed in 1987 and 1989 to lower distortions on investment. As Figure 10 indicates, throughout much of the 1980s Chile ran either a government surplus or a small deficit, while Mexico ran a deficit on the order of 10 percent of GDP. Fiscal reforms undoubtedly played important roles in both Mexico and Chile in inducing higher rates of capital accumulation and work effort. In the next section, we use growth accounting and numerical experiments with a growth model to argue that these reforms had roughly similar impacts on both economies — leaving the differences in their performances still unexplained.

Now consider differences in privatization. (See, for, example, Glade (1996) and Hachette and Luders (1993).) In Chile, by the end of the Allende administration in 1973, a large fraction of the economy was under direct or indirect government control. From 1974 to 1979, the Chilean government reprivatized much of the economy. In contrast, following the 1982 crisis in Mexico, the government nationalized the banking system and, moreover, effectively appropriated the banks' holdings of private companies. Economists like Lustig (1998) estimate that, directly or indirectly, the government controlled 60 to 80 percent of GDP. In 1984, Mexico began to reprivatize what it had nationalized, but only after 1989 was the reprivatization substantial. The nationalized banks were only privatized after 1990. The different paces of privatization had effects both on the incentives to accumulate capital and on the efficiency with which that capital was allocated.

It is worth pointing out, however, that it is easy to exaggerate the importance of privatization in Chile relative to that in Mexico: although the number of state enterprises in Chile was reduced from 596 in 1973 to 48 in 1983, the portion of GDP generated by state enterprises only fell from 39 percent to 24 percent. Chile's national copper company, *Corporación Nacional del Cobre* (CODELCO), was still run by the government in 2000, and its exports of copper accounted for 13.8 percent of Chile's exports. In contrast, crude petroleum exports in Mexico, which are controlled by the government's *Petróleos Mexicanos* (PEMEX), accounted for 9.8 percent of Mexico's exports in 2000. Significantly, however, the government in Chile has allowed private competition in copper extraction, while the government in Mexico has not done so in petroleum extraction.

We turn now our attention to the banking sector. (See, for example, Barandiarán and Hernández (1999) and Gruben and Welch (1996).) One way that differences in the workings of the banking systems manifested themselves was in the amount of private lending in the two economies. Figure 11 graphs private credit (which consists of all loans to the private sector and to non-financial government enterprises) as a percent of output. Clearly, there was substantially more private lending taking in place in Chile than in Mexico. In 1973 Chile had 18 national banks and one foreign bank. After a series of financial reforms that included deregulation, low reserve requirements, and opening to foreign competition, the number of financial institutions increased by 1980 to 26 national banks, 19 foreign banks, and 15 *financieras* — the latter being nonbank financial institutions that were subject to less stringent regulations than banks. The explosion of financial institutions that were not highly regulated and that paid market-determined interest rates led to an explosion in private credit.

In Mexico, in contrast, banks were few, highly regulated, and subject to very high reserve requirements. The government set very low deposit rates in order to give low-interest-rate loans to preferred industries. Overall, the banking system in Mexico was used by the government as a way to channel funds to preferred borrowers at low interest rates.

These differences in banking systems led to huge differences in the allocation of credit in the two economies after the crisis. In Chile, credit allocation was determined mostly by the market; in Mexico it was determined by the government. Although banks and financial institutions collapsed and were taken over by the government in both countries, the authorities reacted in very different ways when rescuing the financial sector and restoring credit flows. The Chilean authorities liquidated insolvent banks and *financieras*, quickly reprivatized solvent banks that had been taken over because of liquidity problems, and set up a new regulatory scheme to avoided mismanagement. Banks were able to channel credit to firms at market rates – which were very high immediately following the crisis. The banking reforms in Chile were costly: Sanhueza (2001) estimates that during 1982-1986, the costs amounted to 35 percent of one year's GDP.

In Mexico, in contrast, banks were nationalized and credit was allocated discretionarily at below-market rates. Figure 11 shows that credit to the private sector fell in Mexico after 1982 and continued to be very low for most of the decade. In fact, despite the massive bailout during the 1994-1995 crisis, Mexico's banking system still failed to provide credit to the private sector at levels comparable to that in Chile even in the late 1990s. In contrast, in Chile credit to the private sector expanded during 1982-1985 and steadily declined as a fraction of GDP during the rest of the decade mostly because of GDP growth. In retrospect, it appears that the immediate cost of the bank bailout paid for by Chile during the crisis was more than compensated by later gains.

Finally, consider differences in the timing of the reform of bankruptcy procedures. In Chile, the 1929 bankruptcy law did not provide for an efficient and timely administration of bankruptcies because it relied on poorly paid public officials (*sindico*s) and highly bureaucratic procedures. Until the late 1970s, bankruptcy proceedings languished for years in courts. Following an administrative reform of the bankruptcy management service in 1978, the 1982 bankruptcy reform law clearly defined the rights of each creditor and replaced public *sindicos* with private *sindicos*. The law was passed at the onset of the crisis, and the government allowed firms to go bankrupt, avoiding the use of subsidies to keep them afloat, under the conviction that protection would unnecessarily lengthen the adjustment period.

It was this bankruptcy policy, in retrospect, that was crucial in making the initial phase of the crisis more severe in Chile than in Mexico. Figure 12 shows that bankruptcies increased fivefold between 1980 and 1982 in Chile, but quickly returned to average levels. In contrast, Mexico had an obsolete and unwieldy bankruptcy law from

1943 in place until 2000. The 2000 bankruptcy law includes features similar to Chile's 1982 law, particularly the establishment of bankruptcy specialists (*especialistas de concursos mercantiles*), who are intended to play much the same role as *sindicos* in Chile. Our interpretation is that Chile paid the short-term costs of letting many firms fail and this led to a sharp, but short, fall in output followed by a strong recovery. Mexico, in contrast, attempted to muddle through the crisis. It had a less severe initial downturn, but a much weaker recovery.

Like privatization and the reforms in banking, the reform of bankruptcy procedures in Chile had effects both on the incentives to accumulate capital and on the efficiency with which that capital was allocated. We argue in all three of these cases that it was effects on efficiency that were crucial for explaining the differences between Mexico and Chile after the crisis. Some support for that view is given by the data in Figure 9, which show that the investment rate in Mexico was not much below that in Chile. Our growth accounting analysis in the next section bolsters this view, namely that most of the differences in the paths of recovery stem from differences in productivity and not from differences in factor inputs. Hence, for these types of reforms to account for the different paths of recovery, they must have two features. First, they must show up primarily in productivity. Second, given the timings of reforms discussed above, they must have dynamic effects on productivity that show up gradually over time.

4. GROWTH ACCOUNTING AND THE GROWTH MODEL

To see whether the different timing of reforms can explain the different economic performances of Mexico and Chile, we use growth accounting to answer the questions: What portion of the different performances of Mexico and Chile can be accounted for by differences in inputs of factors like capital and labor? What portion can be accounted for by differences in the efficiency with which these factors were used?

Growth Accounting

In this paper, we employ the aggregate Cobb-Douglas production function

$$Y_t = A_t K_t^{\alpha} L_t^{1-\alpha} , \qquad (1)$$

where Y_t is output, K_t is capital, L_t is labor, and A_t is total factor productivity (TFP),

$$A_t = Y_t / K_t^{\alpha} L_t^{1-\alpha}. \quad (2)$$

To calculate A_t, given series for Y_t and L_t, we need to choose a value for α and to generate series for K_t. National income accounts indicate that the share of labor compensation in GDP valued at factor prices (GDP at market prices minus indirect taxes) in both Mexico and Chile is small relative to, say, that in the United States. In 1980, for example, according to the United Nations (1986), this share — which corresponds to $1-\alpha$ in our production function — was 0.42 in Mexico and 0.53 in Chile. We choose a higher value of the labor share for our growth accounting and numerical experiments, 0.70 — corresponding to $\alpha = 0.30$ — for two reasons, however. First, measured labor compensation in countries like Mexico and Chile fails to account for the income of most self-employed and family workers, who make up a large fraction of the labor force. Gollin (2001) shows that, for countries where there is sufficient data to adjust for this mismeasurement, the resulting labor shares tend to be close to the value in the United States, 0.70. Second, a high capital share implies implausibly high rates of return on capital in our numerical experiments. (We provide alternative growth accounting and numerical experiments for a production function in which $\alpha = 0.60$ in Appendix B; the qualitative nature of our conclusions does not change.)

To calculate a capital stock series, we cumulate investment, I_t, using

$$K_{t+1} = (1-\delta)K_t + I_t. \quad (3)$$

for some chosen depreciation rate δ and an initial condition on capital. We use a depreciation rate $\delta = 0.05$ for both countries, and, for the initial condition on capital, we assume the capital-output ratio grew from 1960 to 1961 by the same amount that it did over the period 1961-1970. As a check, we note that with these choices the share of capital consumption in GDP, which in the model is measured by $\delta K_t / Y_t$, is equal to the number reported by the United Nations (1986) for Mexico in 1980. To reproduce the corresponding number for Chile in 1980, we would need a higher depreciation rate, $\delta = 0.08$. We choose to use $\delta = 0.05$ for two reasons. First, we want to use the same production technology in our growth accounting and numerical experiments for Chile as for Mexico. Second, a higher value of δ for Chile yields implausibly low values of the capital-output ratio there. (We provide alternative growth accounting and numerical experiments for a production technology in which $\delta = 0.08$ in Appendix B; the qualitative nature of our conclusions does not change.)

Given our choice of α and generated series for K_t, we can calculate TFP series. Figure 13 plots the series for Mexico and Chile detrended by 1.4 percent per year. We detrend at this rate because in a balanced growth path, where output and capital per worker grow by 2 percent per year, TFP would have to grow by 1.4 percent per year, $1.02^{1-0.3} = 1.0140$. What is striking about Figure 13 is how closely the TFP data match those for GDP per working-age person in Figure 1. (In fact, the correlation between detrended A_t and detrended Y_t / N_t is 0.99 for Mexico and 0.92 for Chile.) This suggests that it was not changes in inputs that were responsible for the crises and recoveries in Mexico and Chile, but rather the efficiency with which these factors were used.

