

ABSTRACT

This dissertation develops a dynamic programming model to explain how the credibility of policy announcements influences the behavior over time of key macroeconomic variables. The model then is applied to explain how lack of credibility contributed to the 1994 Mexican crisis.

One important element of the Mexican stabilization program of 1987 (*Pacto*) was periodic pre-announcements of the future path of the peso exchange rate. Inflation rates were expected to converge to the lower devaluation rates. Indeed, inflation declined from triple to single digits, but the economy experienced sustained real appreciation, current account deficits, and a consumption boom followed by post-boom recession.

The dissertation shows that these stylized facts can be explained by lack of credibility of the exchange rate regime among private agents, which created incentives to substitute present for future consumption, thereby sparking a consumption boom, unsustainable current account deficits, and the foreign exchange crisis.

Dynamic programming methods are used to model private agent behavior under different credibility regimes. Shortcomings of earlier studies on credibility are avoided by introducing expectations regarding future policies into the decision problem of private agents. The model explores the impact of different credibility levels on the time path of key variables. One important contribution is to make private-agent beliefs endogenous, by linking them to the current account. A credibility sensitivity parameter makes consideration of other influences on credibility possible.

Using numerical methods, the model is calibrated and simulated with parameters consistent with the Mexican economy. In contrast with a full credibility regime, when there is uncertainty about the commitment and ability of the authorities to adhere to their announcement, the model is very successful in replicating the stylized facts of a consumption boom-cum-bust, chronic current account deficit, and steady real appreciation. The simulation is more successful when the degree of credibility is endogenously determined rather than exogenous.

Additional simulations, to take into account positive (NAFTA) and negative (Colosio, Chiapas) shocks, which may have influenced credibility, generate time paths for the variables that closely replicate actual behavior. Credibility matters, and lack of credibility may be a major factor explaining the Mexican crisis.

DEDICATED TO MY MOTHER

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TABLE OF CONTENTS

ABSTRACT	ii
DEDICATION	iv
ACKNOWLEDGMENTS	v
VITA	vi
LIST OF TABLES	ix
LIST OF FIGURES	x
PAGE	
INTRODUCTION	1
CHAPTERS:	
1. MEXICO’S MACROECONOMIC PERFORMANCE	5
1.1. Historical Perspective	5
1.2. Exchange Rate Management	9
1.3. Results from the Stabilization Efforts	12
1.3.1 Slow convergenge of inflation rate to the devaluation rate ..	12
1.3.2 Deterioration of the current account	14
1.3.3 Consumption boom followed by a postboom recession ...	17
1.4 The 1994 Mexican Economic Crisis	18
2. THEORY ABOUT POLICY CREDIBILITY	22
2.1. Time Inconsistency of Optimal Policies	23
2.2. Models of Monetary Policy Credibility	26
2.3. Models of Exchange Rate as a Policy Instrument	30
2.4. Limitations to Game Theoretic Models	32
2.5. Empirical Evidence of the Credibility Hypothesis	33
2.6. Econometric Policy Evaluation and the Lucas Critique	36
3. THE DYNAMIC MODEL	39
3.1. Structure of the Model	40

3.2. Full Credibility	44
3.3. Numerical Results	49
3.4. Concluding Remarks	55
4. RATIONAL EXPECTATIONS DYNAMIC MODEL	57
4.1. Sources of Lack of Policy Credibility	58
4.2. Rational Expectations Model with Fixed Probability of Reneging .	60
4.3. Numerical Results	66
4.4. Rational Expectations Model with Probability of Reneging as Function of the Current Account	71
4.5. Numerical Results	76
4.6. Conclusions	80
5. SENSITIVITY ANALYSIS	83
5.1. Sensitivity of the Model to the degree of Policy Credibility	84
5.2. Simulation of the Events before the 1994 Economic Crisis	89
5.2.1 The NAFTA shock	90
5.2.2 The Colosio shock	94
5.2.3 The world interest rate shock	97
5.3. Conclusions and Policy Lessons	101
6. CONCLUSIONS	105
6.1. Overview	105
6.2. Limitations and Future Directions	109
APPENDIX	
A. Programs for Chapters 3, 4, and 5	111
LIST OF REFERENCES	130

LIST OF TABLES

TABLE		PAGE
1.1.	Macroeconomic Indicators, 1954-1994	8
1.2	Mexican Exchange Rate Management, 1987-1994	11

LIST OF FIGURES

FIGURE		PAGE
1.1	Annual Rates of Inflation and Devaluation (End of Period)	13
1.2	Price Index of Tradable and Nontradable Goods (1980=100) ...	14
1.3	Current Account (Billions of Dollars)	15
1.4	Domestic Savings, 1984-1993 (Percentage of GDP)	16
1.5	Real Private Consumption, Quarterly Change (1980=100)	18
3.1	Steady-state path of consumption of non-tradables	51
3.2	Steady-state path of real exchange rate	51
3.3	Steady-state path of inflation rate	52
3.4	Time path of consumption of tradables under low regime	53
3.5	Inflation rate convergence to new steady-state in low rate regime .	54
4.1	Consumption of tradables. Fixed probability of renegeing.	67
4.2	Level of bonds. Fixed probability of renegeing	68
4.3	Consumption of non-tradables	69
4.4	Real exchange rate. Fixed probability of renegeing	70
4.5	Inflation rate. Fixed probability of renegeing.	70
4.6	Consumption of tradables. Probability of renegeing as a function of the current account.	78
4.7	Current account. Probability of renegeing as a function of the current account.	78
4.8	Consumption of non-tradables. Probability of renegeing as a function of the current account.	79

4.9	Real exchange rate. Probability of renegeing as a function of the current account.	79
4.10	Inflation rate. Probability of renegeing as a function of the current account.	80
5.1	Sensitivity of consumption of tradables to changes in η	87
5.2	Sensitivity of the current account to changes in η	87
5.3	Sensitivity of the inflation rate to changes in η	88
5.4	Probability of renegeing as function of the current account	88
5.5	Consumption of tradables. The NAFTA shock	92
5.6	Current account. The NAFTA shock	92
5.7	Inflation rate. The NAFTA shock.	93
5.8	Probability of renegeing. The NAFTA shock.	93
5.9	Consumption of tradables. The Colosio shock.	95
5.10	Current account. The Colosio shock.	96
5.11	Inflation rate. The Colosio shock.	96
5.12	Probability of renegeing. The Colosio shock.	97
5.13	Consumption of tradables. The world interest rate shock.	99
5.14	Current account. The world interest rate shock.	99
5.15	Inflation rate. The world interest shock.	100
5.16	Probability of renegeing. The world interest rate shock.	100

INTRODUCTION

At the end of 1987, the Mexican Government launched an economic stabilization program known as the "Pact of Economic Solidarity" or the *Pacto*. The main goal of this program was to combat the high and persistent inflation that was plaguing the Mexican economy at that time. One important component of the program was the pre-announcement of the future path of the exchange rate. The fact that this new policy on the exchange rate regime was deliberately made public in advance of its implementation reflected the consensus that economic policies are more effective if they are **credible** to private economic agents. In particular, the credibility of the *Pacto* depended not only upon the conduct of monetary policy and exchange rate management, but also upon the perceived coherence of the overall macroeconomic program.

Over the course of seven years, the *Pacto* successfully brought inflation down from triple to single digit levels. This achievement was accompanied, however, by a sustained real appreciation of the peso, widening current account deficits, and a consumption boom followed by a post-boom recession. The devaluation of the peso at the end of 1994 and the subsequent economic crisis called into question the success of the overall stabilization program.

Economists who have analyzed the events leading up to 1994 have generated an ongoing debate on the causes of the economic crisis and on whether the Mexican authorities should have devalued the peso earlier. The objective of this dissertation is to demonstrate that, from the beginning of its implementation, private agents did not believe that the exchange rate regime included within the framework of the *Pacto* was credible. Further, this lack of credibility created incentives for private economic agents to substitute present for future consumption thereby sparking a consumption boom and larger current account deficits. This dissertation contributes to the debate over the cause

of the 1994 economic crisis by capturing the idea that the lack of credibility of government policy can jeopardize an entire stabilization program. Most of the studies within the credibility literature have focused on monetary policy to lower inflation rates by using a game theoretic approach. In these models, government policies are the endogenous outcome of the interaction between policymakers and private agents. More recent contributions treat government policy as exogenous and analyze stabilization programs in developing economies marked by high-inflation where credibility is a central issue. Both approaches face important technical and conceptual problems. Addressing some of these problems is an important contribution to the existing literature.

The purposes of this dissertation are to explain the stylized facts surrounding Mexico's stabilization program and to address the issue of lack of credibility in the permanent reduction of the rate of devaluation of the peso. In contrast to earlier models, beliefs held by private agents about the credibility of government policy are endogenously determined here. The model uses parameters estimated in other studies to make the results consistent with the structure of the Mexican economy. The model is calibrated and simulated to explore its ability to explain the observed consumption boom and bust.

Dynamic programming methods are used in order to avoid some of the technical and conceptual problems associated with the earlier credibility literature. In particular, the approach avoids problems about policy prescription associated with Lucas' critique to econometrics. The use of this technique has also the advantage of introducing expectations regarding future policy decisions into the decision problem of the private sector. This is a fundamental feature of the new approach to policy analysis.

The format for the dissertation is as follows. Mexico's macroeconomic performance from 1987 to 1994 is reviewed in Chapter 1. This chapter also discusses

exchange rate management as well as the results from the stabilization program. Chapter 2 reviews the literature on policy credibility including game theoretic models as well as examples of empirical research. The analysis shows that, while these models offer some insight into economic policymaking, they suffer from various conceptual limitations and technical problems. The structure of the dynamic model is introduced in Chapter 3. In addition, a perfectly credible exchange rate regime is simulated in this chapter. In Chapter 4, the model is modified to include the assumption that private economic agents believe, with certain fixed probability, that the government will renege on its announced exchange rate policy. Moreover, a dynamic model with endogenous credibility is introduced, where private economic agents update their beliefs every period. Private agents look at the current account of the balance of payments to form their beliefs about government behavior.

In Chapter 5, the dynamic model is simulated under several values of key parameters to gauge the reaction of the system to these changes. Moreover, the events leading up to the 1994 Mexican economic crisis are linked to key parameters of the model in order to analyze either the strengthening or the weakening of the credibility of the government's policy as time goes by. Final remarks and policy lessons close the chapter. Overall conclusions are presented in Chapter 6.

To summarize, this dissertation aims at establishing the importance of policy credibility as the driving source of the observed consumption boom and bust in the Mexican economy during the stabilization program and the resulting crisis. The following outcomes have been accomplished:

1. An examination of the macroeconomic events leading up to the Mexican economic crisis of 1994. In addition, the main results from the Mexican exchange rate-based stabilization program are analyzed.
2. A review of the current literature on policy credibility and of the theoretical and conceptual problems encountered in earlier models.

3. A contribution to the existing literature on policy credibility with a dynamic model which replicates the main stylized facts observed in Mexico during the *Pacto*. In contrast to earlier models, policy credibility is endogenous.
4. A contribution to the new approach to policy analysis by the use of dynamic programming methods. This technique has the advantage of taking into account both the dynamic character of credibility problems, and the expectations regarding future policy decisions into the current decision problem of the private sector.
5. A more thorough understanding of the causes of the 1994 Mexican economic crisis by capturing the idea that the lack of credibility of government policy can jeopardize an entire stabilization program.

CHAPTER 1

MEXICO'S MACROECONOMIC PERFORMANCE

1.1 Historical Perspective

From a historical perspective, high inflation rates and slow economic growth have been a recent phenomenon in Mexico.¹ From 1954 to 1970, real gross domestic product (GDP) registered an average rate of growth of 6.5 percent per year, well above a high annual population growth rate of 3.2 percent, and inflation averaged only 4.5 percent per year. Throughout this period, the exchange rate remained unchanged at 12.5 pesos per US dollar and the deficit of the public sector averaged just over 1 percent of GDP.

This period of stable growth can be attributed to a number of factors. First, the Mexican government prudently managed public finances which helped keep inflation rates low. Basic infrastructure projects such as railways, irrigation systems, electricity networks and roads were funded without the use of inflationary finance. Stability and infrastructure development increased the profitability of private investment which, combined with fiscal incentives to both domestic and foreign investors, helped channel resources into capital formation. Moreover, an inward looking import substitution development strategy, using tariff and non-tariff barriers to trade provided a captive market to investors, thus leading to rapid industrialization. Finally, a fast growing and increasingly important financial sector began to lend to private firms for long-term capital projects instead of the traditional practice of lending for working capital only.

¹ This section draws upon Aspe (1993), Cárdenas (1996), Dornbusch (1993), and OECD (1992).

The Mexican economy of the early 1980s, however, was showing signs of strain. The import substitution strategy, which had served Mexico for so long, had led to high prices relative to prevailing world prices for domestically produced goods, which were often of inferior quality. Mexican firms found that they had lost their competitiveness in world markets due to low quality products. In addition, a volatile political environment during the 1960s had culminated in the brutal suppression of student unrests in Mexico City in 1968. In order to regain political approval, the administration of Luis Echeverría decided to adopt populist policies which led to heavy deficit spending and monetary expansion.² In 1976, at the end of his presidency, inflation showed signs of acceleration, the public deficit increased to 9.1 percent of GDP, and the peso had to be devalued for the first time since 1954.

With large oil discoveries and the possibility of external borrowing at low interest rates, López Portillo, Echeverría's successor, embarked upon more aggressive public spending and monetary expansion policies. By 1982, foreign borrowing by the public sector was extensively used, not only to finance a large public deficit, which had increased to almost 17 percent of GDP, but also to defend the fixed exchange rate in the face of mounting speculation and capital flight.³ The reserve losses that followed forced the Mexican authorities to announce another devaluation and the moratorium of debt service on Mexico's commercial loans, thereby setting off the global debt crisis.

When President de la Madrid took power in 1983, he faced the worst economic crisis that Mexico had ever suffered. Persistently high fiscal deficits and lax monetary policy were causing rampant inflation. In order to service a large external debt, Mexico

² Populist policies emphasize economic growth and income distribution and deemphasize the risks of inflation and deficit financing. For a broader discussion see Dornbusch and Edwards (1993).

³ Estimates of capital flight in the 1980-82 period range from 17.3 billion to 23.4 billion U.S. dollars (Dornbusch, Goldfajn and Valdés, 1995).

was also transferring large amounts of resources to foreign banks. Furthermore, due to the perception held by international commercial banks that Mexico was unable to manage the economy responsibly, further credit to the Mexican government was being denied. In addition, four decades of protectionist trade had led to an export sector heavily dependent on oil. As a result, the overall level of exports began to contract as the price of oil began to plummet in the early 1980s.

As a response to the crisis, the de la Madrid administration adopted an economic program aimed at increasing the soundness of public finances as a precondition for inflation reduction and at improving the ability to service the country's external debt. The rate of devaluation of the peso was reduced as a strategy to lower the inflation rate, but the latter decreased slowly and the appreciation of the exchange rate negatively affected manufacturing exports.