Taking natural logarithms of the production function, we follow Hayashi and Prescott (2001) in rearranging terms to obtain

$$\log\left(\frac{Y_t}{N_t}\right) = \frac{1}{1-\alpha}\log A_t + \frac{\alpha}{1-\alpha}\log\left(\frac{K_t}{Y_t}\right) + \log\left(\frac{L_t}{N_t}\right), \tag{4}$$

where N_t is the number of hours available for work by working-age persons. We use this expression to decompose the change in real GDP per capita over the period t to $t+s$ as

$$\begin{aligned}\left[\log\left(\frac{Y_{t+s}}{N_{t+s}}\right) - \log\left(\frac{Y_t}{N_t}\right)\right]/s &= \frac{1}{1-\alpha}\left[\log A_{t+s} - \log A_t\right]/s \\ &+ \frac{\alpha}{1-\alpha}\left[\log\left(\frac{K_{t+s}}{Y_{t+s}}\right) - \log\left(\frac{K_t}{Y_t}\right)\right]/s + \left[\log\left(\frac{L_{t+s}}{N_{t+s}}\right) - \log\left(\frac{L_t}{N_t}\right)\right]/s.\end{aligned} \tag{5}$$

The first term on the right-hand side of this equation is the contribution to growth of TFP changes, the second is the contribution of changes in the capital-output ratio, and the third is the contribution of changes in hours worked per working-age person. On a balanced growth path, output per worker and capital per worker grow at the same rate, and the capital-output ratio and hours worked per working-age person are constant. On such a path, our growth accounting would attribute all growth to changes in TFP. In our growth accounting, therefore, the second two terms measure the contributions of deviations from balanced-growth behavior: changes in the investment rate and changes in work effort.

Table II

Growth accounting:

Decomposition of average annual changes

in real output per working-age person (percent)

	data	model base case	model tax reform
Mexico			
Crisis 1981-1987			
change in Y/N	-3.28	-4.80	-4.80
due to TFP	-5.22	-5.22	-5.22
due to K/Y	2.06	3.17	3.17
due to L/N	-0.12	-2.75	-2.75
Stagnation 1987-1995			
change in Y/N	-0.66	-1.59	-0.07
due to TFP	-0.98	-0.98	-0.98
due to K/Y	0.63	-0.17	0.50
due to L/N	-0.31	-0.43	0.41
Recovery 1995-2000			
change in Y/N	3.04	2.04	2.53
due to TFP	2.59	2.59	2.59
due to K/Y	-0.74	-1.92	-1.29
due to L/N	1.19	1.37	1.23
Chile			
Crisis 1981-1983			
change in Y/N	-11.19	-11.48	-11.48
due to TFP	-9.61	-9.61	-9.61
due to K/Y	5.29	6.49	6.49
due to L/N	-6.87	-8.36	-8.36
Recovery 1983-2000			
change in Y/N	4.43	2.96	4.37
due to TFP	3.57	3.57	3.57
due to K/Y	-0.17	-1.15	-0.23
due to L/N	1.03	0.54	1.03

The first column in Table II presents the growth accounting for Mexico and Chile during the period 1981 to 2000. This growth accounting confirms the impression given by comparing Figures 1 and 13. Most of the economic fluctuations in output per working-age person Y_t / N_t in the two countries were due to changes in total factor productivity A_t, rather than changes in the capital-output ratio K_t / Y_t or in the hours per working-age person L_t / N_t: In Mexico, TFP accounted for a fall in the logarithm of output per working-age person of 0.39, compared to the fall of 0.25 in the data, during the crisis and stagnation periods 1981-1995; it accounted for an increase of 0.13, compared to the increase of 0.15 in the data, in the recovery period 1995-2000. In Chile, TFP accounted for a 0.19 fall, compared to 0.22 in the data, during the crisis period 1981-1983; it accounted for an increase of 0.61, compared to 0.75 in the data, during the recovery period 1983-2000.[4]

Numerical Experiments

Although growth accounting indicates that most of the changes in output in Mexico and Chile were due to changes in TFP, the contributions of changes in the capital-output ratio and of changes in hours worked per working-age person were not negligible. How much of these changes can we account for as equilibrium responses to the observed productivity shocks in a growth model?

To answer this question, we calibrate a simple growth model of a closed economy in which consumers have perfect foresight over the sequence of TFP shocks to Mexico and to Chile. The representative consumer maximizes utility function

$$\sum_{t=1980}^{\infty} \beta^t \left[\gamma \log C_t + (1-\gamma)\log(N_t - L_t)\right] \tag{6}$$

subject to the budget constraint in each period,

$$C_t + K_{t+1} - K_t = w_t L_t + (1-\tau_t)(r_t - \delta)K_t + T_t \tag{7}$$

and an initial condition on capital, K_{1980}. Here N_t is the number of hours available, taken to be 100 hours per week, 52 weeks per year for working-age persons, and $(N_t - L_t)$ is leisure. In addition, τ_t is the income tax rate on capital income, which we

[4] In interpreting our results, remember that we using logarithmic approximations to growth rates, which are accurate for small rates, but not for large ones: The logarithmic approximation says, for example, that Mexico's output per working-age person grew by 15.2 (=5×3.04) percent between 1995 and 2000; it actually grew by 16.4 percent ($e^{0.152} = 1.164$). On the other hand, the logarithmic approximation says that Chile's output per working-age person grew by 75.3 (=17×4.43) percent between 1983 and 2000; it actually grew by 112.3 percent ($e^{0.753} = 2.123$). The major advantage of using logarithms is that they allow us to do an additive decomposition of the determinants of growth.

start by assuming fixed — but later lower to mimic the fiscal reforms — in Mexico and Chile in the 1980s. T_t is a lump-sum transfer that in equilibrium is equal to the tax revenue $\tau_t(r_t - \delta)K_t$. (In Appendix B we show that the qualitative nature of our conclusions are not very sensitive to the specification of the utility function.)

Given the production technology that we have used for growth accounting, the feasibility constraint for this model is

$$C_t + K_{t+1} - (1-\delta)K_t = A_t K_t^{\alpha} L_t^{1-\alpha}. \quad (8)$$

Here we include government spending and net exports in consumption. To run numerical experiments, we need to impose values on the parameters β and γ in the consumer's utility function and on the tax parameter τ_t. Using the first-order conditions for maximization problem of the representative consumer in our model economy, we obtain

$$\beta = \frac{C_t}{C_{t-1}\left[1+(1-\tau_t)(r_t-\delta)\right]} \quad (9)$$

$$\gamma = \frac{C_t}{C_t + w_t(N_t - L_t)}, \quad (10)$$

where r_t and w_t are, of course, the marginal products of the production function with respect to K_t and L_t. Rather than fix the tax rates in Mexico and Chile and estimate a different discount factor β for each country, we fix $\beta = 0.98$ in each country and. estimate a different average tax parameter τ_t over the period 1960-1980. We obtain $\tau_t = 0.43$ for Mexico and $\tau_t = 0.51$ for Chile. Our view is that people are fundamentally the same across countries, but that different tax distortions induce different consumption-investment decisions. To find γ, however, we simply take averages using (10) and data from 1960-1980. We estimate $\gamma = 0.30$ for Mexico and $\gamma = 0.28$ for Chile.

It would be equally possible to fix the same value of γ in both countries and to estimate different tax distortions to consumption-leisure decisions, like consumption taxes and labor taxes, for each country. Despite some changes in these sorts of taxes in both Mexico and Chile, however, we find that the value of γ in (10) does not vary much over the period 1960-2000 in either country. It is worth remembering, however, that our estimates of γ implicitly incorporate differences in tax distortions and labor market institutions in the two countries.

The second column in Table II and the first columns of graphs in Figures 14 and 15 report the results of our base case numerical experiments. In each country, we set K_{1980} equal to its observed value in 1980 and compute the perfect foresight equilibrium path where the sequence of TFP, $A_{1980}, A_{1981}, \ldots, A_{2000}$, is given by data and TFP after 2000 is assumed to grow at the same average rate as it did over the period 1960-2000. Notice that, for both Mexico and Chile, the model captures that initial decline in output well, but misses from about 1985 on. In particular, it predicts that detrended output in 2000 should be about 20 percent below its value in the data in both countries. In terms of the model's results, it seems equally surprising that Chile did so well in its recovery period and that Mexico did not do worse.

Our discussion of structural reforms in the previous section suggests that changes in taxes may have changed incentives to accumulate capital in both Mexico and Chile. The results of our base case numerical experiments suggest, however, that such reforms had effects that were roughly equal, leaving at question what caused the different performances in the two countries in differences in TFP. We analyze this possibility by running new numerical experiments in which we introduce the same tax reform in both Mexico and Chile in 1988.

Using (9), we estimate that both countries had tax rates of $\tau_t = 0.12$ over the period 1988-2000. The third column in Table II and the second columns of graphs in Figures 14 and 15 report the results of numerical experiments where we compute the equilibrium in which consumers have perfect foresight between 1980 and 1988, they are surprised by a tax reform in 1988 that in Mexico lowers τ_t from 0.43 to 0.12 and in Chile lowers τ_t from 0.51 to 0.12, and they have perfect foresight from then on. Notice that the model now does an accurate job of accounting for both the crises and the recoveries in Mexico and Chile. Furthermore, there is some direct evidence that the sorts of tax distortions that we have estimated are sensible: In Chile, for example, taxes on firms' income were lowered from 46 percent to 10 percent in 1984; this tax was increased to 15 percent in 1991 (see Larraín and Vergara (2000)). Interestingly, although the tax reform has direct effects only on the incentive to accumulate capital, it increases the incentive to work by raising real wages.[5]

The tax reform that we have imposed on the model is crude and is sure to miss important institutional details and matters of timing. (The results for Chile, for example, look better if we impose the tax reform earlier.) Nonetheless, the results of our numerical experiments are striking and the message is clear: Changes in tax policy were undoubtedly important in both countries, but they cannot explain more than a small fraction of the differences in the recoveries. In both Mexico and Chile, changes in the capital-output ratio and changes in hours worked per working-age person contributed to making the recovery stronger than the base case model predicts. Within the context of our model, the same crude tax reform in both countries can roughly account for these changes in factor inputs. Consequently, to explain the different experiences in Mexico and Chile, we need to explain the different performances of TFP.

5. HOW REFORMS CAN INCREASE TFP

Since most of the differences in the recovery paths in Mexico and Chile can be directly traced to the different paths for TFP, any serious explanation for the different economic performances must boil down to an explanation of the different productivities. Our hypothesis is that higher productivity growth in Chile was driven by the timing of reforms in three areas: privatization, banking, and bankruptcy procedures. Given the data on the speed of, and relative importance of, privatization in the two countries, we conjecture that reforms to banking and bankruptcy procedure were quantitatively more important than privatization in determining the differences in productivity. In this section, we sketch out simple examples of how the removal of distortions in each of these three areas can lead to higher productivity.

Before we turn to our examples, let us contrast our hypothesis with a potential explanation for measured productivity movements that is common in the business cycle

[5] Notice that the model overpredicts work effort in the early 1980s in both countries, both before and during the crisis. This is not a matter of secular trends: Remember that we have calibrated the crucial parameter, γ, for determining work effort to data from the 1960s and 1970s. Hours worked per working-age person were, in fact, low by historical standards during the early 1980s in both countries.

literature (see, for example, Burnside, Eichenbaum, and Rebelo (1993)). This explanation is that unobserved movements in factor utilization cause large movements in measured productivity. To make this concrete, supposed that aggregate output Y is produced according to the Cobb-Douglas function

$$Y = A(uK)^{\alpha}(eL)^{1-\alpha} \tag{11}$$

where $0 \leq u \leq 1$ is unobserved capacity utilization of capital and $0 \leq e \leq 1$ is unobserved labor effort. It is important to note that variations in e do not correspond to variations in the employment rate, the participation rate, or average hours worked: if these variations are properly measured, they show up as variations in L. If we observe K and L in the data and do not observe u or e, we would mistakenly identify movements in $\overline{A} = Au^{\alpha}e^{1-\alpha}$ as changes in productivity instead of correctly identifying them as movements in factor utilization. In our growth accounting exercise, for example, we have used L/N to measure work effort, but we should have used eL/N.

Such shifts in utilization may be important in the onset of the crisis. It seems farfetched, however, to argue that they can account for large differences in productivity movements between countries over a period of a decade or more, when firms are making new investments and hiring new workers. Indeed in Mexico, the country with falling productivity, the story would have to be that, at the same time that the average firm in Mexico was gradually lowering its utilization rate of capital, it was investing in new capital. Similar comments apply to labor: at the same time firms were supposedly "hoarding" labor by requiring low effort, on average, they were hiring new workers. This type of behavior is inconsistent with that of firms in the standard growth model.

One could imagine a richer model in which some firms were under utilizing factors and hiring no new factors at the same time that others were utilizing factors fully and hiring new factors. Even so, it is hard to imagine that this situation could have persisted and even worsened for as long as a decade. Presumably, during that long of a period, the depreciation of physical capital and the natural turnover of workers would have gradually raised the utilization rates, not persistently lowered them.

In contrast, our general hypothesis is that, absent reforms, government policy distorted the allocations of resources both within and across sectors and this led the economy to be inside the aggregate production possibility frontier. As reforms were carried out, the economy moved closer to the production possibility frontier, and this movement showed up as an improvement in productivity.

Static Inefficiencies

The government's favored treatment of certain sectors can interfere with the market mechanism and lower aggregate productivity. To see this in the simplest possible example, consider an economy with two sectors in which labor L_i produces a homogenous output good Y_i according to the production function $Y_i = A_i L_i^{\alpha}$, $i = 1,\ 2$. For simplicity, set $A_1 = A_2 = 1$. The aggregate resource constraint is $L_1 + L_2 = L$.

Before the reform, sector 1 is the government enterprise sector that is subsidized at rate τ_1 and sector 2 is the private sector that is taxed at rate τ_2. Any residual from the taxes and subsidies is financed with lump-sum taxes or transfers. A competitive labor market equates the marginal products of labor in the two sectors, which implies

$$\frac{L_1}{L_2} = \left(\frac{1+\tau_1}{1-\tau_2}\right)^{\frac{1}{1-\alpha}}. \tag{12}$$

Substituting the allocations of labor back into the resource constraint and solving yields

$$Y(\tau_1,\tau_2) = \frac{1+\left(\frac{1+\tau_1}{1-\tau_2}\right)^{\frac{\alpha}{1-\alpha}}}{\left[1+\left(\frac{1+\tau_1}{1-\tau_2}\right)^{\frac{1}{1-\alpha}}\right]^{\alpha}} L^{\alpha}. \tag{13}$$

Now imagine a privatization that sets both the subsidy and the tax to zero. The efficient allocation of labor would be $L_i = L/2$ and the aggregate output would be $Y(0,0) = 2^{1-\alpha} L^{\alpha}$. Relative to the efficient allocation, before reform the government enterprise in sector 1 produces too much output, and the private firm in sector 2, too little output. Overall, output is lower in the economy before reform than it is afterward. If $\alpha = 3/4$ and $\tau_1 = \tau_2 = 1/3$, for example, then output in the distorted economy is about 10 percent less than in the undistorted economy. Consequently, productivity would rise with the reform.

This example illustrates how distortions can affect the static aggregate production possibility frontier. We have focused on a direct subsidy, but any differential treatment for one sector over another will have a similar impact. It illustrates how, in theory, different paths for privatization in the two countries can lead to different paths for aggregate productivities.

In terms of the data, the timing of the privatization in the two countries does not match up well with the differences in productivity. This makes it doubtful that privatization can be the main force that accounts for the different paths of productivity. During the crucial period 1987-1995 Chile was growing and Mexico was stagnating. In Chile, most privatization had already occurred well before this time, while, in Mexico, it was vigorously under way. Consequently, unless there are long lags between changes in incentives and changes in the allocation of resources, this story will not work. Galal *et al*. (1994) estimate that improvements in productivity were achieved very rapidly in privatized firms in Mexico and Chile.

Reforms in the banking sector can also reduce static inefficiencies similar to those in the privatization story above. Suppose that, before banking reform, the government chooses some firms or sectors to favor with low-interest-rate loans. Holding fixed the return on deposits, these lower interest rates for one sector must be paid either by higher rates in the unfavored sector or by transfers to the banking system from the government.

Consider a model in which, for simplicity, we suppress labor and let the production functions be given by $A_i K_i^{\alpha}$, $i = 1,\ 2$. Sector 1 receives a proportional subsidy of τ_1 on the interest rate that it pays on loans, and sector 2 pays a tax τ_2. The first-order conditions for profit maximization are

$$\frac{\alpha A_1 K_1^{\alpha-1}}{(1-\tau_1)} = \frac{\alpha A_2 K_2^{\alpha-1}}{(1+\tau_2)} = r \qquad (14)$$

We can think of these subsidies and taxes as being accomplished through preferential lending by banks. Any net revenues that are needed are supplied to the banks using lump-sum taxes or transfers. The relative allocations of capital are given by

$$\frac{K_1}{K_2} = \left(\frac{A_1}{A_2}\right)^{\frac{1}{1-\alpha}} \left(\frac{1+\tau_2}{1-\tau_1}\right)^{\frac{1}{1-\alpha}} \qquad (15)$$

In contrast to the efficient outcome, a higher fraction of the capital stock is allocated to the subsidized sector than is warranted by the differences in productivity. For a fixed level of total capital, these distortions lower the amount of output due to sectoral misallocations, as in the first example. If these distortions decrease the incentives to make loans, as they did in Mexico, then they can also lead to a lower level of overall capital and have an additional negative effect on output.

Despite the static nature of the inefficiency, this story has potential for explaining the differences in TFP performance: Banking reform was the major reform that Chile had not gotten right in the 1970s and had to redo in the 1980s. See Galvez and Tybout (1985) for a description of the sort of preferential lending arrangements that existed for some firms, but not others, in Chile before the crisis. Furthermore, the privatization of the Mexican banking system in the early 1990s did not make it an efficient provider of credit, as Figure 11 and the problems in 1995 demonstrate.

Dynamic Inefficiencies

One way poorly designed bankruptcy rules can lead to lower aggregate productivity is by discouraging poorly performing firms from exiting from production. By keeping alive firms that otherwise would have died, in equilibrium, these poorly designed rules can prevent new potentially productive firms from entering. The models developed by Atkeson and Kehoe (1995) and Chu (2001) could be used to address such issues. In these models, new firms enter with the newest technology, stochastically learn over time, and then exit when their prospects for further productivity improvements are poor. In such models, any policy that interferes with the natural birth, growth, and death of production units based on prospective productivities can move the economy further and further inside the production possibility frontier and will show up as a decrease in measured productivity. Simulations by Chu (2001) indicate that these dynamic distortions can have enormous effects over time.

To get some idea of how this sort of model works, consider Atkeson and Kehoe's (1995) model in which production is done in a continuum of plants. Each plant has its own level of productivity A and is operated by a manager. A plant with productivity A has the production function $y = A^{1-\nu}(k^{\alpha}l^{1-\alpha})^{\nu}$. The manager's span of control parameter, $\nu < 1$, determines the degree of diminishing returns at the plant level. A manager who decides to operate a plant chooses capital k and labor l to maximize static returns

$$d_t(A) = \max_{k,l} A^{1-\nu}(k^{\alpha}l^{1-\alpha})^{\nu} - r_t k - w_t l - w_t^m, \tag{16}$$

where w_t^m is the manager's opportunity cost of not working or starting another plant. Let the solutions be denoted $k_t(A)$ and $l_t(A_t)$. For a given distribution $\lambda_t(A)$ of productivities across plants, it is easy to show that aggregate output is given by $Y_t = \overline{A}_t^{1-\nu} K_t^{\alpha} L_t^{1-\alpha}$ where

$$\overline{A}_t = \int_A A\lambda_t(dA) \tag{17}$$

is aggregate productivity and $K = \int_A k_t(A)\lambda_t(dA)$ and $L = \int_A l_t(A)\lambda_t(dA)$ are aggregate capital and labor. That is, aggregate productivity depends on the mean of the productivities of all of the plants that are in operation.

Over time, the productivity of each plant evolves stochastically: a plant with productivity A at t has random productivity $A\varepsilon$ at $t + 1$, where ε is drawn from a probability distribution $\pi(\varepsilon)$. The crucial decision for the manager of whether or not to operate a plant is dynamic and is described by the Bellman equation

$$V_t(A) = \max[0,\ V_t^o(A)] \qquad \text{where } V_t^o(A) = d_t(A) + \frac{1}{1+R_t}\int_\varepsilon V_{t+1}(A\varepsilon)\pi(d\varepsilon) \tag{18}$$

Here R_t is the market rate of interest between periods t and $t + 1$, $V_t^o(A)$ is the value if the plant is operated in the current period, and $V_t(A)$ is the maximum of the returns from either closing the plant or operating it. New plants can enter according to a similar process. The outcome of all the managerial decisions to operate or not is a new distribution $\lambda_{t+1}(A)$ over productivities in period $t + 1$.