Both the September, 1985 Mexico City earthquake and the sharp decline (53.4 percent) of the average dollar price of crude oil exports in 1986 severely affected any attempt to achieve those two goals. Public revenues from oil decreased from US \$14.7 to US \$6.2 billion, by an amount equal to the total agricultural output (Gil and Ramos, 1988; Aspe, 1993). The deterioration of the terms of trade due to the oil price collapse made a downward adjustment in the real effective exchange rate unavoidable, and the authorities let the peso depreciate well in excess of domestic inflation throughout 1986. Rapidly rising peso prices of imports and falling real incomes, brought about by the adverse terms of trade shock, led to a combination of accelerating inflation and slower growth in output.

In 1987, the economy experienced triple-digit rates of inflation, peaking at close to 160 percent per year. Although this is far lower than the rates experienced by many Southern Cone countries, the administration still felt that due to the close proximity to the US and previous low inflation experience, combating inflation should be their number one priority.

Period	President	Real GDP ^a	Inflation ^b	Exchange Rate ^c End of period Depreciation ^d
1954-70	n.a.	6.5	4.5	12.5 0
1971-76	Echeverría	6.4	14.2	22.7 12.7
1977-82	López Portillo	7.1	29.0	120.1 39.5
1983-88	de la Madrid	1.1	89.0	2,471.5 71.3
1989-94	Salinas	3.0	16.0	3,438.1 3.5

^a Average annual growth rate, 1980=100

^b Average annual growth rate, CPI, 1978=100

^c Pesos per dollar

^d Average annual depreciation

n.a. Not applicable

Table 1.1: Macroeconomic Indicators, 1954-1994.

Source: Own calculations based on Cárdenas (1996), tables A.4 and A.5; inflation rate for 1954-70 is from Aspe (1993).

1.2 Exchange Rate Management

In December, 1987 the de la Madrid administration launched a new stabilization program known as the "Pact of Economic Solidarity" (PSE or *Pacto*).⁴ In addition to the well-known policy recommendations of tight monetary and fiscal policies, such as spending cuts, realignment of public goods prices to reflect costs, broad-based tax reforms, and the privatization of a significant number of state-owned enterprises, the *Pacto* also included income policies. An important element was the agreement among the leaders of the main sectors of the economy: entrepreneurs, workers, farmers, and the government. This agreement took the form of a national-unity coalition which set guidelines for prices and wages.

One essential component of the program was the preannouncement of the future path of the exchange rate. This regime involved the public announcement of a fixed timetable of the exchange rate over a specified period with the explicit understanding that it would not be modified during that period. Table 1.2 shows, for example, that after December 15, 1987, during the initial stages of the *Pacto*, the Mexican authorities depreciated the controlled rate by 18 percent per year. Later, the peso was fixed to the dollar at \$2,257.50. Then, in December of 1988, the controlled exchange rate was subject to a preannounced daily depreciation of 1.0 peso per dollar per day, resulting in an annual nominal depreciation of 16.68 percent. In a span of more than seven years, the exchange rate regime was reviewed periodically at each *Pacto* renovation and was modified repeatedly. The major changes are listed chronologically in Table 1.2.

It was expected that the preannouncement of the exchange rate, as part of the overall stabilization package, would generate disinflationary effects by opening the

⁴ Salinas took power in December, 1988 and launched the "Pact for Stability and Economic Growth" (PECE), which was designed along the same lines as the PSE. For a complete description and chronology of events of both *Pactos* see Aspe (1992), (1993).

domestic economy to increased international trade and capital flows. That is, the exchange rate would act as a nominal anchor to curb inflation via increasing the likelihood that international competition would constrain domestic price-setting decisions.⁵

The adoption of an exchange rate band in November, 1991 was viewed as a useful way to allow for short-run flexibility of the nominal exchange rate without necessarily abandoning the role of the exchange rate as a key nominal anchor - a role that was now attributed to the preannounced central parity rate.

⁵ Trade liberalization measures were accelerated and maximum tariffs were lowered from 100 to 20 percent within the period of December 1987 to December 1988, and practically all import licenses were eliminated, except for the agricultural, automobile, petroleum, electronics, and pharmaceutical sectors. For a complete description of trade liberalization policies see Aspe (1993).

Announcement Date	Exchange Rate (pesos/dollar)		Exchange Rate Regime
	Market	Controlled	
15 Dec. 1987	2,227.50	2,198.50	Controlled rate depreciated by 18%; spread between controlled and free rate reduced to 1.5 %
28 Feb. 1988	2,297.50	2,257.00	Peso pegged to dollar at 2,257.50 pesos/\$
12 Dec. 1988	2,297.50	2,257.00	Daily preannounced depreciation of 1.0 peso/\$ per day
3 Dec. 1989	2,655.50	2,612.00	Daily preannounced depreciation of 0.80 peso/\$ per day
11 Nov. 1990	2,925.15	2,921.40	Daily preannounced depreciation of 0.40 peso/\$ per day
10 Nov. 1991	3,086.4	Free and controlled rates merged; introduction of fluctuation band with the band's ceiling crawling at 0.20 peso/\$ per day and the floor remained fixed at 3,051.20 pesos/\$
20 Oct. 1992	3,155.2	Rate of the crawl of the band's ceiling was increased to 0.40 peso/\$ per day
3 Oct. 1993	N\$3.2944	Crawling peg would remain at 0.40 peso/\$ per day, an implied annual rate of depreciation of 4.6 percent
20 Dec. 1994	N\$3.4712	15.3 percent depreciation of the band's ceiling, maintaining the same crawling peg of 0.40 peso/\$ per day

Note: On January 1, 1993 a new monetary unit -new peso- was introduced. One new peso is equivalent to one thousand "old" pesos (N\$1/\$1,000).

Table 1.2: Mexican Exchange Rate Management, 1987-1994.

Sources: Schwartz (1994); Aspe (1993); OECD (1992); Banco de México (1994).

1.3 Results from the Stabilization Efforts

While the Pacto achieved its primary goal of lowering inflation rates, several empirical irregularities arose after 1988. The following sections detail the main results from the Mexican exchange rate-based stabilization program.⁶

1.3.1 Slow convergence of the inflation rate to the devaluation rate

Price stability can be the immediate result of using the exchange rate as the nominal anchor. Indeed, a marked reduction of inflation rates was observed in the first few months following the implementation of the Pacto at the end of 1987. From annual rates of inflation in the triple-digit range, the stabilization program succeeded in bringing inflation down to the single-digit range: 19.7 in 1989, 18.8 in 1991, 8.0 in 1993, and 7.0 percent in 1994.

It was believed that under this program the inflation rate would quickly converge to the current rate of devaluation plus the inflation rate of Mexico's largest trading partner, the US. However, such convergence was never achieved. As Figure 1.1 illustrates, the inflation rate remained above the rate of depreciation during the whole implementation of the program. The initial rate of depreciation was 16.7 percent per year compared to a CPI inflation of 19.7 percent in 1989. The following year, the depreciation rate was lowered from 80 to 40 centavos (cents) per day, which implied an annual rate of

⁶ Evidence suggests that exchange-rate based stabilization programs implemented at several points in time in Argentina, Brazil, Uruguay, Chile, and Israel share the same "stylized facts" explained in this section for the Mexican case. See Calvo and Végh (1993); Kiguel and Liviatan (1992); Végh (1992).

depreciation of 9.8 percent compared to a CPI inflation of 29.9 percent. When the rate of depreciation was lowered to 20 centavos per day, the slow convergence of inflation was evident by 1992: the annual rate of depreciation that year was 1.42 percent compared to an annual rate of inflation of 11.9 percent.

As the depreciation of the peso against the dollar had been below Mexico's inflation differential vis-á-vis the United States, the country's real exchange rate had appreciated for most of the duration of the stabilization program. By January 1994, the real exchange rate had appreciated by more than 56 percent relative to the level prevailing in March, 1988, when the nominal exchange rate was fixed (Calvo and Mendoza, 1995). Wages in dollars, another measure of the real exchange rate, increased 13.8 percent from 1989 to 1993. An index of the real exchange rate on a multilateral basis shows a real appreciation of 76 percent over the 1987-93 period (Dornbusch and Werner, 1994). It is evident that prices in Mexico, on a dollar basis, had risen relative to those in the rest of the world.

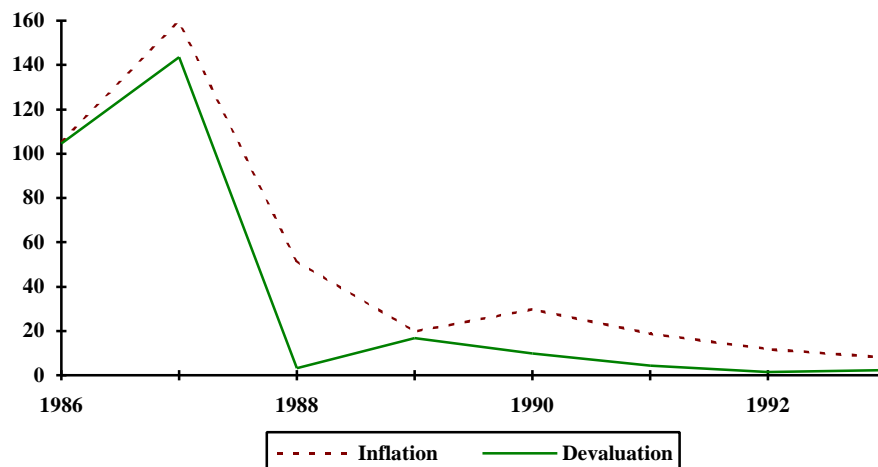


Figure 1.1: Annual Rates of Inflation and Devaluation (End of Period).
Source: Macro Asesoría Económica (1995).

The real appreciation was not due to higher inflation rates for tradable goods in the Mexican economy relative to the United States, but to persistent high inflation rates in nontraded goods. This led to a sharp increase in the relative price of nontradables, with the price index of non-tradables (services) growing faster than that of the tradables (durable goods) as shown in Figure 1.2.

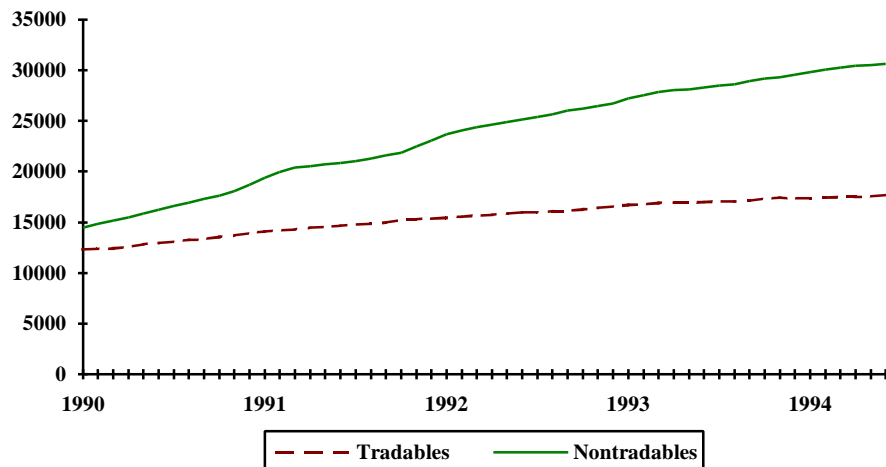


Figure 1.2: Price Index of Tradable and Nontradable Goods (1980=100).
Source: Macro Asesoría Económica (1993; 1995).

1.3.2 Deterioration of the Current Account

The real appreciation of the exchange rate (lower price of tradables with respect to non-tradables) resulted in a deterioration of the balance of trade by making imports and exports cheaper. Imports were encouraged and exports were discouraged. From 1987 to 1993, exports increased 11 percent per year, but imports increased 23 percent per year. As a consequence, the current account surplus of \$3.8 billion dollars in 1987 turned into a

large deficit of \$23.4 billion dollars in 1993. By 1994, the external imbalance widened even more to a \$28.8 billion dollars, a deficit equivalent to 7.7 percent of GDP.

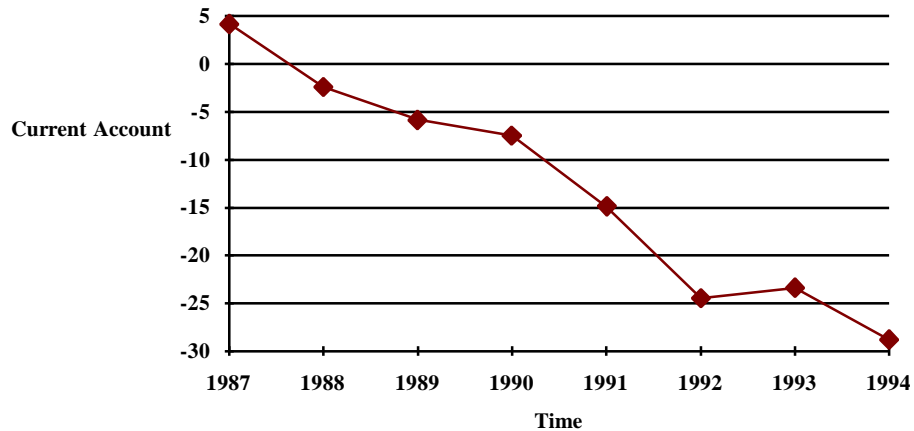


Figure 1.3: Current Account (Billions of Dollars).
Source: Nacional Financiera (1995).

The widening of the current account deficit in 1994 was a result of investment as a proportion of GDP remaining stable, from 23.2 in 1993 to 23.5 in 1994, combined with a fall in domestic savings of almost 1 percent of GDP, from 16.7 in 1993 to 15.8 in 1994. The decrease in domestic savings was entirely due to a decrease in public savings, which reflects the increase in government consumption during those years (Banco de México, 1994).

If we compare the period before the *Pacto* with the period immediately following its implementation, we see that there was a marked change in the composition of domestic savings. In particular, as the public sector shifted from being a negative-saving sector prior to the stabilization program to a positive-saving sector after the first two years of the implementation of the program, the private sector began to lower its level of savings dramatically, as shown in Figure 1.4. Moreover, the rising surplus of the

operational balance of the public sector implies that its real resource use no longer contributed negatively to the current account of the balance of payments. This clearly points out that a consumption boom driven by the private sector was in place, which concurrently lowered domestic savings and contributed heavily to the current account deficit.

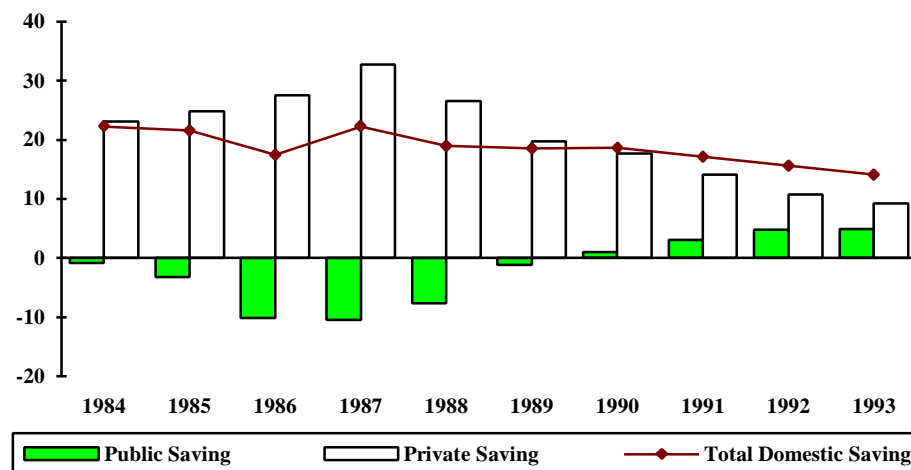


Figure 1.4: Domestic Savings, 1984-1993 (Percentage of GDP).
Source: Cárdenas (1996), cuadro V.3.

The current account deficits were financed by large capital inflows starting two years after the implementation of the Pacto. On the one hand, foreign direct investment averaged \$3.9 billion dollars per year in the 1989-1993 period. By 1994, this inflow registered a significant increase of 82 percent with respect to the previous year.⁷ Portfolio equity investment, on the other hand, helped by the proliferation of Mexican investment

⁷ Liberalization of the Foreign Investment Code began in 1984. Guidelines issued in 1989 further liberalized procedures and opened new areas of investment previously reserved to Mexican citizens and led to greater automaticity in granting approvals of investment projects. For a complete description see Ros (1994).

funds in international markets, jumped from \$0.5 billion dollars in 1989 to \$28.9 billion dollars in 1993, but then decreased to \$8.2 billion dollars in 1994 (Banco de México, 1994). In fact, most of these assets were quoted in the form of ADRs in the New York Stock Exchange, thus making them highly liquid. While liquidity made them particularly attractive to investors, it also made the flows more volatile and prone to reversals.

1.3.3 Consumption boom followed by a postboom recession

Two years prior to the *Pacto*, *i.e.* in 1986 and 1987, total private consumption decreased at an average quarterly rate of about 1 percent. The consumption boom started in the fourth quarter of 1988, when total private consumption increased by 4.5 percent in comparison to the previous quarter. The year of 1989 is the most striking example of the consumption boom phenomenon, when private consumption increased at an average quarterly rate of 6.3 percent. The upward trend in consumption followed until the second quarter of 1992. From Figure 1.5 we can see that at this point the consumption boom turned into a recession.⁸

⁸ Kiguel and Liviatan (1992) analyzed 12 different stabilization programs and showed that a boom-recession cycle has characterized both failed and successful stabilizations, with the recession often setting in before the program ends. See also Végh (1992).

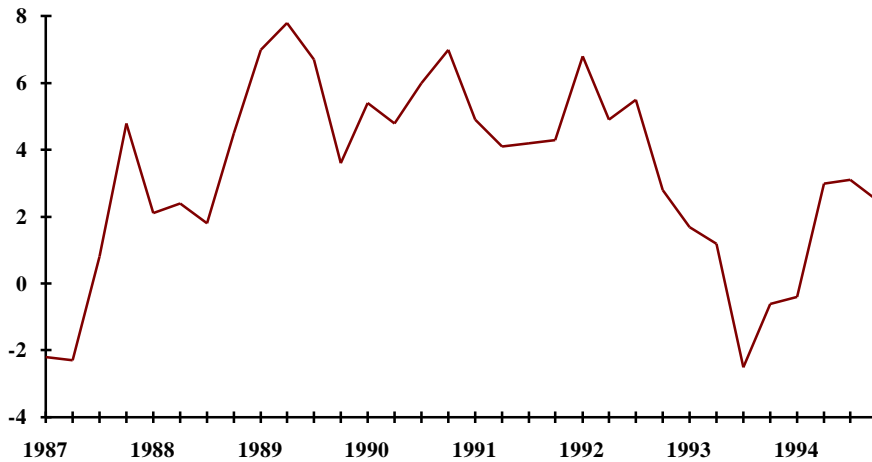


Figure 1.5: Real Private Consumption, Quarterly Change (1980=100).
Source: Nacional Financiera (1995).

1.4 The 1994 Mexican Economic Crisis

Although the *Pacto* did bring down the inflation rate in Mexico, the devaluation of the peso at the end of 1994 and the subsequent collapse of the Mexican economy calls into question its overall success. Economists who have tried to explain the events leading up to the devaluation have split into different points of view, which has generated an ongoing debate.

On one side are the economists led by Rudiger Dornbusch (1994, 1995), who argue that the stabilization program had brought GDP growth to a standstill and that the main culprit for the Mexican economic crisis was an overvalued currency. They point out that prices for domestic goods rose much quicker than prices for imported goods thus forcing the real exchange rate to appreciate. As a result, imports rose quickly while exports rose only modestly, leading to a widening in the current account deficit. In early

1994, they warned that the peso was already overvalued by at least 20 percent and growth was not going to return unless there was a real devaluation. Further, they reject the idea held by the Mexican authorities that productivity growth could keep Mexican goods competitive in world markets and thus avoid larger current account deficits. Oks and van Wijnbergen (1995) show, for example, that the productivity-adjusted ratio of US-Mexico manufacturing wages was only 1.026. That is, the unit labor cost differential was almost non-existent. Thus, any future appreciation of the peso would erode any external competitiveness it might have.

According to Dornbusch *et al.*, the authorities did not adopt their recommendations for devaluing the peso for political reasons, since it was an election year. Political unrest in the southern state of Chiapas and the assassination of the presidential candidate for the ruling party put pressure on the government to maintain an "all is well" policy through the election. By the time the new administration took over, devaluation was no longer an option but a necessity. On December 19, 1994, the Mexican authorities announced a widening of the exchange rate band ceiling by 15.3 percent. The peso then suffered a speculative attack by foreign investors who felt betrayed since they had been assured throughout the year that a devaluation would never happen. Two days later, with foreign reserves drying up, the Bank of Mexico was forced to allow the exchange rate to freely float.

In contrast to this view, the Mexican authorities have defended their policies by claiming that the peso was never overvalued. Schwartz (1994) pointed out that the exchange rate regime was credible and the exchange rate band was flexible enough to absorb any shocks to the economy. In fact, when the exchange rate regime was first adopted, not only did Mexico have large foreign exchange reserves, but it also was in the favorable position of having an *undervalued* currency, which would allow the exchange rate to appreciate without hurting its external competitiveness. Furthermore, they pointed to productivity growth in the industrial sector of 8 percent in 1994 as proof that Mexican

goods could stay competitive in world markets (Gil-Diaz, 1995). In addition, the approval of NAFTA coupled with earlier reforms would increase national wealth. When the first runs on the peso occurred in April, 1994 and then in November, which were successfully sterilized by central bank intervention, they were attributed to transitory political uncertainty, not to an overvalued currency. Thus, the Mexican authorities felt that any attempt to implement a managed devaluation would only accelerate the run on the peso.

Still, other economists argue that the collapse of the Mexican economy was due to an inadequate policy response to the political shocks of 1994. Sachs, Tornell, and Velasco (1995) show that in the aftermath of the assassination of Donaldo Colosio in March, 1994, the exchange rate experienced a nominal devaluation of close to 10 percent and interest rates increased by 7 percent. Even so, capital continued to flow out of the country. The government stubbornly insisted on maintaining the exchange rate regime and preventing any increase in interest rates. Interest rates were kept low by expanding domestic credit and converting peso-denominated government loans into dollar-denominated loans. The result was a sharp fall in foreign currency reserves and an increase in short-term dollar denominated debt. That is, the government became illiquid. Investors, realizing the vulnerability of the Mexican government, had little choice but to withdraw their funds since, if other investors stopped lending to Mexico, the Mexican government would be unable to repay their outstanding loans.

In the background of this debate lies the question as to whether the exchange rate regime was viewed by private agents as being credible, especially considering the fact that so much of the stabilization program was based on the preannouncement of the devaluation of the exchange rate. In fact, the success of the *Pacto* rested heavily on the assumption that private agents believed that the exchange rate regime was credible. If these agents did not believe in the announcement of the government, then it could be argued that their behavior would have repercussions on the economy, independently of the initial merits of the policy package. Specifically, if consumers perceived that the

announced devaluation rate would be only temporary and that it would change with some probability, then there was an incentive for them to consume heavily now before the exchange rate regime was changed. This intertemporal substitution would have real effects on the economy. A consumption boom would have put upward pressure on the real exchange rate causing an already overvalued peso to appreciate even further. The government would then be obliged to change its policy.

The credibility of the success of the stabilization program depended not only upon monetary policy and exchange rate management, but also upon the perceived coherence of the overall macroeconomic program. The slowdown of economic growth, the increase in wages in dollar terms, eroding any gains in productivity, and the increasing deficit of the current account were all signals to private agents about the unsustainability of the economic program. Moreover, there is also the possibility that the Mexican authorities were tempted to modify their announcement in response to political and social pressures, such as the assassination of Colosio, the official party's candidate, and the uprising in Chiapas. All these factors might have put pressure on the government to renege on its promise to defend the exchange rate and, as a consequence, credibility was weakened.

This dissertation contributes to the debate over the causes of the 1994 economic crisis by capturing the idea that the lack of credibility of government policy can jeopardize the entire stabilization program. Much of the literature on credibility has been devoted to explaining this phenomenon. In the next chapter I review much of what has been done in this area.

CHAPTER 2

THEORY ABOUT POLICY CREDIBILITY

In 1987, the Mexican authorities chose the goal of immediately reducing the inflation rate from three digits to one digit. Conventional macroeconomic theory suggests that, in order to achieve this goal, a set of contractionary fiscal and monetary policies must be adopted. For these policies to have the desired effect of lower inflation, it is important that they are perceived by the public as **credible** and **sustainable**. Until recently, macroeconomic theory explored the consequences of given exogenous policy rules while ignoring the possibility that the government may change these policies sometime in the near future. With the introduction of rational expectations theory, the analysis was extended to include the interdependence between the behavior of private, forward-looking agents, who may view government policy as neither credible nor sustainable, and policymakers. An important element of these theories is that government policy is not exogenous in the analysis.

This chapter reviews the theory about policy credibility. Section 2.1 outlines the general nature of the problem facing private agents; that is, the time inconsistency of optimal policies. Section 2.2 examines theories that model the reactive behavior of private agents and of the policymakers who set monetary policy by using game theoretic approaches. Section 2.3 looks at similar game theoretic models where policymakers use exchange rates as an integral part of a macroeconomic stabilization plan. It has been argued that fixed exchange rates provide a reputational constraint on government behavior. If the authorities renege on their promise on fiscal discipline and undertake an overly expansive credit policy, they will be forced to abandon the parity and devalue. Although the game theoretic approaches offer insights into government behavior, they

suffer from a variety of drawbacks which are summarized in Section 2.4. Section 2.5 focuses on empirical work in testing for policy credibility. Generally, these studies are applied to stabilization programs in high-inflation economies, particularly in Latin America. The different techniques used and their drawbacks are also considered. Section 2.6 explains the disadvantages of using econometrics in analyzing policy credibility and introduces the advantages of the dynamic model used in this dissertation.

2.1 Time Inconsistency of Optimal Policies

In macroeconomics, the analysis of policy credibility originated with the pioneering work of Kydland and Prescott (1977) and Calvo (1978). The credibility issue arises because the policymakers have an incentive to pursue a strategic advantage and seek short-run gains by renegeing on previously announced policies. The authors refer to this type of problem as the **time inconsistency** of optimal policies. This means that an optimal policy computed at the beginning of a planning horizon does not remain optimal at a later date.

Kydland and Prescott provide the following definition for the case in which expectations about future policies are considered. "A policy sequence $\{x_1, x_2, \dots, x_T\}$ is time consistent if, for each time period t , x_T maximizes [the objective function] $W(x)$, taking as given previous decisions x_1, \dots, x_{t-1} , and future policy decisions, $(x_s, s > t)$, are similarly selected" (p.475).

An implication of this definition is that if a policy is time consistent, the policymakers have no reason to revise their decisions at future moments of time, since the policy computed at the beginning of the planning horizon is still the best policy when re-optimizing at later dates.⁹

⁹ An optimal policy is said to be **time consistent** if, when recompute at a later date, we simply obtain a truncated version of the optimal policy calculated at the initial date, *i.e.* if it satisfies Bellman's Principle of Optimality (Petit, 1990). This principle states that "an optimal policy has the property that, whatever the initial state and decision

There are two sources of time inconsistent policies. The first one, emphasized by Kydland and Prescott (1977), refers to the lack of rules or institutional structures within the economy which limit the discretionary power of the authorities. Several solutions to address this problem have been suggested (Blackburn and Christensen, 1989):

(a) Policy decisions are associated with binding constraints imposed by some external commitment, like joining a fixed exchange rate system (such as the European Monetary System) or a gold standard.

(b) The use of explicit legislation, such as setting a prescribed rule for money creation or legally establishing an independent central bank that does not have the motives or strategic advantages that would otherwise weaken credibility.

(c) The commitment, on behalf of the policymakers, to pursue a national economic program by not yielding to outside pressure for change.

In addition to these solutions, it is theorized that policymakers can be threatened and "punished" if they are either unwilling or unable to commit themselves. This takes the form of informal mechanisms imposed by private agents, such as the threat of capital flight or high wage settings that may lead to inflation.

The second source of time inconsistent policies is described by Calvo (1978). Here, policy instruments, such as a distortionary tax on capital, have distortionary effects on the behavior of private agents. An example developed by Fischer (1980) illustrates this idea. A government interested in raising revenues has the option to tax capital or labor income.

The assumption is made that, if the government naively assumes that private agents do not form rational expectations about future government decisions, the optimal policy is to tax capital income. If the private sector is behaving rationally, however, this

are, the remaining decisions must constitute an optimal policy with regard to the state resulting from the first decision" (Bellman, 1957).

tax would tend to reduce capital accumulation, both present and future, and thereby, it would induce a decrease in tax revenues. This is the distortionary effect of a capital income tax on capital accumulation. The time inconsistency problem arises because the *ex ante* optimal policy, capital income taxation, is not optimal *ex post* and consequently lacks credibility if the policymaker is free to re-optimize.

An important implication is that if policymakers are able to make binding commitments to their announced policies, time inconsistency is not a serious problem. In Calvo's own words, "no inconsistency arises if the government optimizes at t_0 and abides by the dictates of that policy for all $t \geq t_0$; so one possible proposal could be constraining the government to do just that for a given t_0 " (p.1422).¹⁰

Time inconsistency and credibility are used equivalently, but the latter is a much broader concept. According to the statement of the problem, the literature has different definitions of policy credibility. The most general interpretation is that credibility is the extent to which beliefs about the current and future course of economic policy are consistent with the program originally announced by the policymakers (Blackburn and Christensen, 1989). Credibility is thus viewed as a measure of the degree to which policymakers "tie their hands" on future policies by issuing policy announcements.

Schelling (1982) and Taylor (1982) mention a number of factors that are likely to influence the credibility of policy announcements. Among these factors are the reliability of the data upon which policymakers condition their decisions and forecasts, the feasibility and controllability of policy instruments, the ability of a government to carry out a new economic program, and whether it will be tempted to modify this program in response to political pressures. Taylor argues that a new program should be superior to the program it is replacing if it is to be credible.

¹⁰ As Calvo (1978) points out, Bellman's Principle of Optimality holds when the constraints facing the planner at time t_0 are the same as those at time $t_0 + h$, $h > 0$.

Although the factors above are important for establishing credibility, the majority of the literature has focused on the strategic interactions of policymaking. Specifically, it has focused on the interdependence between the behavioral patterns of private rational individuals and centralized policymakers. This is discussed in the next section.