So far we have described a simple version of the model in which the probability distribution $\pi(\varepsilon)$ that generates shocks to plant-specific productivity does not change with plant age. In the data, the labor employed and output produced by a cohort of plants tend to start low when they are young, grow for the next 20 years or so, and then gradually decline (see, for example, Cahmi, Engel, and Micco (1997) for evidence from Chile). To capture this sort of pattern, Atkeson and Kehoe (1995) modify the model. They add a frontier level of new technology that grows over time, and they allow the mean value of shocks to the productivity of a plant to increase for the first twenty years and then to decrease. In the model, new plants start with the newest technology, but little specific knowledge on how to use it. Over time, these plants build up their specific knowledge and grow as they draw shocks to productivity from a distribution with an increasing mean. After 20-some years, the mean of the shocks ε starts to fall, as the learning process slows down. Plants then decline in size and eventually die.

Now consider the effects of a distortion in the financial system in which the government encourages the banks to lend at a subsidized rate $R_{1t} = \hat{R}_t(1-\tau_{1t})$ to firms (identified with plants in the model) in sector 1 and to lend to other firms at a relatively high rate $R_{2t} = \hat{R}_t(1+\tau_{2t})$. The favored firms discount the future less than the unfavored ones. Substituting these distorted interest rates into the Bellman equation (18) produces different solutions to the managers' dynamic programming problems in sectors 1 and 2. In particular, favored firms will choose to continue to operate in situations where unfavored firms would choose to shut down: even if a favored firm experiences a low productivity A, it will be more prone than an unfavored firm to borrow to cover losses and to continue operating, hoping for a favorable shock ε to increase its productivity in the future.

Consider next the effects of inefficient bankruptcy procedures that make it difficult for firms to exit or subsidize the losses of firms to keep them operating. This distortion causes firms to keep operating for longer than they would have with no distortions.

Together, distortions in the financial system and bankruptcy procedures change the mix of firms that operate in the economy, leading to inefficiently many low-productivity firms continuing. This leads to a lower value of aggregate productivity $\overline{A}$.

How would the removal of these distortions affect the path of productivity over time? Some effects would be immediate. Upon removal, some previously favored firms that would have continued will fail, and some unfavored firms that would have failed will continue. The more subtle, and potentially more important, effects take more time to show up in aggregates. The removal of distortions would encourage new firms to enter. Such new firms would have the newest technologies, but would build up their organization-specific productivity only slowly over time. Consequently, removing these distortions would show up with a lag in the aggregate productivity statistics.

6. CONCLUDING REMARKS

The sort of lag between government policy change and the resulting change in productivity discussed in the previous section may, in fact, provide major roles for Chile's trade reforms and privatization in the 1970s in explaining productivity increases a decade or more later. Openness to foreign direct investment and deregulation in domestic industry, once again reforms that took place in Chile earlier than Mexico, also may have played significant roles. To disentangle the dynamic effects of these reforms on productivity and output from the effects of banking and bankruptcy reforms, more work is needed: the task for the future is to build a quantitative model that incorporates the theoretical structure sketched out in this section and to calibrate it to Mexico and Chile. The challenge is to use the same model to explain why Chile boomed while Mexico stagnated. This paper has provided sharp directions pointing to where the explanation can be and where the explanation cannot be.

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APPENDIX A: DATA SOURCES

Data cited in text: The data on current account deficits, LIBOR, and nominal exchange rates are from the International Monetary Fund's *International Financial Statistics* (*IFS*). The data on crude petroleum and copper exports in 1960 are from the United Nations' *International Trade Statistics Yearbook*; these same data for 2000 are from the web sites of Mexico's *Instituto Nacional de Estadística Geografía e Informática* (http://dgcnesyp.inegi.gob.mx/) and the *Banco Central de Chile* (http://sie.aplicaciones.cl/basededatoseconomicos/). The information on the exports of CODELCO in 2000 is from the web site of the *Comisión Chilena del Cobre* (http://www.cochilco.cl/home/esp/frameset-estadistica.htm). The data on the fraction of total external debt that is public or publicly guaranteed is from the World Bank's *World Development Indicators 2001* (*WDI*) CD-ROM. The information on the fraction of GDP generated by government enterprises is from *WDI*.

Data for growth accounting: The GDP series are from *IFS*. The investment series used to compute the capital stocks are the sum of gross fixed capital formation and change in inventories reported by *IFS*. The labor series have been estimated using data from a number of sources: The labor inputs for both countries are the products of total employment and a survey of average hours per worker. In Mexico, total employment from 1980-1990 is total employment from the *Penn World Table 5.6* multiplied by the ratio of *Penn World Table* employment and *IFS* employment in 1988. This series is spliced with the available data on employment reported by *IFS* for the 1990s. The data for missing years were calculated using linear interpolation. Employment in Mexico in 1999 has been calculated as the product of the economically active population in 1999 from *WDI* and the ratio of employment in 1998 to the economically active population in 1998. Employment in 2000 has been calculated by multiplying the value of an index of manufacturing employment reported by the OECD in *Main Economic Indicators* in 2000 by the average ratio of this index to total employment over the 1996-1999 period. The average hours worked in Mexican manufacturing series is calculated using an index of total hours and an index of total employment from *Main Economic Indicators*. The labor series in Chile is calculated computed using data on total employed from the *Penn World*

Table 5.6 from 1980-1985 and total employment reported in *IFS* from 1985-2000. The hours series is Average Hours Worked in Urban Santiago from the survey *Encuesta de Ocupación y Desocupación* released quarterly by the *Departamento de Economía, Universidad de Chile*.

Table I: All the data are from *IFS*.

Figure 1: The real GDP series are indices of real GDP volume from *IFS*. The population aged 15-64 is from *WDI*. These data end in 1999. The population aged 15-64 in 2000 was estimated by linear extrapolation.

Figure 2: The real GDP series are real GDP per capita in constant dollars (international prices, base year 1985). These series are downloaded from the World Bank's *Global Development Network Growth Database*. To convert GDP per working-age person we use the population data from *WDI*. The data for 2000 have been calculated using the 1999 data and the real growth rated from the data in Figure 1.

Figure 3: The data are from *IFS*: the price of copper is the London price, while the price of oil reported in the average world price. Both series are deflated using the U.S. PPI from *IFS*.

Figure 4: The real manufacturing wage in Chile is a series reported in *Indicadores Mensuales de Empleo y Remuneraciones* from Chile's *Instituto Nacional de Estadísticas*. The real wage in manufacturing for Mexico was created by splicing a series reported by *IFS* with a series from Organization for Economic Co-Operation and Development's *Main Economic Indicators*. The *IFS* series is deflated using the CPI reported by *IFS*. The OECD series is a real series. These series are spliced using their ratio in 1995.

Figure 5: The real exchange rates are calculated using period averages of the nominal exchange rates and Consumer Price Indices from *IFS*.

Figure 6: The series are the ratios of nominal imports and exports and nominal GDP from *IFS*.

Figure 7: The U.S. PPI is from *IFS*. The export values in U.S. dollars are from *WDI* and the World Trade Organization's *International Trade Statistics 2000.*

Figure 8: Total external debt for 1980-1999 is from *WDI*. The GDP series are from *IFS*, and are converted into U.S. dollars using period average nominal exchange rates from *IFS*. The 2000 value was obtained from the *Banco Central de Chile*'s *Boletín*

Mensual, Julio 2001 for Chile and the Economic Commission for Latin America and the Caribbean's *Economic Survey of Latin America and the Caribbean, 2000-2001*.

Figure 9: Nominal investment and nominal GDP are from *IFS*.

Figure 10: Government surplus is from *IFS*. The value of the surplus in Chile in 2000 is from the *Estadísticas de las Finanzas Públicas 1990-2000*, *Dirección de Presupuesto, Ministerio de Hacienda.*.

Figure 11: Both the private credit and GDP series are from *IFS*. Private Credit is the sum of claims on Non-Financial Public Enterprise and Claims on Private Sector.

Figure 12: The data on bankruptcies in Chile correspond to the number of new filings, not the number of resolutions; the *Fiscalía Nacional de Quiebras* of the *Ministerio de Justicia* provided the authors with these data on request.

APPENDIX B: SENSITIVITY ANALYSIS

Tables III and IV present the growth accounting and numerical experiments for alternative specifications of the model.

Table III presents the results for a specification of the model with the sort of large capital share suggested by Mexico and Chile's national accounts, $\alpha = 0.60$, and for a specification with the sort of high depreciation rate suggested by Chile's national accounts, $\delta = 0.08$. The growth accounting and the numerical exercises still indicate that it is mostly fluctuations in TFP that account for the different growth paths of Chile and Mexico. The specification with $\alpha = 0.60$ is unattractive because it implies implausibly high (before tax) rates of returns on capital, averaging over 20 percent in both countries throughout 1960-2000. These returns are out of line with the sorts of real interest rates found in the International Monetary Fund's *International Financial Statistics*. The specification with $\delta = 0.08$ is unattractive because it implies low capital-output ratios, averaging 1.90 in Mexico and 1.55 in Chile over the period 1960-2000. Both specifications require unattractive calibrations of capital taxes: For the specification with $\alpha = 0.60$, we estimate $\tau_t = 0.76$ in Mexico and $\tau_t = 0.81$ in Chile during the period 1960-1980 and $\tau_t = 0.68$ in Mexico and $\tau_t = 0.70$ in Chile during the period 1988-2000. In the numerical experiments with a tax reform, we lower τ_t to 0.68 in both countries in 1988. For the specification with $\delta = 0.08$, we estimate $\tau_t = 0.50$ in Mexico and $\tau_t = 0.61$ in Chile during the period 1960-1980 and $\tau_t = 0.19$ in Mexico and $\tau_t = 0.26$ in Chile during the period 1988-2000. In the experiments with a tax reform, we lower τ_t to 0.20 in 1988.