2.2 Models of Monetary Policy Credibility

Inflationary expectations have a significant influence on current wage and price decisions. It is essential for a policy, whose goal is to lower inflation, to be credible. This is why much of the work on credibility focuses on low-inflation monetary policies. This literature has developed to a large extent from Barro and Gordon's (1983) and Barro's (1986) seminal work on monetary policy, which is based on Kydland and Prescott's model. These authors emphasize the interdependence between the behavior of private, forward-looking agents and policymakers. To examine this interdependence, they use a game theoretic approach. The credibility issue emerges because, in seeking short-run gains, the policymakers may have an incentive to renege on their previously announced policies.

Barro and Gordon's exercise consists of an infinite number of repetitions of a single-shot game where the policymaker and the private sector minimize their respective loss functions. In particular, the policymaker minimizes the costs of inflation, while the private sector minimizes its forecast of inflation. It is assumed that both players know each other's loss functions; that is, the model presumes complete information. The assumption of an infinite time horizon is also necessary, so the game does not unravel backwards, leading to the non-cooperative Nash outcome for all periods.¹¹ The moves of

¹¹ Hahn (1982) demonstrates that in a rational expectations full-information world, money cannot exist in an economy of finite duration. This can be seen as follows: suppose that the economy terminates at some date T. At this terminal date, rational agents will refuse to hold paper money. At T-1, the same reasoning applies leading to a worthless money at every date.

the policymaker are the inflation rates, π_t , in each period t and those of the private agent are predictions of inflation, π^e_{t-1} , formed in period $t-1$.

A central assumption is that the policymaker has the scope to influence output by engineering inflationary surprises. Concerning this point, the authors discuss in some detail that, although high output and low inflation rates are desirable for the policymaker, there are benefits resulting from "surprise inflation", i.e. $\pi_t > \pi^e$. One source of benefits derives from the expectational Phillips curve, where the unanticipated monetary expansions lead to increases in real economic activity. Another source of benefits from surprise inflation are government revenues, such as proceeds from inflationary finance, and depreciation of government liabilities fixed in nominal terms.¹² An important outcome of the game is that policy commitment is welfare superior to discretionary policy, which results in a non-cooperative game. That is, if the government can credibly commit itself to low or no inflation, society will be better off. The problem is that policymakers find it difficult to make credible commitments and, in the absence of any constraints that "tie the government's hands," any promise of a low-inflation policy will lack credibility. Barro and Gordon answered this question by referring to punishment forces. Specifically, low inflation rates are sustained by beliefs that if the policymakers were to choose high inflation rates, the public would "punish" them by expecting high inflation in subsequent periods. This, in turn, drives up the demand for higher wages, further fueling inflation and increasing the government's loss function. Hence, the cost of cheating today involves an increase in inflationary expectations in the future.

¹² Barro (1983) focuses on the proceeds from inflationary finance. The expectation of inflation determines people's holdings of real cash balances at $t-1$. Surprise inflation depreciates the real value of these holdings, which allows the government to issue more new money in real terms as a replacement.

Similar to Barro and Gordon's approach, Barro (1986) modeled a game in which surprise inflation in the current period generates higher expected inflation in the future through a loss of government reputation. In contrast to the previous model, however, the credibility problem is examined in the context of a game with incomplete information. That is, the public is unsure about either the policymakers' preferences or about their technology for making commitments. The extent of **reputation** is understood to be a well-defined time-dependent state variable that would correspond to an outside observer's subjective probability that the policymaker is of type 1, capable of commitments so there is no incentive to deviate from zero inflation, or of type 2, with no capacity to make commitments and, therefore, the temptation to create surprise inflation.¹³ As the policy is observed, however, the private sector gradually gathers information and learns about the actual priorities of the policymakers. This means that each player's beliefs must be consistent with a Bayesian updating process.¹⁴

The outcome of the game is also in contrast with Barro and Gordon's, since it admits the possibility of fluctuations in inflation and output which depend on the finite time horizon of the game, the rate of discount, and the stock of reputation.

Backus and Driffill (1985) constructed a game theoretic model close to Barro's. The main difference is that the game is symmetric in that both players, the government

¹³ Barro uses reputation and credibility as similar terms. However, there is an important distinction between the two. Reputation refers to a government, while credibility refers to a given policy (Agénor and Taylor, 1992).

¹⁴ The equilibrium in this model, derived on the basis of Bayes' rule, is a set of strategies and posterior beliefs that satisfy the following conditions: (i) in every period, the strategies of the private sector and the government's policy rule are optimal, and (ii) given the equilibrium policy rules followed by the two types of government, the posterior beliefs of the private sector are derived from the prior and the observation of government policy in period 1. For further discussion see Persson and Tabellini (1990).

and the private sector, do not know the identity of the other. As in Barro's, the main feature of their model shows that, even with a finite time horizon, the ideal policy of zero inflation can be sustained for a while by reputational forces. Moreover, they also show that the same reputational forces will increase the costs of disinflation by raising expectations of inflation above the actual rate.

Andersen (1986) took a different approach and considered a policy game under an asymmetric information structure where the policymaker has access to information not readily known to the private sector. Specifically, the policymaker has an incentive to either (i) misrepresent its information (money supply) to manipulate inflationary expectations and hence create an output effect or (ii) truthfully reveal its information. Within a one-shot game, this author analyses these incentive problems under rules such as a constant money supply and discretionary policy. One important result of the game is that private agents are never worse off under discretion than under a rule. This may provide some explanation for why discretionary powers are granted to the monetary authorities.

The time inconsistency problem can thus be overcome by punishment or by reputational forces. Another way to overcome it is to delegate policy to individuals who do not share the public's view about the relative importance of output and inflation. Rogoff (1985) developed this idea and demonstrated that inflation- and hence expected inflation- is lower when monetary policy is controlled by someone who is known to be especially averse to inflation.¹⁵ Therefore, society can make itself better off by appointing a policymaker who places a greater weight on inflation prevention.

¹⁵ In a recent study, Alesina and Summers (1993) constructed an index of central bank independence for 16 industrialized countries and show that inflation rates do tend to be lower on average in economies where this institution has a greater degree of autonomy.

2.3 Models of Exchange Rate as a Policy Instrument

The literature on the use of the exchange rate as an anchor for the domestic price level has focused recently on the credibility effect of the government's commitment to defend the parity. If the authorities' commitment is not credible, private agents will expect higher prices and any attempt to reduce inflation will be very costly. In this case, establishing credibility means that the public is convinced that the government is not going to deviate from its exchange rate target in order to secure the short-run benefits that arise with surprise inflation.

Horn and Persson (1988) developed a game theoretic model based on Barro and Gordon's (1983) framework, but related it to credibility in an exchange rate system. Their results are qualitatively similar to those of Barro and Gordon's, where the commitment solution provides a better outcome than the discretionary alternative and, therefore, people are better off. This supports an argument in favor of a fixed exchange rate, assuming the commitment can be made binding and perceived as such by wage setters or trade unions.

An important contribution from Horn and Persson to the previous analysis is that a change in government regime is likely to eliminate inflation and inflationary expectations in the short run with no loss in output. In the medium term, unions demand higher wages if they believe that there is a positive probability that the new regime, an expansionary type, is going to devalue the domestic currency. At the end of the game, when the new policy is again credible, the union sets wages accordingly and output returns to the full-employment level. In this sense, as in Barro's (1986) model, Horn and Persson admit the possibility of fluctuations in inflation and output which depend, in this case, on the credibility of the government's policy announcement.

Andersen and Risager (1991) constructed a model where the credibility issue relies, this time, on the government's "stable prices" announcement as its major goal and,

hence, the authorities declare that they will adhere to a tight, fixed exchange-rate policy. They assume that from the beginning of the game, policy announcements lack credibility because the private sector is well aware that the government may have an incentive to renege. In this type of setting, the consequences of disinflation are quite different from Barro and Horn's and from Persson's, since Andersen and Risager show that there exists an equilibrium where disinflationary policy is bound to lead to a loss in output in the short run. Specifically, private agents may attach a non-zero probability that a type 2 policymaker will start out by generating high inflation so that a recession may emerge at the beginning of the game and not just during the period of fluctuations.

In recent work, Agénor (1994) discusses the role of credibility factors in the conduct of exchange rate policy in developing countries. The exchange rate is determined by a policymaker who cares about external competitiveness and price stability. The players involved in this strategic game are the price setters in the non-tradable sector and the government. Under perfect information about the policymaker's preferences, the optimal strategy is a fixed exchange rate provided that the discounted future costs of inflation are less than the current gain from an exchange rate devaluation.

The analysis also considers how reputational factors and signaling considerations may help mitigate the time inconsistency problem faced by the policymaker when choosing an exchange rate policy. Barro's (1986) argument on reputational forces is extended and credibility can be achieved, in this setting, if the policymakers worry enough about their reputation and if they balance future losses of credibility against immediate prospective balance-of-payments gains.

When considering signaling factors, fixing the exchange rate or lowering the rate of depreciation of the exchange rate may prove successful for the anti-inflationary policymaker to "reveal its type" and, therefore, enhance the credibility of a stabilization program. This result provides an interesting argument in support of an exchange rate freeze in stabilization programs like the ones pursued by Latin American countries and

Israel. Agénor also argues, however, that there are situations in which signaling considerations in developing countries are incapable of mitigating the time inconsistency problem of a fixed exchange rate. For instance, if a country faces an unsustainably large current account deficit and financing constraints, any attempt in signaling the anti-inflationary commitment of the policymaker is futile and a "high" rate of depreciation will appear inevitable.

It has been argued that forming a monetary union within which a group of countries adopt a common currency and fix their parity against a major currency, like the European Monetary System, is an alternative way to attach credibility to a fixed exchange rate regime and signal the policymaker's commitment to low inflation (Giavazzi and Pagano, 1988; Lane and Rojas-Suárez, 1992). Agénor briefly examines these issues and suggests that when a country is subject to large nominal shocks, it may be optimal to alter the exchange rate. Thus, such monetary arrangements should provide some degree of discretion through an escape clause mechanism, provided that devaluations occur only under exceptional circumstances.

2.4 Limitations to Game Theoretic Models

One important outcome of some of the game theoretic models is that society is better off under certain situations. One objection to this approach is that these models are simply not detailed enough to draw definite conclusions about social welfare. They rely on an arbitrary specification of society's preferences while budget sets and endowments are not spelled out. Therefore, any claim about the economic agents' welfare is unconvincing (Blackburn and Christensen, 1989; Persson, 1988). Another limitation of these models is that the choice of the commitment or punishment period is determined arbitrarily in the majority of the models (Levine, 1990). Moreover, as in most repeated games, the models that introduce reputation as a way for pre-commitment suffer from the

problem of having many possible reputational equilibria and the government and all private agents must "coordinate" one of them (Persson, 1988).

Finally, although game theoretic models have certainly contributed to credibility theory and have provided useful insights into the policy problem, an important limitation is that empirical work is difficult in this case. Theory suggests that inflation is related to such variables as the policymakers' ability to commit, their ability to establish reputation, punishment mechanisms, timing, and the degree of aversion to inflation, all of which are hard to measure. If credibility theory is going to offer useful additions to existing interpretations of events or reveal previously unexplained phenomena, empirical research is necessary. The following section reviews this area of investigation.

2.5 Empirical Evidence on the Credibility Hypothesis

To date, there has been very little empirical analysis of credibility problems (Persson, 1988; Blackburn and Christensen, 1989; Persson and Tabellini, 1990). Credibility issues are likely to show up, however, in many areas of macroeconomic policymaking and vary according to the statement of the problem. This section focuses more on critical aspects of the different methods employed for empirical research rather than on the results of the papers, as some of the techniques used are not well suited to the problem addressed and have led to highly suspect estimation results.

Some empirical analyses have made use of the prediction error method as a technique in testing for credibility effects (Christensen, 1987; Kremers, 1990). This method consists of estimating, over the pre-reform period, a model of the inflationary process and forming predictions over the post-reform period. If such predictions overestimate the inflation rate during the new policy regime which actually shows lower inflation (*i.e.*, if there are negative forecast residuals), the disinflationary policy is regarded as credible. The logic for this is that the model does not take into account such a regime change and, therefore, it ignores the effect this change has on expectations.

There exist, however, some drawbacks to the prediction error method. The first one is the nature of the method itself, which depends on a rather tenuous comparison between two distinct policy regimes. Since the prediction errors might explain almost anything not considered explicitly in the regression model, this procedure is generally unsatisfactory in testing for the credibility hypothesis. The second disadvantage has to do with the particular models to which the test is applied. It is argued that variables that adjust sluggishly, such as inflation, employment, and output, are not well suited for testing the forward-looking aspects involved in the theory (Blackburn and Christensen, 1989).

Baxter (1985) took a different approach in her attempt to measure the credibility of the introduction of a pre-announced exchange rate policy in Argentina and Chile in the late 1970s. She used a Bayesian learning procedure in which the credibility of a policy is defined as the public's subjective probability that the government is pursuing a reform policy rule. In her model, rational agents look, beyond exchange rates, at the total government policy package of monetary and fiscal policies. The results of the analysis show that the measure of policy credibility declined over time for Argentina but not for Chile. A partial explanation for this is the fact that Chile established a tight fiscal reform, while Argentina maintained a high fiscal deficit throughout the reform period. Consequently, Argentines attached a positive probability to the event that the reform would be abandoned in the future since the fiscal policy was incompatible with the reformed monetary policy.

Even though the Bayesian approach is closer to the spirit of the theoretical models of credibility and reputation, it has some disadvantages. If policy announcements are correlated with some omitted variables, it is difficult to distinguish between changes in the goodness of fit of the time-series model generating expectations and changes in policy credibility. Furthermore, the results can be more misleading if the relationships

between the policy announcement and other relevant variables change during the sample period (Agénor and Taylor, 1992).

Agénor and Masson (1995) used a model that captures the effect of credibility and reputational factors on exchange rate expectations in the lead-up to the December 1994 crisis of the Mexican peso. Expectations of exchange rate changes depend on the probability that the policymaker is "weak" or "tough" and the *ex ante* probability that a given type will decide to devalue in the light of a shock to official reserves. The former probability is updated using a Bayesian procedure.

The static regression's results, using the differential in interest rates for Cetes (short-term treasury bills denominated in pesos) and Tesobonos (short-term dollar liabilities denominated in pesos) as a measure of devaluation expectations, show that prior to the peso collapse in December 1994 there were no significant increase in devaluation fears and no perceived shift in the authorities' policy priorities.

Some obvious drawbacks of the type of framework used by Agénor and Masson lie in the fact that the regression results depend crucially upon a particular belief of the private sector. That is, devaluation expectations reflect the assessment about the policymaker "type," which has a major influence on the evolution of reputational factors. It is not clear, however, where this assessment comes from or what determines it. Furthermore, these authors focus on credibility problems that start to arise only towards the period leading to the collapse of the peso, even though the Mexican stabilization program was being implemented since December 1987. Certain important events that occurred before the crisis, like changes in monetary and fiscal policies, are not considered in the model and consequently some of their final conclusions may be biased.