Table IV presents the results for specifications of the model that use the utility function

$$\sum_{t=1980}^{\infty} \beta^t \tilde{N}_t^{\eta} \left(\left[\left(\frac{C_t}{\tilde{N}_t} \right)^{\gamma} \left(\frac{N_t - L_t}{N_t} \right)^{1-\gamma} \right]^{\phi} - 1 \right) / \phi .$$

Here $\tilde{N}_t$ is an adult equivalent measure of population that puts weight 1/2 on persons not of working age and weight 1 on working-age persons. The utility function used in the paper is, of course, the special case where $\phi = \eta = 0$. The second and third columns of

Table IV report the results of numerical experiments where $\phi = -1$ and $\eta = 0$. The fourth and fifth columns report the results of experiments where $\phi = 0$ and $\eta = 1$. Because neither specification changes the production technology, the growth accounting stays the same. For the specification with $\phi = -1$, we estimate $\tau_t = 0.36$ in Mexico and $\tau_t = 0.47$ in Chile during the period 1960-1980 and $\tau_t = 0.06$ in Mexico and $\tau_t = -0.03$ in Chile during the period 1988-2000. In the experiments with a tax reform, we lower τ_t to 0.04 in 1988. For the specification with $\eta = 1$, we estimate $\tau_t = 0.66$ in Mexico and $\tau_t = 0.72$ in Chile during the period 1960-1980 and $\tau_t = 0.45$ in Mexico and $\tau_t = 0.31$ in Chile during the period 1988-2000. In the experiments with a tax reform, we lower τ_t to 0.35 in 1988. The numerical experiments still indicate that the differences in TFP paths account for most of the differences in the economic performances of Mexico and Chile.

Table III

Sensitivity analysis: Alternative production technologies

Average annual change in real output per working-age person (percent)

	$\alpha = 0.60$			$\delta = 0.08$		
	data	**model base case**	**model tax reform**	**data**	**model base case**	**model tax reform**
Mexico						
Crisis 1981-1987						
change in Y/N	-3.28	-2.89	-2.89	-3.28	-4.45	-4.45
due to TFP	-10.40	-10.40	-10.40	-4.94	-4.94	-4.94
due to K/Y	7.24	9.31	9.31	1.78	2.72	2.72
due to L/N	-0.12	-1.80	-1.80	-0.12	-2.23	-2.23
Stagnation 1987-1995						
change in Y/N	-0.66	-1.47	-0.21	-0.66	-1.34	-0.01
due to TFP	-2.56	-2.56	-2.56	-0.80	-0.80	-0.80
due to K/Y	2.21	1.67	2.32	0.37	-0.32	0.40
due to L/N	-0.31	-0.58	0.03	-0.31	-0.21	0.39
Recovery 1995-2000						
change in Y/N	3.04	1.41	2.38	3.04	1.91	2.43
due to TFP	4.45	4.45	4.45	2.67	2.67	2.67
due to K/Y	-2.60	-4.13	-3.16	-0.82	-1.90	-1.35
due to L/N	1.19	1.09	1.09	1.19	1.14	1.11
Chile						
Crisis 1981-1983						
change in Y/N	-11.19	-10.46	-10.46	-11.19	-10.54	-10.54
due to TFP	-22.84	-22.84	-22.84	-9.62	-9.62	-9.62
due to K/Y	18.52	20.07	20.07	5.30	6.58	6.58
due to L/N	-6.87	-7.69	-7.69	-6.87	-7.50	-7.50
Recovery 1983-2000						
change in Y/N	4.43	1.80	3.77	4.43	2.66	4.18
due to TFP	4.00	4.00	4.00	3.37	3.37	3.37
due to K/Y	-0.60	-2.53	-1.05	0.03	-1.08	-0.05
due to L/N	1.03	0.33	0.82	1.03	0.37	0.86

Table IV

Sensitivity analysis: Alternative utility functions

Average annual change in real output per working-age person (percent)

		$\phi = -1$		$\eta = 1$	
	data	**model base case**	**model tax reform**	**model base case**	**model tax reform**
Mexico					
Crisis 1981-1987					
change in Y/N	-3.28	-4.45	-4.46	-4.38	-4.38
due to TFP	-5.22	-5.22	-5.22	-5.22	-5.22
due to K/Y	2.06	3.18	3.18	3.74	3.74
due to L/N	-0.12	-2.41	-2.41	-2.89	-2.89
Stagnation 1987-1995					
change in Y/N	-0.66	-1.56	-0.22	-1.94	-0.13
due to TFP	-0.98	-0.98	-0.98	-0.98	-0.98
due to K/Y	0.63	-0.06	0.48	-0.02	0.64
due to L/N	-0.31	-0.52	0.28	-0.94	0.21
Recovery 1995-2000					
change in Y/N	3.04	1.95	2.41	1.64	2.45
due to TFP	2.59	2.59	2.59	2.59	2.59
due to K/Y	-0.74	-1.78	-1.18	-2.19	-1.32
due to L/N	1.19	1.14	1.00	1.24	1.18
Chile					
Crisis 1981-1983					
change in Y/N	-11.19	-10.71	-10.71	-11.64	-11.64
due to TFP	-9.61	-9.61	-9.61	-9.61	-9.61
due to K/Y	5.29	5.97	5.97	6.58	6.58
due to L/N	-6.87	-7.07	-7.07	-8.61	-8.61
Recovery 1983-2000					
change in Y/N	4.43	2.87	4.22	2.32	4.25
due to TFP	3.57	3.57	3.57	3.57	3.57
due to K/Y	-0.17	-1.15	-0.29	-1.63	-0.37
due to L/N	1.03	0.45	0.93	0.37	1.05

Figure 1. Real GDP per working-age (15-64) person detrended by 2 percent per year.

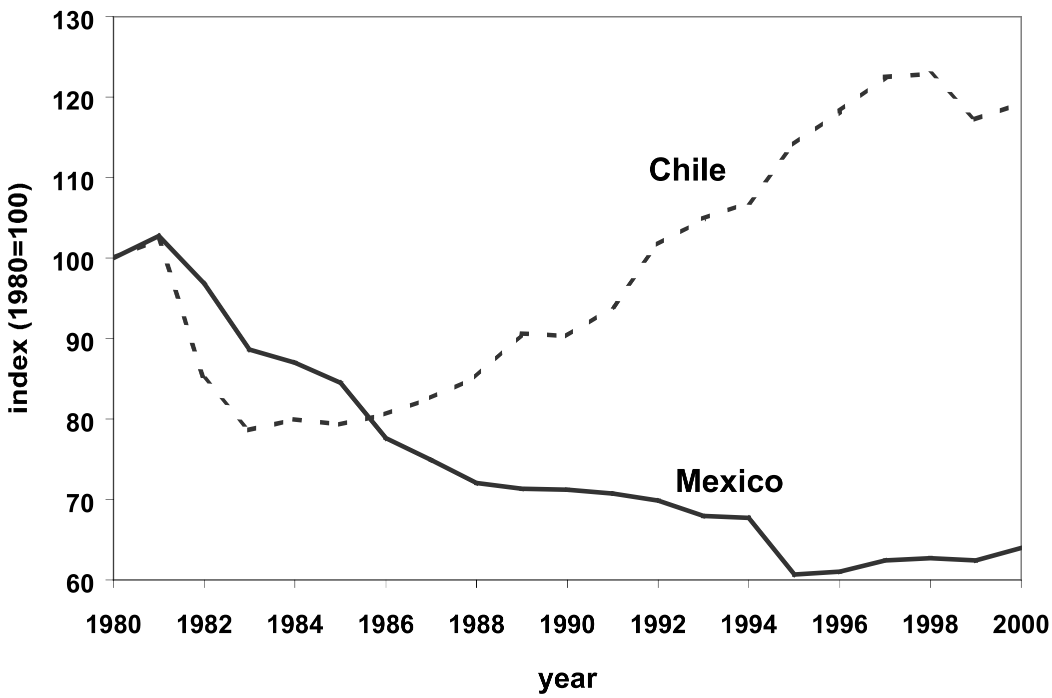

Figure 2. Purchasing power parity real GDP per working-age (15-64) person.

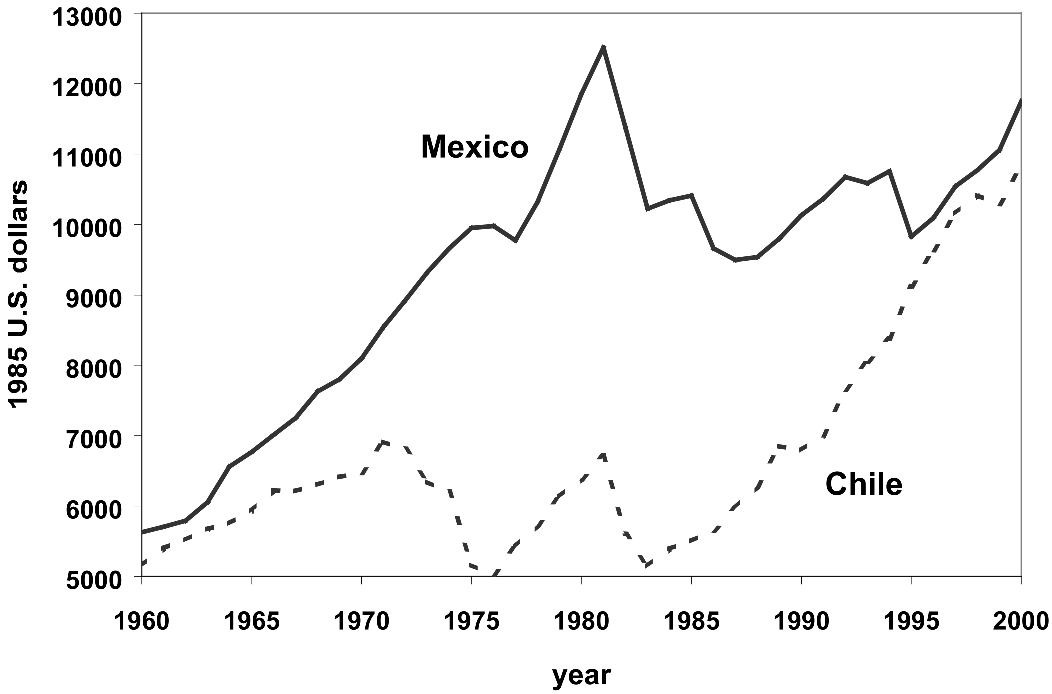

Figure 3. Commodity prices deflated by U.S. PPI.