Chapter 1 showed that the Mexican exchange rate-based stabilization program was accompanied by an initial expansion of private consumption followed later on by a contraction. This behavior has also been observed in other exchange rate-based stabilization programs in high-inflation countries such as Argentina, Chile, Uruguay,

Brazil, and Israel (Kiguel and Liviatan, 1992; Végh, 1992). This consumption cycle has been attributed to lack of credibility in the program, in the sense that rational agents view the reduction in the devaluation rate as temporary (Calvo, 1986; Calvo and Végh, 1993). Reinhart and Végh (1995) tested the empirical evidence of this lack of credibility or "temporariness" hypothesis by comparing the predictions of a simple model to the actual figures for six major exchange rate-based stabilization programs. Specifically, the model yields a closed-form solution for consumption as a function of the inter-temporal elasticity of substitution, the time path of the nominal interest rate, and the credibility horizon (the number of periods that the program is expected to last). Assuming that the initial nominal interest rate is expected to prevail again at some time in the future, they compute the predicted increases in consumption for each stabilization program.

The main conclusion that emerges from the analysis is that in those episodes where the nominal interest rates fell substantially (*Austral*, *Cruzado*, Israeli and *Pacto*), the predicted increase in consumption is of an order of magnitude that compares well with the actual figures. Particularly, the lack of credibility hypothesis accounts for 82.7 percent of the actual increase in consumption under the Mexican *Pacto*.

2.6 Econometric Policy Evaluation and the Lucas Critique

Besides the disadvantages of the different methods mentioned above, another criticism is the lack of structural dynamics in the models. More adequate would be a dynamic approach in which the data could pick up the change in inflationary expectations due to the announced change in future policy. However, even dynamic models suffer from an important limitation of econometrics in testing for policy credibility.

The use of econometric models for policy evaluation relies on the assumption that the relationships which describe the behavior of economic agents are not altered as a consequence of variations in the environment. However, as is well known, Lucas (1976) established that this assumption is wrong and demonstrated the inherent instability of

reduced form relationships under perceived changes in the structure of the economy or policy regime. As he emphasized, "to obtain the decisions...we have to attribute to individuals some view of the behavior of the future values of variables of concern to them" (p. 26). Therefore, methods of policy credibility evaluation based on macroeconomic models that ignore these links can be misleading and induce policymakers to adopt the wrong policies.

As a consequence of the Lucas critique to econometrics, dynamic optimization methods have been used as a new approach to the analysis of policy evaluation (Petit, 1990). These types of methods have the advantage of taking into account both the dynamic character of the credibility problems considered and the expectations regarding future policy decisions into the current decision process of the private sector.

The model used in this dissertation is a variant of the model in Calvo and Végh (1993). This model is adequate for the use of dynamic programming methods, since it provides a simple and plausible explanation of the dynamics of the exchange rate stabilization policies applied to the Mexican experience. In particular, the structural dynamics captured in the model are key in understanding the outcome of the inflation stabilization program.

The dynamic model relies on inter-temporal consumption substitution effects as the key channel through which stabilization policies may have real effects. Analytically, the main advantage of the dynamic model is that no consumption boom and bust associated with the exchange rate-based program arises if the *Pacto* is fully credible. This feature of the model makes it easier to identify the lack of credibility of government's announcements.

Finally, the simpler version of the model allows for extensions, such as introducing endogenous credibility, without substantially changing the implications of the exchange rate-based stabilization program.

CHAPTER 3

THE DYNAMIC MODEL

Credibility has been defined as the extent to which beliefs concerning a given policy do match official announcements about the policy. Specifically, when the Mexican Government announces a permanent reduction in the rate of devaluation, private agents may or may not believe that the announcement is credible. The announcement is fully credible when private agents believe that there will be no future deviations from the announced policy. When the policy is not credible, private agents believe that there is a probability that in the next period the rate of devaluation will go back to its initial level.

The model used in this dissertation is a variant of the model in Calvo and Végh (1993). Along the lines of Calvo (1986), this model relies on inter-temporal substitution effects as the key channel through which stabilization policies may have real effects. Here, the model is run under two different scenarios. The first scenario, described in this chapter, assumes that private agents are naive and blindly believe in the government's claims. That is, policy announcements are considered fully credible. Using parameters estimated for the Mexican economy, the model is used to show how the economy moves to its steady state given some constant rate of devaluation. The dissertation then demonstrates how the economy adjusts to a new steady state, given that the government announces a permanent reduction in the rate of devaluation, under the assumption that this announcement is also fully credible.

Under the second scenario, described in the following chapter, the model is modified to include the assumption that private agents are rational and that they form their beliefs about the probability that the authorities renege or abide by their announcement by observing real economic variables.

The chapter proceeds as follows. Section 3.1 introduces a variant of Calvo and Végh's model, which is the basis for the full credibility and rational expectations scenarios. In Section 3.2, an infinite horizon dynamic model is developed in order to analyze the economic implications of a fully credible government announcement. Section 3.3 describes the numerical results. Concluding remarks are offered in Section 3.4.

3.1 Structure of the Model

Consider a small open economy inhabited by a large number of identical and infinitely-lived individuals that formulate optimal inter-temporal plans for consumption. The representative individual maximizes:

$$U(C) = \sum_{t=0}^{\infty} \mathbf{b}^t \frac{C_t^{1-\mathbf{s}}}{1-\mathbf{s}} \quad \mathbf{s} > 0, 0 < \mathbf{b} < 1, \quad (3.1)$$

where $U(\cdot)$, the instantaneous utility function, is increasing, twice-continuously differentiable, and strictly concave; \mathbf{b} is the subjective discount rate, and \mathbf{s} is the coefficient of relative risk aversion (that is, $1/\mathbf{s}$ is the inter-temporal elasticity of substitution).

Allowing for intra-temporal allocation of consumption of non-traded and traded goods, C is represented according to the following constant elasticity of substitution (CES) function:

$$C = (cnt_t^{\mathbf{r}-1/\mathbf{r}} + ct_t^{\mathbf{r}-1/\mathbf{r}})^{\mathbf{r}/\mathbf{r}-1} \quad \mathbf{r} > 0, \quad (3.2)$$

where cnt_t and ct_t denote consumption of non-traded (or home) and traded goods, respectively. The parameter \mathbf{r} denotes the intra-temporal elasticity of substitution between these two goods.

The representative individual is required to use money to carry out consumption purchases. Specifically, he is subject to a cash-in-advance constraint:

$$\mathbf{a}\left(\frac{cnt_t}{e_t} + ct_t\right) \leq m_t \quad \mathbf{a} > 0, \quad (3.3)$$

where \mathbf{a} is a parameter that can be interpreted as the length of time money must be held to finance consumption (Feenstra, 1985). The real exchange rate, e_t , is defined as the relative price of traded goods in terms of non-traded goods; that is, $e \equiv EP^T/PNT$, where E is the nominal exchange rate (in units of domestic currency per unit of foreign currency), P^T is the (constant) price of the traded good in foreign currency, and PNT is the domestic price of the home good. Real money balances in terms of traded goods are denoted by m ; that is, $m \equiv M\bar{E}P^T$, where M stands for nominal domestic money balances.

In addition, the consumer can hold an internationally traded bond, b , which yields a constant return in terms of traded goods equal to r . Thus, the overall budget constraint faced every period by the representative individual is:¹⁶

$$\frac{ynt_t}{e_t} + yt_t + (1+r)b_t = \frac{cnt_t}{e_t} + ct_t + i_t m_t + b_{t+1}, \quad (3.4)$$

where ynt_t and yt_t denote output of non-traded and traded goods, respectively. Note that the nominal domestic interest rate is denoted by i_t . Thus, $i_t m_t$ represents the rental cost of money holdings in terms of traded goods. Furthermore, if i_t is positive, the rational

¹⁶ In contrast to Calvo and Végh's model, the government sector is not modeled explicitly here as it does not add to the analysis. Specifically, all lump-sum transfers to private agents have no real effects since they originate from proceeds from money creation or seignorage. Moreover, Mendoza and Uribe (1997) have shown that a model in which seignorage and transaction costs are rebated to households as lump-sum transfers fails to account for key features of the data.

consumer will hold the minimum money balances necessary for consumption. In turn, equation 3.3 is binding.

Moreover, perfect capital mobility is assumed, which implies:

$$i_t = r + e_t , \quad (3.5)$$

where e_t is the policy variable and represents the rate of devaluation at time t . Thus, the nominal interest rate will change one-to-one should the government announce a change in the rate of devaluation, e_t ($e_t = \frac{(E_t - E_{t-1})}{E_{t-1}}$). It is important to emphasize that the rate of devaluation is exogenous. That is, the model does not consider the government's optimal policy problem of setting the devaluation rate.

Note that since the world price of the traded goods, P^T , is also exogenous, the real exchange rate adjusts only to inflation in the non-traded goods sector and to the rate of devaluation. That is:

$$e_{t+1} = \frac{E_{t+1} P^T}{P_{t+1}^{NT}} = \frac{(1 + e_{t+1}) E_t P^T}{P_t^{NT} (1 + p_{t+1})} = \frac{(1 + e_{t+1}) e_t}{1 + p_{t+1}} , \quad (3.6)$$

Consider now the supply side of the economy. It is assumed that the supply of traded goods is exogenously given and constant, *i.e.*, $y_t = y$. The supply of non-traded goods, y_{nt} , is demand-determined and follows the staggered-prices model of Calvo (1983). Under this framework, firms set prices in a non-synchronous manner, taking into account the expected future path of excess demand and of the average price level prevailing in the economy. Since only a small number of firms may change their individual prices at any point in time, the price level is a predetermined variable. Inflation, however, is free to jump because it reflects changes in individual prices charged by firms.

Some full employment level of output of non-tradables, \bar{y} , is assumed. Thus, the supply of non-traded goods is equal to the minimum of either the full employment level of output or the demand for non-traded goods:

$$y_{nt_t} = \min(\bar{y}, cnt_t), \quad (3.7)$$

If $cnt_t > \bar{y}$, the market for non-tradables is necessarily out of equilibrium, leading to price inflation as some firms increase their individual prices. Over time, the proportion of firms that have yet to respond to excess demand declines, so that inflation falls over time. Following Calvo's model, the rate of change, over time, in the inflation rate is negatively related to excess demand. Formally:

$$\dot{p} = -\xi D_t, \quad (3.8)$$

where \dot{p} ($= \dot{P}/P$) is the rate of change in the inflation rate of home goods, and $D_t = cnt_t - \bar{y}$ is a measure of excess demand in the home goods market. Furthermore, as equation 3.8 indicates, the *rate of change* in inflation is a negative function of excess demand, which implies that the greater the excess demand this period, the higher the prices set next period by individual firms and the lower the inflation rate will be next period. This inflationary behavior can be captured by the following linear rate of inflation:

$$P_{t+1} = \mathbf{j} (cnt_t - \bar{y}), \quad (3.9)$$

where ϕ represents the speed of adjustment of prices in the non-tradable sector. Equation 3.9 can be positive or negative indicating either price inflation or deflation depending on

whether demand for non-tradables is greater than or less than the full employment level of production \bar{y} .

Finally, the current account is given by:

$$ca_t = y_t + rb_t - ct_t, \quad (3.10)$$

where $ca_t = (b_{t+1} - b_t)$, represents the change in foreign bonds in the economy at time t . Equation 3.9 states that the current account balance is the difference between income and expenditure in traded goods.

3.2 Full Credibility Scenario

A scenario with full credibility can be developed as follows. It is assumed that before the policy announcement, the economy is at a steady-state equilibrium. Policymakers then announce at $t=0$ a permanent reduction in the rate of devaluation, from e^h to e^l , where $e^h > e^l$. Although there is a commitment to keep this promise, note that the policy may or may not be sustainable in the sense that the government is going *to be able* to continue it. Economic, social, or political factors may work to put pressure on the authorities to change their policy. According to theory, by renegeing on their promise, a time inconsistency problem will emerge. Nevertheless, the announcement is *viewed* by private agents to be fully credible and they believe that the rate of devaluation will stay at e^l forever.

Before formally presenting the dynamic model, the following notation is introduced:

Regime:

$$d_t \in \{h, l\}$$

where h represents the high rate regime and l represents the low rate regime.

Policy variable:

$$\mathbf{e} = \begin{cases} \mathbf{e}^h = \text{high devaluation rate} \\ \mathbf{e}^l = \text{low devaluation rate} \end{cases}$$

State variables:

$$e_t = \text{real exchange rate}$$

$$b_t = \text{bond holdings}$$

Decision variables:

$$ct_t = \text{consumption of tradable goods}$$

$$cnt_t = \text{consumption of non-tradable goods}$$

Payoff:

$$\frac{(cnt_t^m + ct_t^m)^{(1-s)/m}}{1-s}$$

State transitions:

$$e_{t+1} = \frac{(1 + \mathbf{e}_{t+1})e_t}{1 + \mathbf{j} cnt_t - \mathbf{j} y}$$

$$b_{t+1} = yt + (1+r)b_t - ct_t$$

Given this notation, the representative private agent chooses paths for cnt_t and ct_t to maximize the utility function (equation 3.1), given the CES functional form (equation 3.2), subject to the cash in advance and overall budget constraints (equations 3.3 and 3.4, respectively).

Substituting 3.3, holding with equality, into 3.4, the optimization problem is expressed as the following infinite horizon dynamic programming representation or Bellman equation in the state space comprised by e_t , the real exchange rate and b_t , bonds:

$$V(e_t, b_t) = \underset{cnt, ct \geq 0}{\text{Max}} \left\{ \left(\frac{(cnt_t^m + ct_t^m)^{(1-s)/m}}{1-s} \right) + \mathbf{B}V(e_{t+1}, b_{t+1}) \right\}, \quad (3.11)$$

subject to:

$$\frac{ynt_t}{e_t} + yt + (1+r)b_t - (1+i_t \mathbf{a}) \left(\frac{cnt_t}{e_t} + ct_t \right) - b_{t+1} = 0, \quad (3.12)$$

where $\mathbf{m} = (\mathbf{r} - 1) / \mathbf{r}$ and recalling that \mathbf{r} and $1/\mathbf{s}$ are the intra-temporal and inter-temporal elasticities of substitution, respectively. Note that the value function is the same under a low rate or a high rate regime, since either regime is considered to be fully credible and to last forever.

The first-order conditions with respect to cnt_t and ct_t and the Euler equations are:

$$(cnt_t^m + ct_t^m)^{\frac{1-s-m}{m}} (cnt_t^{m-1}) = \mathbf{B}^e \left[\frac{e \mathbf{j} (1 + e_{t+1})}{(1 + \mathbf{j} cnt_t - \mathbf{j} \bar{y})^2} \right] + \mathbf{q} \left(\frac{1 + i_t \mathbf{a}}{e_t} \right) \quad (3.13)$$

$$(cnt_t^m + ct_t^m)^{\frac{1-s-m}{m}} (ct_t^{m-1}) = \mathbf{B}^b + \mathbf{q}(1 + i_t \mathbf{a}), \quad (3.14)$$

$$\mathbf{I}(e_t) = \mathbf{B}^e \left[\frac{1 + e_{t+1}}{(1 + \mathbf{j} cnt_t - \mathbf{j} \bar{y})} \right] - \mathbf{q} \frac{ynt_t}{e_t^2} + \mathbf{q}(1 + i_t \mathbf{a}) \frac{cnt_t}{e_t^2}, \quad (3.15)$$

$$\mathbf{I}(b) = \mathbf{B}^b (1 + r) + \mathbf{q}(1 + r). \quad (3.16)$$

The shadow prices of the exchange rate and level of bonds are I^e and I^b , respectively, and q is the shadow price associated with the budget constraint.

Equation 3.14 equates the marginal utility of consumption of traded goods to the shadow price of the constraint, q , times the effective price of tradable goods, $(1+i_t)\mathbf{a}$, which consists of the market price, unity, plus the opportunity cost of money held per unit of traded goods consumed. The marginal utility of consumption of non-tradables, expressed in equation 3.13, can be interpreted in the same manner except that the right-hand side also includes the fact that consumers internalize their effect on the real exchange rate and inflation.

The demand for non-tradable goods can be found by dividing equation 3.13 by 3.14, which yields the following:

$$cnt_t = \left[\frac{\mathbf{I}^e A + \frac{q(1+i_t)\mathbf{a}}{e_t}}{\mathbf{I}^b + q(1+i_t)\mathbf{a}} \right] ct_t, \quad (3.17)$$

where

$$A = \left[\frac{e\mathbf{j}(1+e_{t+1})}{(1+\mathbf{j}cnt_t - \mathbf{j}\bar{y})^2} \right]$$

The above system of equations has important implications under a fully credible government announcement. Perfect capital mobility in equation 3.5 and the first-order conditions determine the time paths of consumption of tradables and non-tradables which, in turn, dictate how inflation and the exchange rate move to their steady-states. In particular, since agents blindly believe in what the government says, any announcement of a reduction (or increase) in the devaluation rate is perceived as permanent. If the devaluation rate is expected to prevail forever, the nominal interest rate is perceived to be

constant as well. This implies that the time path of the effective price of tradables, $(1+i_t\mathbf{a})$, is also constant over time, and there is no incentive to engage in inter-temporal substitution of consumption for this good. That is, the time path of ct will remain flat.

More formally, by definition, the inter-temporal elasticity of substitution measures the percentage change in the ratio of tradables at two different points in time in response to a percentage change in the price ratio:

$$\frac{1}{\mathbf{s}} = - \frac{\frac{\Delta(CT_{t+1}/CT_t)}{(CT_{t+1}/CT_t)}}{\frac{\Delta((1+E(i_{t+1})\mathbf{a})/(1+i_t\mathbf{a}))}{((1+E(i_{t+1})\mathbf{a})/(1+i_t\mathbf{a}))}} \quad (3.18)$$

Under the full credibility scenario, the expected effective price for tradable goods next period is the same as the current effective price. Thus, the ratio $(1+Ei_{t+1}\mathbf{a})/(1+i_t\mathbf{a})$ equals one. Since there is no expected change in the effective price of tradable goods, there is no inter-temporal substitution (*i.e.*, the ratio (CT_{t+1}/CT_t) is equal to one). This implies that both the time path of the effective price of tradables and the time path of ct are constant.

Finally, if ct is constant, then consumers can neither lower nor raise their level of assets as that would imply either a decrease or increase in future consumption of tradable goods. As a result, the level of bonds held by consumers is constant as well. Thus, from the current account equation, under a fully credible scenario, the change in foreign bonds is equal to zero which implies that ct is equal to its permanent income level, $yt + rb$.

3.3 Numerical Results

This section analyzes the Mexican stabilization program based on lowering the rate of devaluation to some new exogenously given level. The model is first simulated under the assumption that the government currently implements an exchange rate policy

where the rate of devaluation is relatively high, that is, $e = e^h$. The model is started away from the steady-state in order to show how the economy adjusts over time, given that the rate of devaluation is expected to remain at that level forever. Once the steady-state has been reached, the policy makers announce a reduction in the rate of devaluation from e^h to e^l , where $e^h > e^l$. This second exercise shows the adjustment of the economy to the new steady-state given that the new policy is also considered to be fully credible.

The system of equations 3.13 to 3.17 provides the framework for examining how the economy reaches the steady-state. The problem is solved by numerical methods to create a polynomial approximation of the shadow price function. The model is parameterized so as to make it roughly consistent with the structure of the Mexican economy during the stabilization program. The parameters $r = 1.107$ and $1/s = 0.43$, the intra-temporal and inter-temporal elasticities of substitution, are generalized method of moments estimates from the panel study of 13 developing countries by Ostry and Reinhart (1992); $a = 2.4$ is the estimate from Feenstra (1985); $b = 0.96$ is taken from Calvo and Mendoza (1994), and the world real interest rate $r = 0.04$ is from Mendoza (1995). In addition, let the full employment level of non-tradable goods, $\bar{y} = 100$, and the endowment of tradable goods, $y_t = 40$. The initial high rate of devaluation is set at $e^h = 15.6$ percent, which corresponds to the implied annual rate of depreciation pre-announced by the Mexican Government in 1988.

Starting the model away from the steady-state, Figures 3.1 - 3.3 show how demand for non-tradable goods, the exchange rate and the inflation rate adjust over time to their steady-state equilibria. Note from Figure 3.1, that the economy starts off with a very high level of excess demand for non-traded goods, due to a high initial exchange rate, which triggers an upward movement in prices for these goods. This, in turn, causes a decrease in the demand for non-tradables in the subsequent period. At the steady-state, the decrease in this demand is zero and the inflation rate is constant. In fact, since the exchange rate is also constant at the steady-state then, by equation 3.6, the steady-state

inflation rate is equal to the rate of devaluation ($\pi^{SS} = e^h$). That is, at the steady-state, the rate of inflation of home goods equals that of traded goods which, in turn, is equal to the announced annual devaluation rate of 15.6 percent (see Figure 3.3). It is worth mentioning that, at the steady-state, the demand for non-tradables is higher than the full employment level, \bar{y} . This arises from the way inflation is treated in the model.¹⁷ Specifically, by combining equations 3.6 and 3.9, the steady-state demand for non-tradable goods is the following:

$$cnt^{ss} = \frac{e^h}{j} + \bar{y}, \quad (3.19)$$

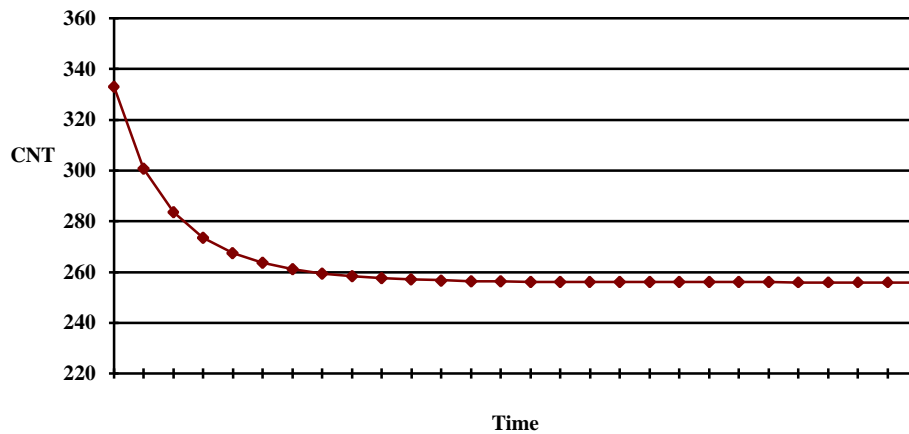


Figure 3.1: Steady-state path of consumption of non-tradables.

¹⁷ These results differ from Calvo and Vegh's in that, at the steady-state, in their model the demand for non-tradable goods is equal to the full employment level \bar{y} . At the steady-state there is still some price inflation in the non-tradable goods sector even when the demand for non-tradable goods is equal to \bar{y} . However, it is reasonable to think that at the steady-state, all firms would eventually bring their prices to the same price level. Thus, the only reason for continuing price inflation is if the demand for non-tradable goods is greater than \bar{y} .

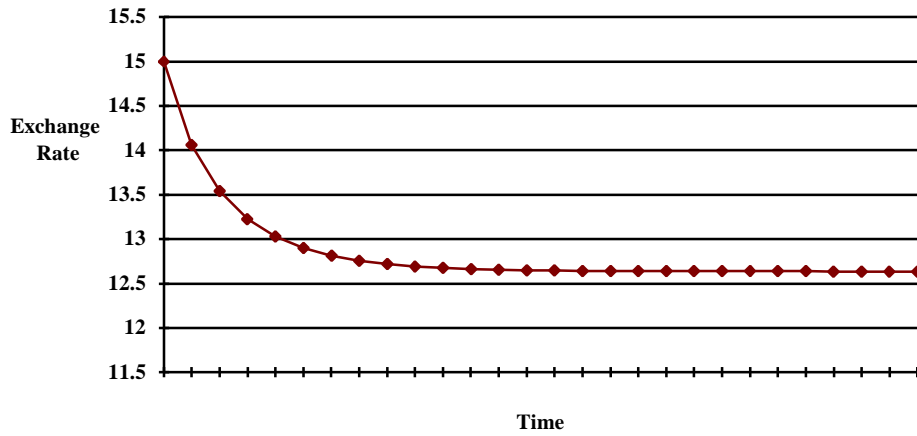


Figure 3.2: Steady-state path of real exchange rate.

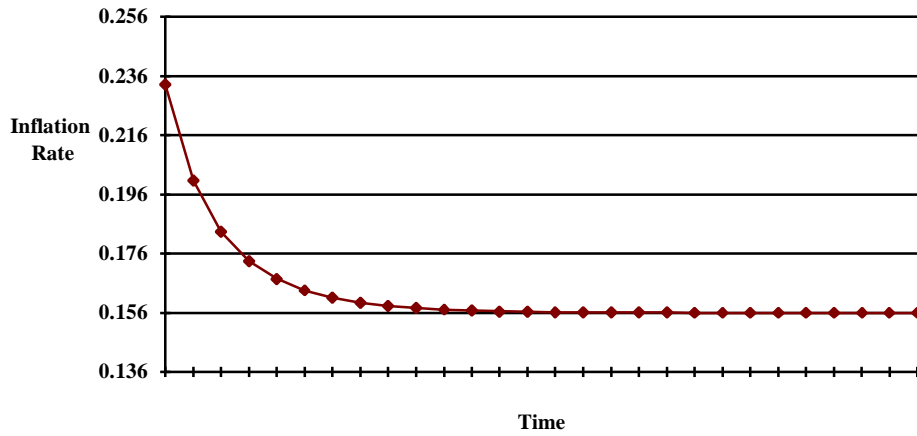


Figure 3.3: Steady-state path of inflation rate.

Now, suppose the economy is at the steady-state just described. At $t = 0$, the Mexican authorities announce that the rate of devaluation is permanently reduced from e^h

to e^l . Let $e^l = 4.6$ percent, which is the lowest implied depreciation rate announced by the government in 1993. Since the announced policy is fully credible, economic agents expect that the implied devaluation rate will stay at the low level indefinitely.

Perfect capital mobility implies that the fall in the rate of devaluation causes the nominal interest rate to immediately adjust to its lower steady-state value. Since the lower nominal interest rate is expected to prevail forever, consumption of tradable goods, ct_t , is still equal to the consumer's permanent level of income, $yt + rb_t$. Thus, under full credibility, the consumption of tradable goods is independent of the rate of devaluation. As Figure 3.4 illustrates, the path of ct_t remains flat because the representative consumer has no incentive to engage in inter-temporal consumption.

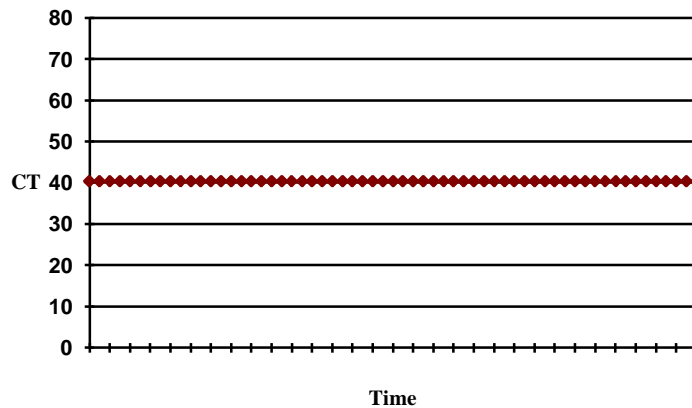


Figure 3.4: Time path of consumption of tradables under low regime.

Since ct_t remains constant under a full credibility scenario, regardless of what the devaluation rate is, the rest of the variables in the economy (consumption of non-tradables, the exchange rate, and the inflation rate) exhibit similar behavior as in Figures

3.1 to 3.3, when converging to their new steady-states. In particular, when the announced devaluation rate is lowered, by equation 3.6, the system is no longer at a steady-state since the current inflation rate is higher than the devaluation rate. This implies that the exchange rate continues to fall, as well as consumption of non-tradables, until the inflation rate converges to its new steady-state equilibrium ($p^{ss} = e^l = 0.046$). As a result of the fact that in the short run inflation is higher than the devaluation rate, there is an appreciation of the real exchange rate (see Figure 3.5).

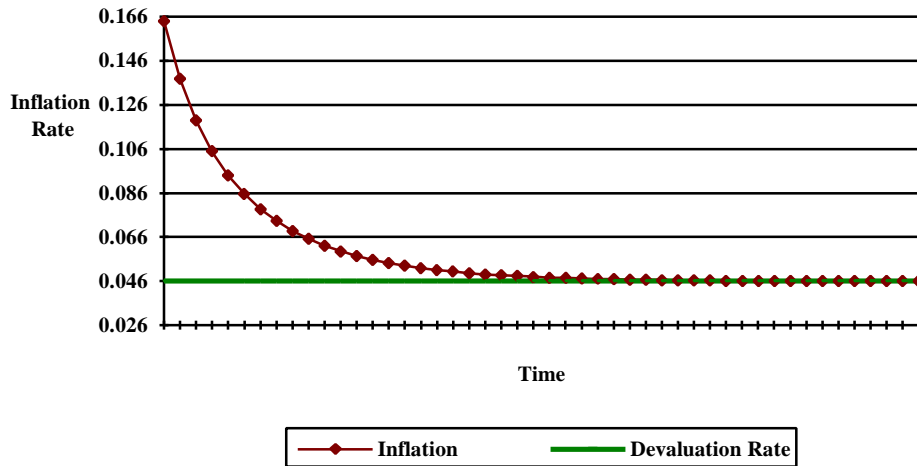


Figure 3.5: Inflation rate convergence to new steady-state in low rate regime.

These predictions of the model are consistent with only some of the main results from the Mexican exchange rate-based stabilization program, as described in Chapter 1. The Mexican authorities believed that under the *Pacto*, the inflation rate would quickly converge to the current devaluation rate. Such convergence, however, was never achieved. During most of the stabilization program, the inflation rate of home goods remained above the rate of devaluation, resulting in a sustained real appreciation of the

domestic currency. Moreover, empirical evidence also showed that the real appreciation was not due high inflation rates for tradable goods, but to persistent high inflation rates in the non-traded goods.

The full credibility model does predict the appreciation of the real exchange rate. However, this is only one of the empirical results that arose after the implementation of the *Pacto* at the end of 1987. In particular, the consumption boom and bust phenomenon and the deterioration of the current account are still left unexplained. To be able to account for these stylized facts, the lack of credibility of government announcements needs to be introduced.