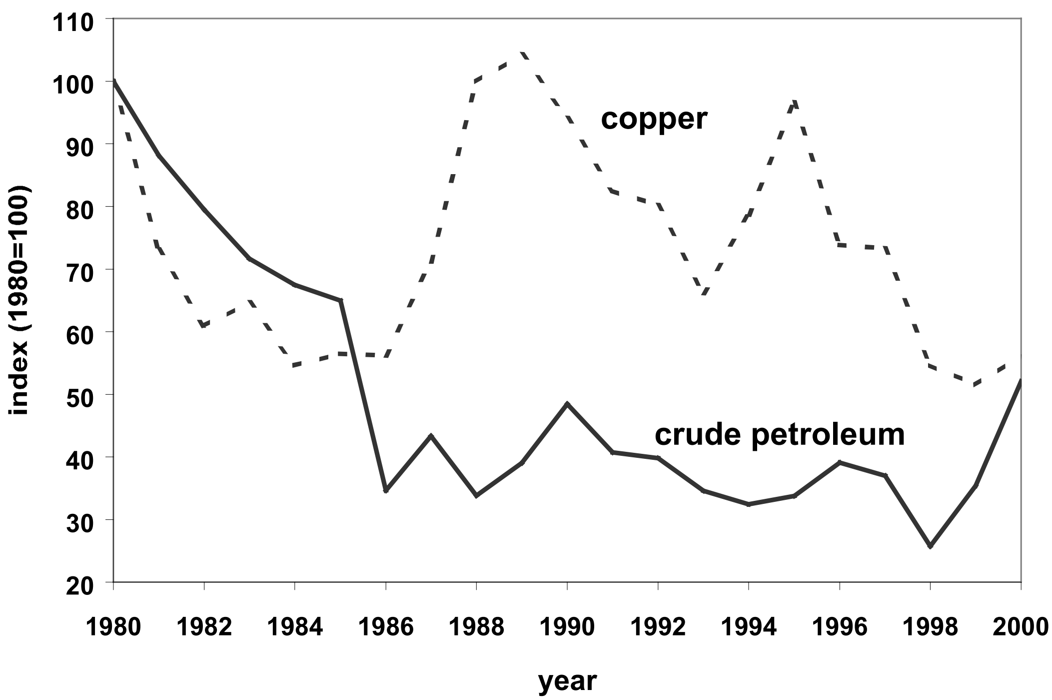

Figure 4. Index of real wages in manufacturing.

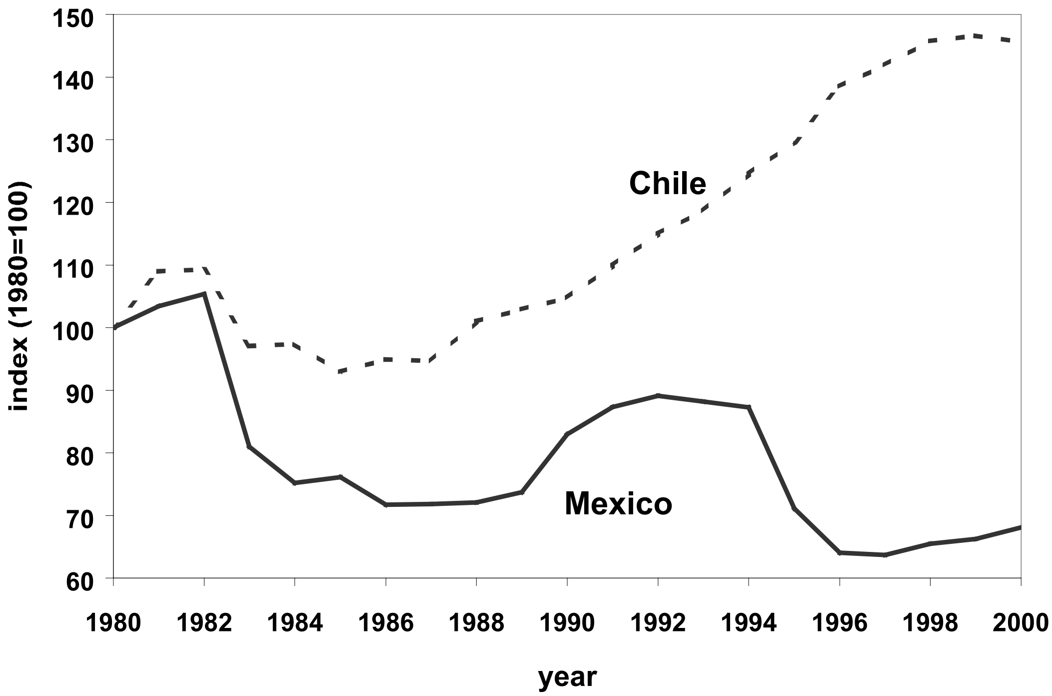

Figure 5. Real exchange rate against the U.S. dollar.

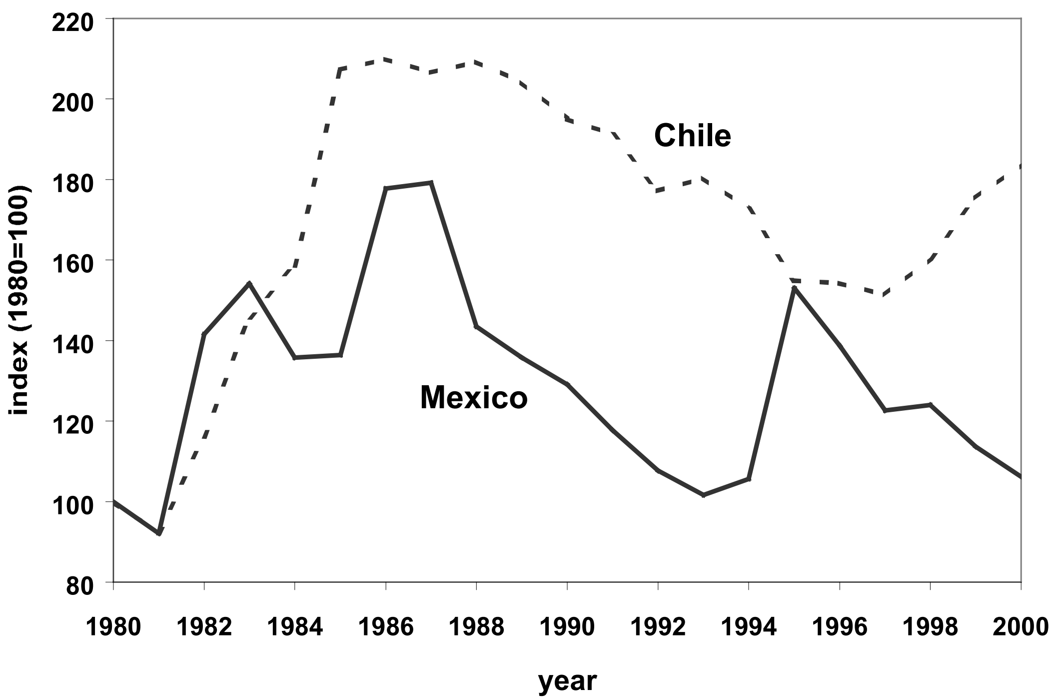

Figure 6. International trade as a percent of GDP.

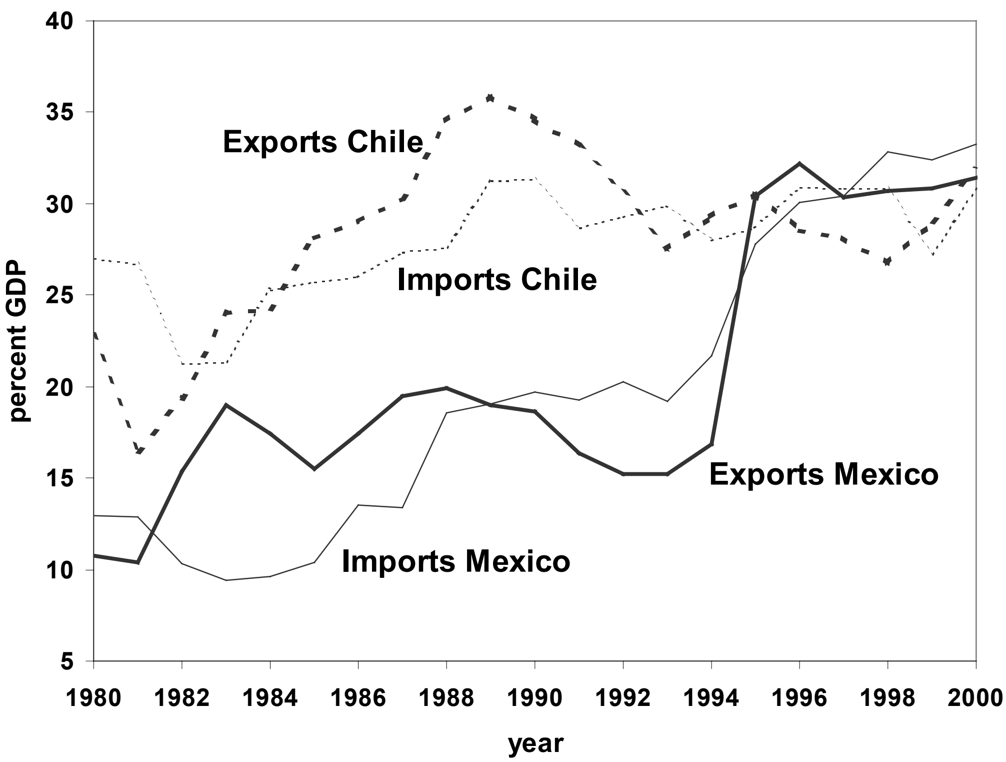

Figure 7. Export value in U.S. dollars deflated by U.S. PPI.