3.4 Concluding Remarks

The structure of the model presented in this chapter is the basis for the two different scenarios of full credibility and rational expectations. In this chapter, the behavior of private agents under the full credibility assumption was modeled as an infinite horizon dynamic model in order to analyze the economic implications of a reduction in the devaluation rate within the context of a stabilization program. The dynamic model was then parameterized to make it consistent with the Mexican economy. The model contributes to the credibility literature by using dynamic programming methods, which allows for a more complete analysis of the time paths of real variables. That is, the model is capable of reproducing numerically what is seen in the literature. In contrast to Calvo and Végh's results, the model demonstrates how the economy looks away from the steady-state and at what speed the economic system moves toward convergence.

Numerical results show that, if the economy starts at a steady-state, a permanent reduction in the rate of devaluation that is fully credible results in a permanent reduction of the inflation rate to its new steady-state value. Also, since private agents view the government's announcement on the devaluation rate to be permanent, the time path of

consumption of tradables remains flat. In other words, if the exchange rate program enjoys full credibility, there is no inter-temporal substitution of consumption.

Empirically, the model replicates some of the stylized facts that arose after the implementation of the *Pacto*. Specifically, it shows a real appreciation of the domestic currency as the rate of inflation of home goods was initially above the devaluation rate until it converged to the steady-state value. The full credibility model, however, does not predict either a consumption boom and bust or current account deficits. Since these empirical facts are germane to the Mexican experience, it is important to modify the model to include the possibility that private agents do not believe government announcements and change their behavior accordingly. This is the focus of the next chapter.

CHAPTER 4

RATIONAL EXPECTATIONS DYNAMIC MODEL

In contrast to the full credibility scenario, this chapter addresses the question of how private agents react when the exchange rate regime is not credible. Here, agents are rational and do not believe blindly what the government claims. Thus, this chapter assumes that agents believe that there is some probability that the low rate of devaluation, e^l , announced by the government at $t=0$, will not be sustained and the rate will go back to its original level, e^h , next period.

The dynamic model built in this chapter deviates from previous studies and builds on the policy credibility literature in two important ways. First, it examines how agents form their beliefs about policy announcements. Second, policy credibility is endogenous in the model.

The private agent's perceived probability of the government renegeing on its commitment is modeled in two ways. In the first case, the economic agent's beliefs about the government announcement are considered to be a parameter that is fixed over time. In this case, policy credibility is exogenous and cannot be updated. In the second case, agents assess the government's ability to stick to its announced policy by looking at the performance of the economy. Specifically, the representative consumer bases his beliefs about the government either renegeing or abiding by its announcement by observing the current account of the balance of payments. Thus, policy credibility is endogenously determined.

This chapter is organized as follows. Section 4.1 describes, on the basis of theory, the likely sources of lack of policy credibility in the Mexican context. An infinite horizon model is developed in Section 4.2, where the representative individual believes that there

is a fifty percent probability that the authorities will renege on their promise and will devalue the exchange rate. The numerical results of the model under these assumptions are described in Section 4.3. In Section 4.4, the probability of renegeing is endogenized by making it a function of the current account. The corresponding numerical results are presented in Section 4.5. Final remarks close the chapter in Section 6.

4.1 Sources of Lack of Policy Credibility

Credibility is defined in the literature as the extent to which beliefs about the current and future course of economic policy are consistent with the program originally announced by the policymakers. There are a number of factors that are likely to influence the credibility of policy announcements. Among these factors are the feasibility and controllability of policy instruments and the ability of the government to carry out a new economic program. Also, there is the possibility that the authorities may be tempted to modify the program in response to political and social pressures.

Unquestionably, the *Pacto* program introduced at the end of 1987 was successful in bringing down inflation. As described in Chapter 1, however, the economic stabilization program had some flaws which may have caused economic agents to perceive that the *Pacto* was unsustainable. First, real appreciation of the exchange rate resulted in a deterioration of the current account by making imports cheaper relative to exports. By the second half of 1994, the current account deficit averaged \$2.5 billion dollars per month and was partly financed with losses of international reserves. Second, the claim by the Mexican authorities that high productivity growth could keep Mexican goods competitive was a fallacy. As Oks and Wijnbergen (1995) have shown, the productivity-adjusted ratio of US-Mexico manufacturing wages was only 1.026. Moreover, Mexican policymakers cited the high rate of growth in exports, but overlooked that wages increased, in dollar terms, 13.8 percent from 1989 to 1993, eroding any gains in productivity. Third, GDP growth slowed down reaching only 0.6 percent in 1993.

In addition, poverty, income distribution, and social problems were factors that might have put pressure on the government to renege on its announcement. In 1993, GDP per capita in constant dollar terms was still below its 1982 level (OECD, 1995). The uprising in Chiapas on January, 1994 was, in part, the outcome of the worsening standard of living of the most neglected segment of Mexican society, the Indian population.

By the end of 1994, there was a fissure in Salinas' cabinet between those who were convinced that growth was being sacrificed at the cost of low inflation and wanted an immediate devaluation and those who argued for restrictive monetary policy and rejected any devaluation (Aspe, 1995). That is, not everyone in the cabinet was convinced about the appropriate future course of economic policy and, moreover, some had doubts about the feasibility of the policy instruments to allow a continuation of the program. This is an important issue as the authorities might have thus signaled to economic agents not *being able* to keep their promise, resulting in less credibility of the program. With reduced credibility, the unsustainability of the program became a self-fulfilling prophecy.

Finally, according to theory, the lack of credibility of announced policies is due to the absence of institutional structures in the economy which limit the discretionary power of the authorities. Even though in 1993 the Mexican Congress passed new legislation on banking, the Bank of Mexico was far from being autonomous as the executive retained the power to decide on exchange rate policy. By not legislating a completely independent central bank, the government retained a strategic advantage. This circumstance might allow it to seek short run gains or yield to political pressures more easily. Since there was no legal mechanism to limit the discretionary power of the Mexican authorities, the probability of renegeing on the promise to defend the exchange rate was increased and, therefore, credibility was weakened.

4.2 Rational Expectations Model with Fixed Probability of Reneging

Agents are assumed to be rational and to believe that there is a positive and fixed probability, γ , that the low rate of devaluation e^l , announced exogenously by the government, will not be sustained and the rate will go back to its original high level, e^h , next period. Thus, $(1 - \gamma)$ is the probability that the government will abide by its announcement and keep the rate of devaluation at the lower level, e^l . This probability arises from the fact that the central bank is not autonomous and the Mexican government has discretionary power in exchange rate policy. That is, the lack of an autonomous institution, which does not have either the motives or strategic advantage to renege on its announcements, gives rise to the expectation of a devaluation of the exchange rate.

It is important to emphasize that γ represents the *beliefs* that private agents have about the credibility of the policy. It does not represent the true probability that policy makers will renege on their announcement. In other words, the government's behavior in setting the policy variable (*i.e.*, the devaluation rate) is considered to be exogenous to the model and what the model captures is the reaction of private agents to policy announcements.

The basic structure of the model is as described in Chapter 3. In addition, the following notation is introduced.

Regime:

$$d_t \in \{h, l\}$$

where h represents the high rate regime and l represents the low rate regime.

Policy variable:

$$e = \begin{cases} e^h = \text{high rate of devaluation} \\ e^l = \text{low rate of devaluation} \end{cases}$$

State variables:

e_t = real exchange rate

b_t = level of bonds

Decision variables:

ct_t = consumption of tradable goods

cnt_t = consumption of non-tradable goods

Payoff:

$$\frac{(cnt_t^m + ct_t^m)(1-s)/m}{1-s}$$

Regime Transitions:

If $d_t = h$, $d_{t+1} = h$

If $d_t = l$, $d_{t+1} = \begin{cases} h & \text{with probability } f(ca_{t-1}) \\ l & \text{with probability } [1 - f(ca_{t-1})] \end{cases}$

State transitions:

$$\text{If } d_t = h, e_{t+1} = \frac{(1 + e^h)e_t}{1 + j cnt_t - j \bar{y}}$$

$$\text{If } d_t = l, e_{t+1} = \begin{cases} \frac{(1 + e^h)e_t}{1 + j cnt_t - j \bar{y}} & \text{with probability } g \\ \frac{(1 + e^h)e_t}{1 + j cnt_t - j \bar{y}} & \text{with probability } (1 - g) \end{cases}$$

$$\text{If } d_t = h \text{ or } l, b_{t+1} = yt + (1 + r)b_t - ct_t$$

Value Functions:

$V_h(e_t, b_t)$ = High rate of devaluation value function

$V_l(e_t, b_t)$ = Low rate of devaluation value function

In this case, there are two value functions since private agents behave differently under the two devaluation regimes, high and low rate. When the rate of devaluation is high, it is assumed that agents believe that this policy is expected to last forever. This is the case of the full credibility scenario, described in Chapter 3. In contrast, when the rate of devaluation is low, the announced policy is viewed as being non-credible. As long as the low rate regime persists, there is always the possibility in every period that the government will renege on its announcement. Thus, the value function for the high rate regime is nested within the low rate of devaluation value function. Given these assumptions, the optimization problems for both regimes are expressed as the following two stochastic infinite horizon dynamic representations or Bellman equations.

$$V_h(e_t, b_t) = \text{Max}_{cnt, ct \geq 0} \left\{ \left(\frac{(cnt_t^m + ct_t^m)^{(1-s)/m}}{1-s} \right) + \beta V_h(e_{t+1}, b_{t+1}) \right\}, \quad (4.1)$$

subject to:

$$\frac{ynt_t}{e_t} + yt + (1+r)b_t - (1+i_t \mathbf{a}) \left(\frac{cnt_t}{e_t} + ct_t \right) - b_{t+1} = 0, \quad (4.2)$$

$$V_l(e_t, b_t) = \text{Max}_{cnt_t, ct_t \geq 0} \left\{ \left(\frac{(cnt_t^m + ct_t^m)^{(1-s)/m}}{1-s} \right) + \mathbf{b} \mathbf{g}^h(e_{t+1}, b_{t+1}) + \mathbf{b} (1-g) V_l(e_{t+1}, b_{t+1}) \right\} \quad (4.3)$$

subject to:

$$\frac{ynt_t}{e_t} + yt + (1+r)b_t - (1+i_t \mathbf{a}) \left(\frac{cnt_t}{e_t} + ct_t \right) - b_{t+1} = 0, \quad (4.4)$$

where $\mathbf{m} = (\mathbf{r}-1)/\mathbf{r}$, recalling that \mathbf{r} and $1/\mathbf{s}$ are the intra-temporal and inter-temporal elasticities of substitution, respectively.

The first-order conditions of the high rate of devaluation value function with respect to cnt_t and ct_t and the Euler equations are the following:

$$(cnt_t^m + ct_t^m)^{\frac{1-s-m}{m}} (cnt_t^{m-1}) = \mathbf{b}^e_h \left[\frac{e \mathbf{j} (1 + e^h)}{(1 + \mathbf{j} cnt_t - \mathbf{j} \bar{y})^2} \right] + \mathbf{q} \left(\frac{1 + i_t \mathbf{a}}{e_t} \right), \quad (4.5)$$

$$(cnt_t^m + ct_t^m)^{\frac{1-s-m}{m}} (ct_t^{m-1}) = \mathbf{b}^b_h + \mathbf{q} (1 + i_t \mathbf{a}), \quad (4.6)$$

$$I_h(e_t) = \mathbf{b}^e_h \left(\frac{1 + e^h}{1 + \mathbf{j} cnt_t - \mathbf{j} \bar{y}} \right) - \mathbf{q} \frac{ynt_t}{e_t^2} + \mathbf{q} (1 + i_t \mathbf{a}) \frac{cnt_t}{e_t^2}, \quad (4.7)$$

$$I_h(b_t) = \mathbf{b}^b_h (1+r) + \mathbf{q} (1+r). \quad (4.8)$$

Dividing equation 4.5 by 4.6, consumption of non-tradable goods in the high rate of devaluation regime is:

$$cnt_t = \left[\frac{\mathbf{b}^e_h A + \mathbf{q}(1+i_t \mathbf{a})}{e_t} \right]^{1/m-1} ct_t, \quad (4.9)$$

where

$$A = \left[\frac{e \mathbf{j} (1 + \mathbf{e}^h)}{(1 + \mathbf{j} cnt_t - \mathbf{j} \bar{y})} \right],$$

and recalling that \mathbf{q} is the shadow price associated with the constraint.

The first-order conditions of the low rate of devaluation value function, equation 4.3, subject to equation 4.4, with respect to cnt_t and ct_t and the Euler equations are:

$$\begin{aligned} (cnt_t^m + ct_t^m)^{\frac{1-s-m}{m}} (cnt_t^{m-1}) = \mathbf{b} \mathbf{g}^e_h \left[\frac{e \mathbf{j} (1 + \mathbf{e}^h)}{(1 + \mathbf{j} cnt_t - \mathbf{j} \bar{y})^2} \right] + \mathbf{b} (1 - \mathbf{g} l^e_l) \left[\frac{e \mathbf{j} (1 + \mathbf{e}^l)}{(1 + \mathbf{j} cnt_t - \mathbf{j} \bar{y})^2} \right] \\ + \mathbf{q} \left(\frac{1 + i_t \mathbf{a}}{e_t} \right), \end{aligned} \quad (4.10)$$

$$(cnt_t^m + ct_t^m)^{\frac{1-s-m}{m}} (ct_t^{m-1}) = \mathbf{b} \mathbf{g}^b_h + \mathbf{b} (1 - \mathbf{g} l^b_l) + \mathbf{q} (1 + i_t \mathbf{a}), \quad (4.11)$$

$$\begin{aligned} l_t(e_t) = \mathbf{b} \mathbf{g}^e_h \left(\frac{1 + \mathbf{e}^h}{1 + \mathbf{j} cnt_t - \mathbf{j} \bar{y}} \right) + \mathbf{b} (1 - \mathbf{g} l^e_l) \left(\frac{1 + \mathbf{e}^l}{1 + \mathbf{j} cnt_t - \mathbf{j} \bar{y}} \right) \\ - \mathbf{q} \frac{y n t_t}{e_t^2} + \mathbf{q} (1 + i_t \mathbf{a}) \frac{cnt_t}{e_t^2}, \end{aligned} \quad (4.12)$$

$$l_t(b_t) = \mathbf{b} \mathbf{g}^b_h (1 + r) + \mathbf{b} (1 - \mathbf{g} l^b_l) (1 + r) + \mathbf{q} (1 + r), \quad (4.13)$$

Under the low rate regime, the demand for non-tradable goods can be found by dividing equation (4.10) by (4.11), which yields the following:

$$cnt_t = \left[\frac{\mathbf{b}g_h^e A1 + \mathbf{b}(1-g)l_l^e A2 + \mathbf{q}\left(\frac{1+i_t\mathbf{a}}{e_t}\right)}{\mathbf{b}g_h^b + \mathbf{b}(1-g)l_l^b + \mathbf{q}(1+i_t\mathbf{a})} \right]^{1/m-1} ct_t \quad (4.14)$$

where

$$A1 = \left[\frac{e\mathbf{j}(1+\mathbf{e}^h)}{(1+\mathbf{j}cnt_t - \mathbf{j}\bar{y})^2} \right],$$

and

$$A2 = \left[\frac{e\mathbf{j}(1+\mathbf{e}^l)}{(1+\mathbf{j}cnt_t - \mathbf{j}\bar{y})^2} \right]$$

4.3 Numerical Results

The purpose of the following exercise is to analyze the time paths of economic variables under the low rate regime. That is, how do private agents react to a policy announcement that is not credible and how does their behavior affect the economy as this policy persists over time. In order to address these issues, numerical methods must be used to find the optimal solutions for cnt_t and ct_t under the low rate regime.