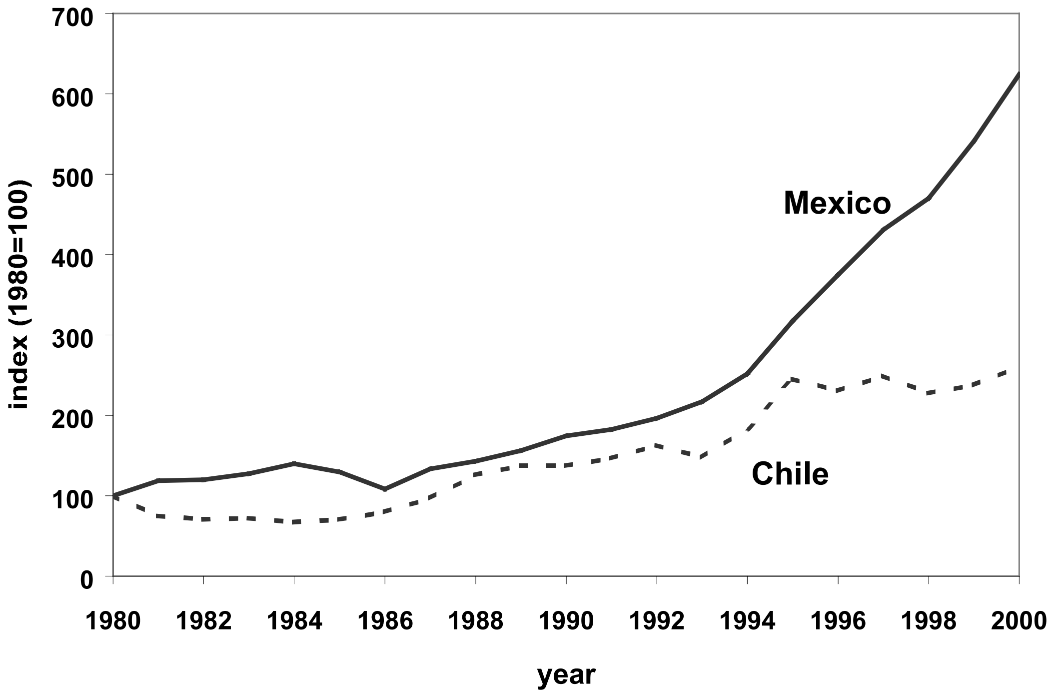

Figure 8. Total external debt as a percent of GDP.

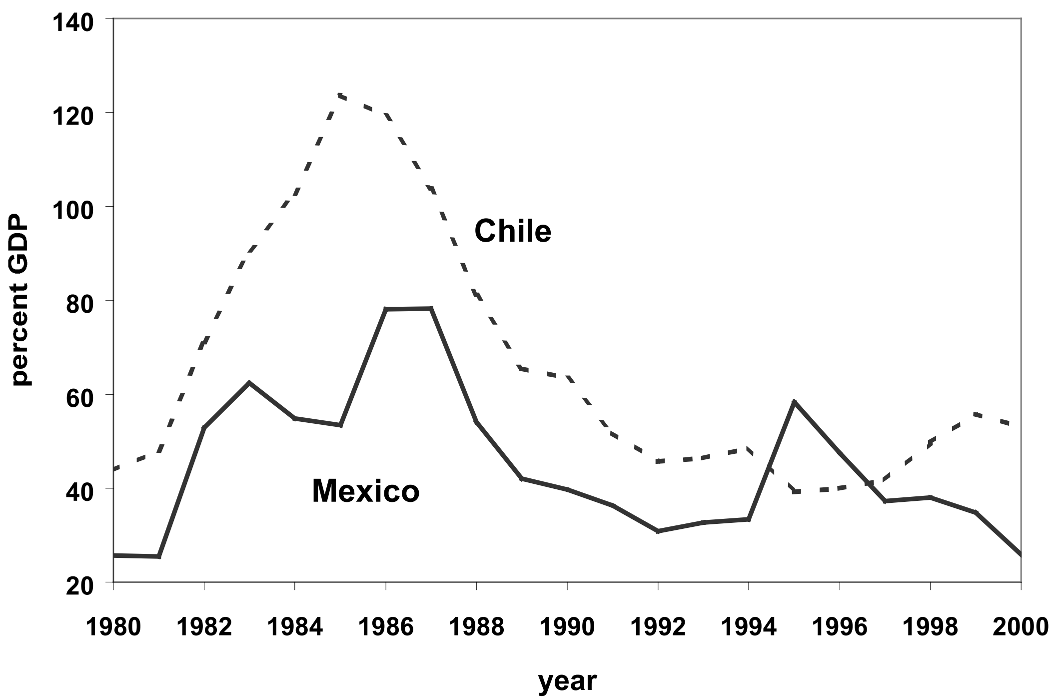

Figure 9. Investment as a percent of GDP

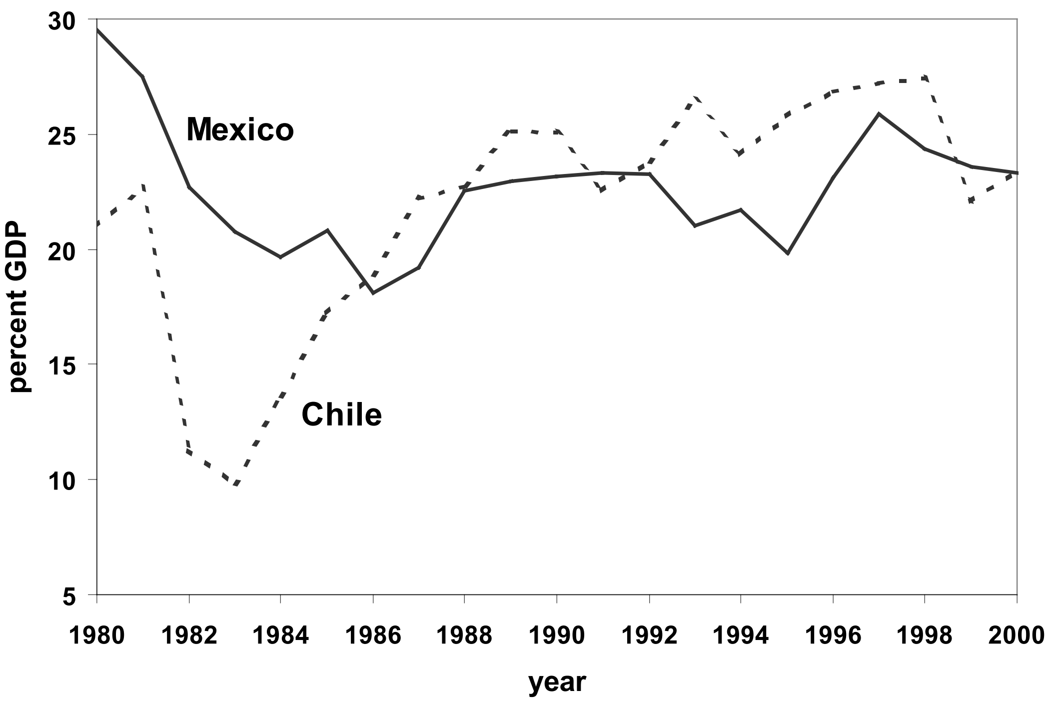

Figure 10. Government surplus as a percent of GDP.

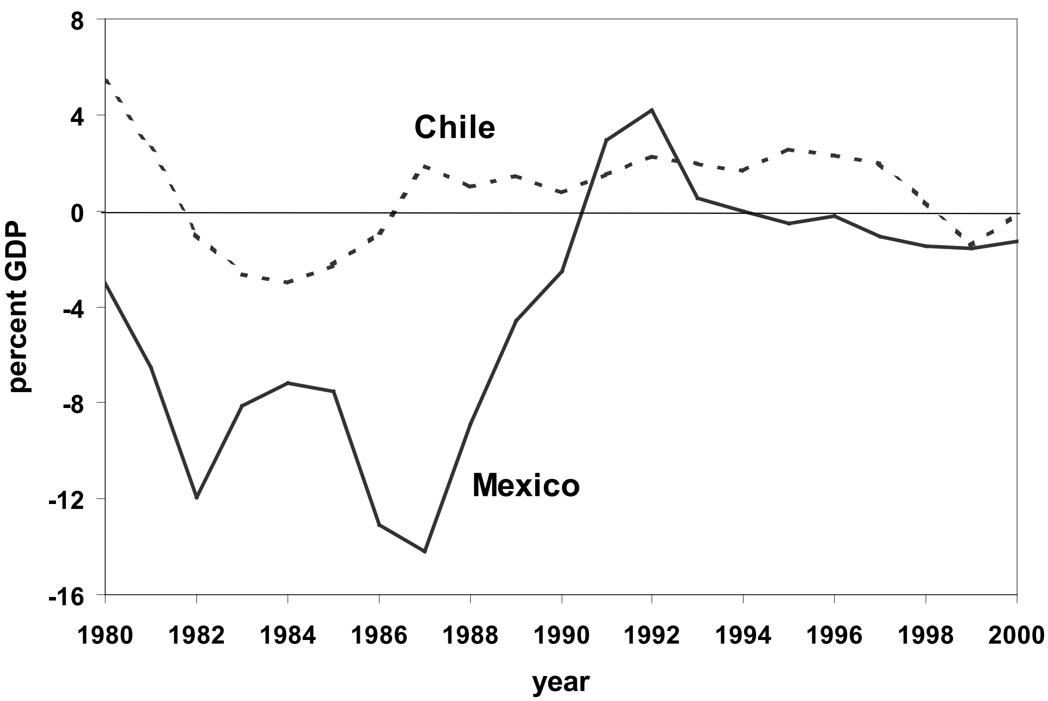

Figure 11. Private credit as a percent of GDP.

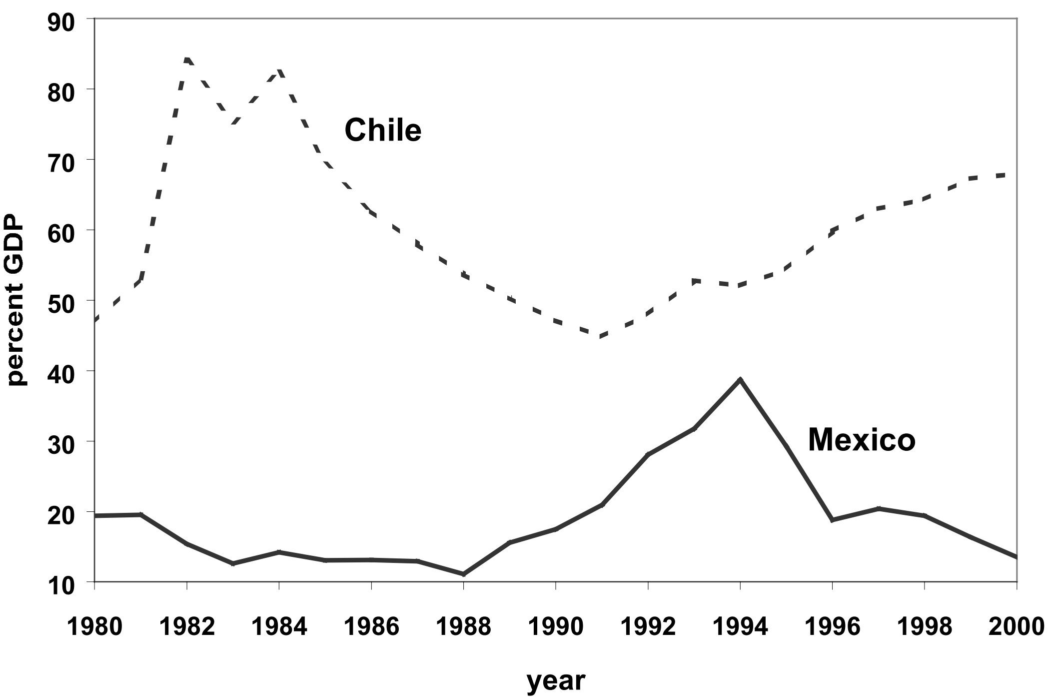

Figure 12. Business bankruptcies in Chile.

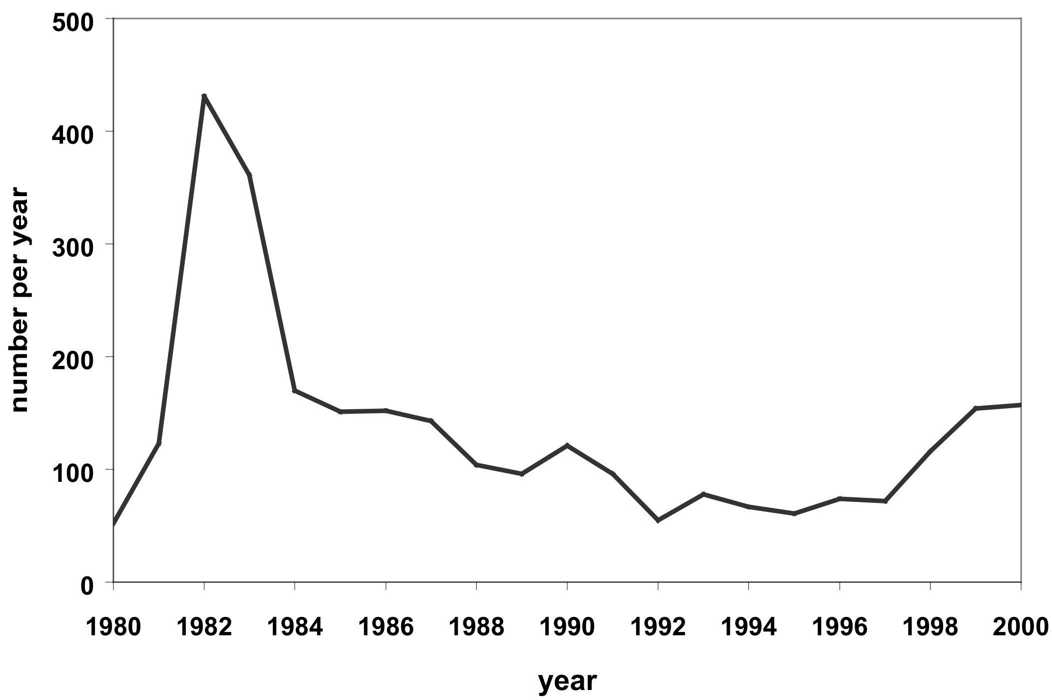

Figure 13. Total factor productivity detrended by 1.4 percent per year.

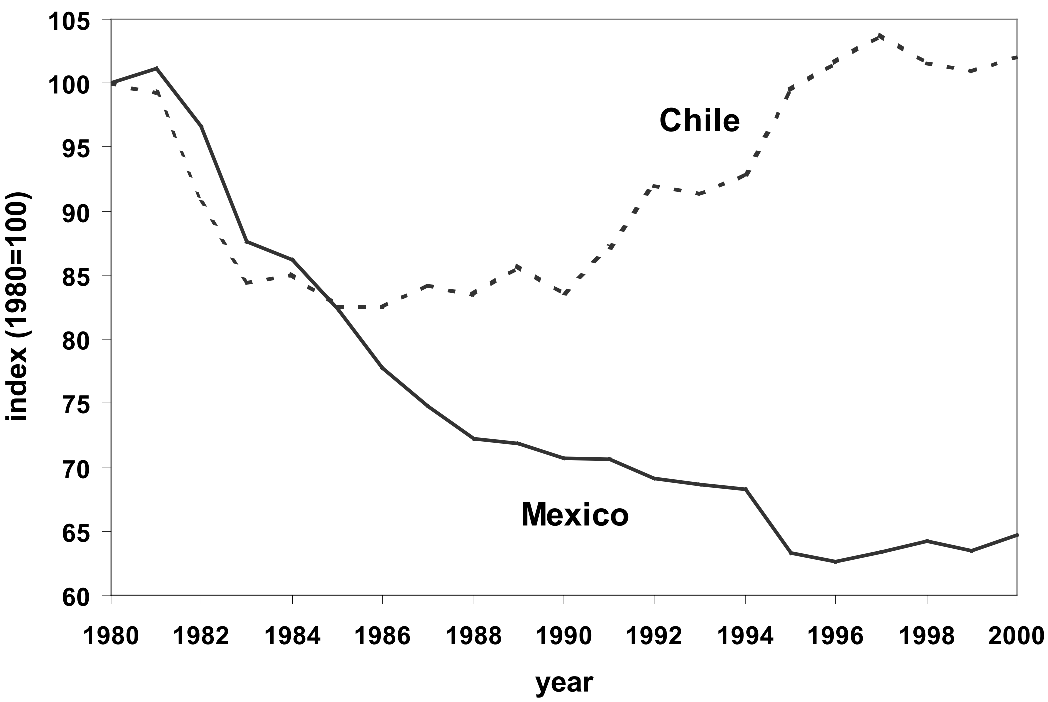

Figure 14. Numerical experiments for Mexico.

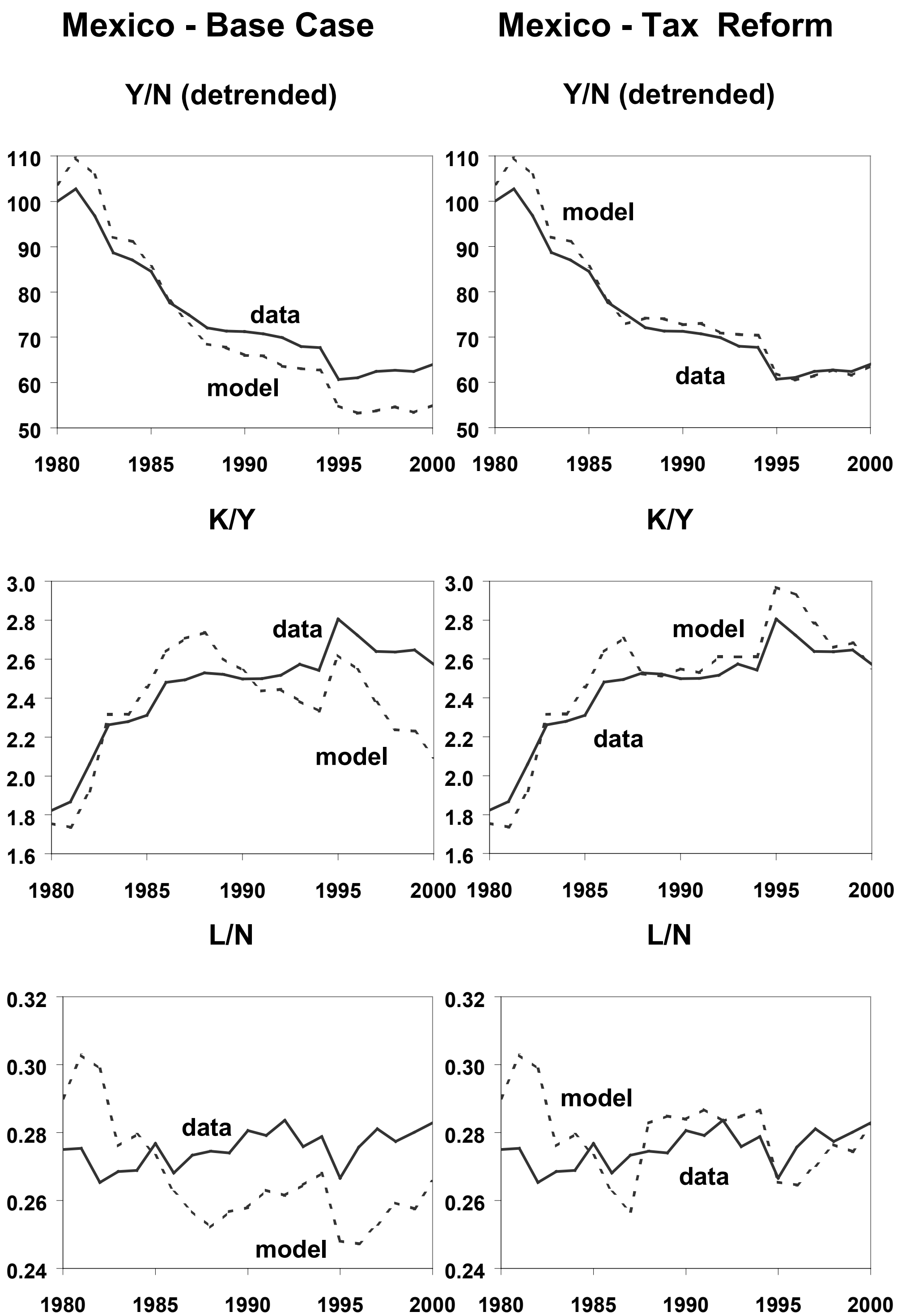

Figure 15. Numerical experiments for Chile.