The low devaluation value function (equation 4.3) has the value function for the high devaluation regime (equation 4.1) nested within it. As a result, the system of equations for the low rate regime, equations 4.10 to 4.14, contain the shadow prices for the state variables, e_t and b_t , for both the high and low rate regimes. That is, under the low rate regime there are four equations and six unknowns. Thus, when solving for the

optimal solutions for cnt_t and ct_t under the low rate regime, it is necessary to compute the polynomial functions for the shadow prices under both the low and high rate regimes.

To be able to accomplish this, the optimal solutions for cnt_t and ct_t and the polynomial approximations for the shadow prices under the high rate regime (equations 4.5 to 4.9) are solved first using the same techniques described in Chapter 3. The high rate regime shadow price polynomials are then used to determine the optimal cnt_t and ct_t and shadow prices under the low rate regime. This makes the system of equations under the low rate regime identified, with only four unknowns and four equations.

The model is parameterized as in Chapter 3 to make it consistent with the structure of the Mexican economy. Now assume that the economy is initially at the steady-state described in Chapter 3, when the authorities announced a high rate of devaluation e^h . Then, at $t=0$ the policy makers make an exogenous announcement concerning a reduction in the rate of devaluation to e^l . It is assumed that the representative consumer believes that there is a fifty percent probability that in the next period the authorities will renege on the announcement and the devaluation rate will go back to its initial level, e^h , and a fifty percent probability that the authorities will abide by their announcement and keep the lower devaluation rate.

Figures 4.1-4.5 show the time paths for the key variables of the dynamic model with a fixed probability of renegeing. At $t=0$, the devaluation rate shifts to $e = e^l$ which, by the assumption of perfect capital mobility immediately moves the domestic nominal interest rate to a lower level (see equation 3.5). The last term on the right-hand side in the first-order condition 4.11 is the effective price of traded goods, which includes both the market price, unity, and the opportunity cost of holding money, $i_t \mathbf{a}$. However, since the policy is not credible, at $t=0$ the current effective price is lower relative to what next period's expected effective price will be. This induces a correspondingly higher consumption of tradables in the current period as shown in Figure 4.1.

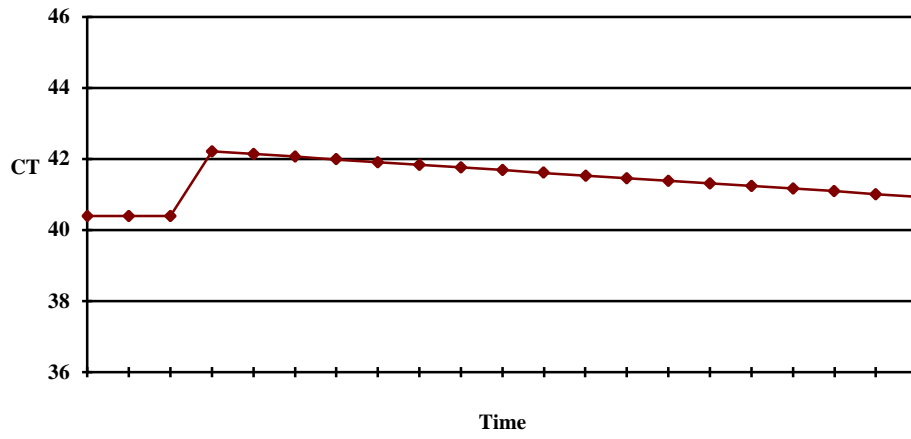


Figure 4.1: Consumption of tradables. Fixed probability of renegeing.

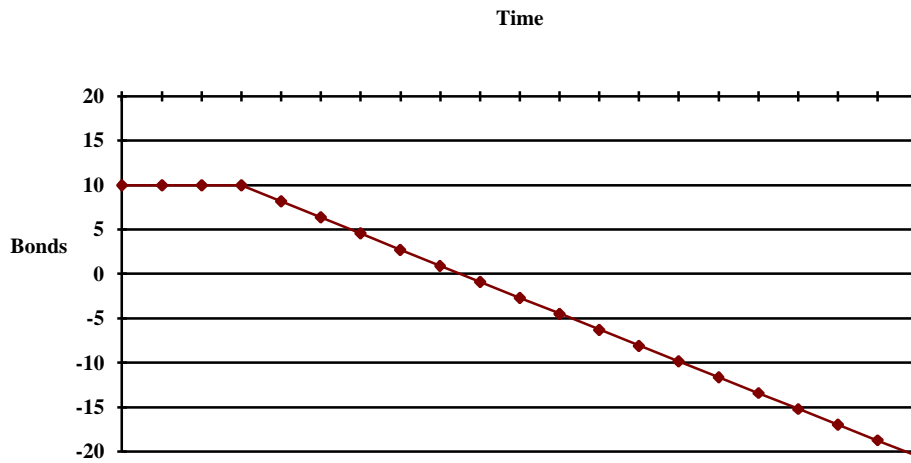


Figure 4.2: Level of bonds. Fixed probability of renegeing.

A key parameter of the dynamic model in determining the response of ct_t is the inter-temporal elasticity of substitution, $1/\sigma$. In particular, if the current effective price is lower than the future expected effective price then, today's consumption of traded goods is higher than in the future. The higher $1/\sigma$, the greater will be today's consumption relative to future consumption.

It is important to mention that as long as we are in the low rate regime, there is always the possibility that the government will renege on its announcement and the devaluation rate will return to its initial higher level. If this occurs, consumption of tradables will be equal to the permanent income level since the high rate regime is assumed to be credible. However, in order to consume more today, the level of assets (*i.e.*, bonds) must decrease, as shown in Figure 4.2. This, in turn, lowers the agent's future permanent income. Therefore, as long as $1/\sigma$ and the expected future effective price remain constant, a lower level of bonds must yield lower current consumption of tradables.

Note that the consumption boom in Figure 4.1 lasts only one period with a prolonged consumption bust starting at $t=1$. This is due to the fact that when the probability of renegeing γ is fixed, the expected effective price for all future periods is constant. Therefore, when policy credibility is exogenously determined and agents do not update their beliefs, a consumption boom cannot be sustained for more than one period.

Moreover, on impact, the rise in consumption of traded goods is accompanied by an immediate rise in the demand for non-tradables (see equation 4.14). Because this higher level of demand is greater than the full employment level \bar{y} , the inflation rate also increases. Since the inflation rate is greater than the devaluation rate, constant at 4.6 percent, the real exchange rate appreciates, which makes non-tradables relatively more expensive than tradables. As long as the exchange rate continues to appreciate, the demand for non-tradables falls. Thus, due to both the appreciation of the exchange rate

and a decline in consumption of tradables (from equation 4.14), the consumption of non-tradable goods exhibits a sharper declining path over time, as Figure 4.3 shows.

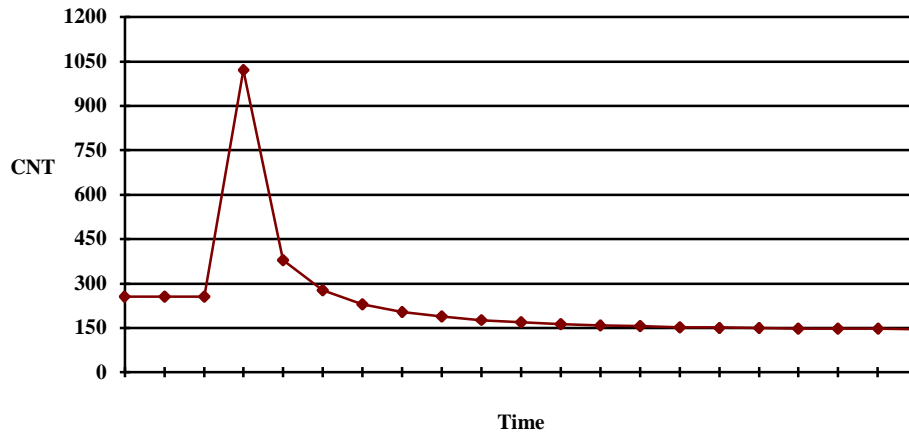


Figure 4.3: Consumption of non-tradables. Fixed probability of reneging.

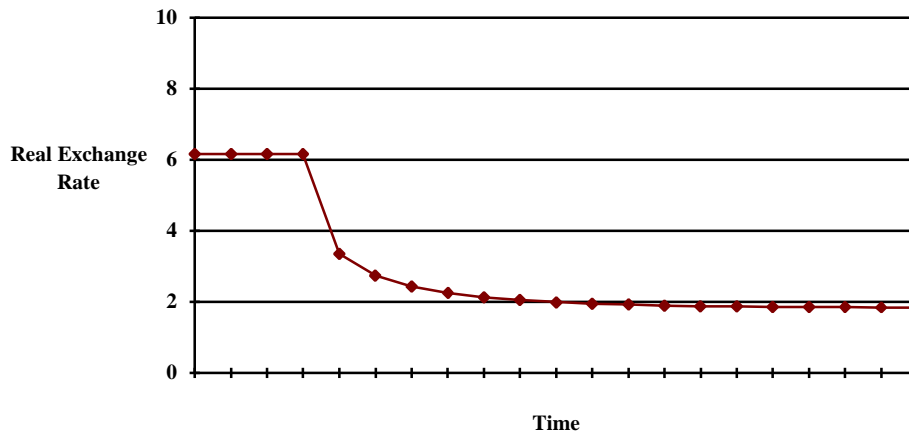


Figure 4.4: Real exchange rate. Fixed probability of reneging.

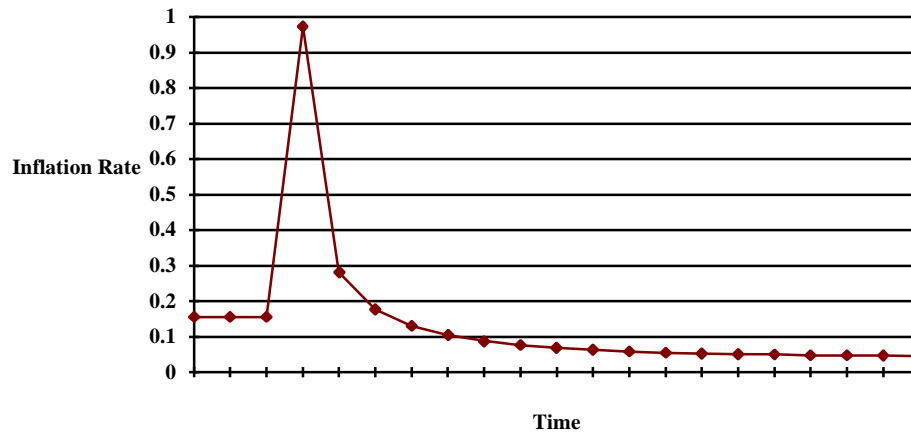


Figure 4.5: Inflation rate. Fixed probability of reneging.

4.4 Rational Expectations Model with Probability of Reneging as Function of the Current Account

The model presented in this section assumes that private agents form their beliefs about government behavior by looking at the current account of the balance of payments and, thus, policy credibility is endogenously determined. Current account deficits are assumed to put pressure on the government to increase the rate of devaluation. Specifically, the probability of reneging, γ , is a function of the current account. If the economy is running a current account surplus, then $f(ca)$ approaches zero, since there is less pressure for the government to change its policy next period. In contrast, a current account deficit suggests that government policy may need to be changed next period. Obviously, the larger the deficit, the greater the belief held by private agents that the government will change its policy and move the level of devaluation back to its higher initial level. In this case, as the current account deficit gets larger, $f(ca)$ approaches one.

Given these assumptions, the probability of renegeing as a function of the current account, ca , is:

$$g = f(ca_{t-1}) = \frac{1}{1 + h e^{ca_{t-1}}} \quad (4.15)$$

Equation 4.15 represents what is known as a logistic distribution function (Gujarati, 1995). The parameter η represents the economic agent's sensitivity to changes in the current account.

The notation for the model with the probability of renegeing as a function of the current account is as follows.

Regime:

$$d_t \in \{h, l\}$$

where h represents the high rate regime and l represents the low rate regime.

Policy variable:

$$e = \begin{cases} e^h = \text{high rate of devaluation} \\ e^l = \text{low rate of devaluation} \end{cases}$$

State variables:

$$e_t = \text{real exchange rate}$$

$$ca_{t-1} = \text{current account}$$

Decision variables:

$$ct_t = \text{consumption of tradable goods}$$

$$cnt_t = \text{consumption of non-tradable goods}$$

Payoff:

$$\frac{(cnt_t^m + ct_t^m)(1-s)/m}{1-s}$$

Regime Transitions:

If $d_t = h, d_{t+1} = h$

If $d_t = l, d_{t+1} = \begin{cases} h \text{ with probability } f(ca_{t-1}) \\ l \text{ with probability } [1 - f(ca_{t-1})] \end{cases}$

State transition:

If $d_t = h, e_{t+1} = \frac{(1 + e^h)e_t}{1 + \mathbf{j} cnt_t - \mathbf{j} \bar{y}}$

If $d_t = l, e_{t+1} = \begin{cases} \frac{(1 + e^h)e_t}{1 + \mathbf{j} cnt_t - \mathbf{j} \bar{y}} \text{ with probability } \mathbf{g} \\ \frac{(1 + e^h)e_t}{1 + \mathbf{j} cnt_t - \mathbf{j} \bar{y}} \text{ with probability } (1 - \mathbf{g}) \end{cases}$

If $d_t = h \text{ or } l, ca_t = yt + r(yt + rb_{t-1} - ca_{t-1} + b_t - ct_{t-1}) - ct_t$

Value Functions:

$V_h(e_t, b_t) =$ High rate of devaluation value function

$V_l(e_t, b_t) =$ Low rate of devaluation value function

The infinite horizon maximization problem for the rational representative agent is:

$$V_h(e_t, ca_{t-1}) = \underset{cnt_t, ct_t \geq 0}{\text{Max}} \left\{ \left(\frac{cnt_t^{\mathbf{m}} + ct_t^{\mathbf{m}}}{1 - \mathbf{s}} \right)^{(1-\mathbf{s})/\mathbf{m}} + \mathbf{B} V_h(e_{t+1}, ca_t) \right\}, \quad (4.16)$$

subject to:

$$\frac{ynt_t}{e_t} + yt + (1+r)b_t - (1+i_t \mathbf{a}) \left(\frac{cnt_t}{e_t} + ct_t \right) - b_{t+1} = 0, \quad (4.17)$$

$$\begin{aligned}
V_l(e_t, ca_{t-1}) = \underset{cnt_t, ct_t \geq 0}{Max} & \left\{ \left(\frac{(cnt_t^m + ct_t^m)^{(1-s)/m}}{1-s} \right) + \mathbf{b}^f(ca_{t-1}) V_h(e_{t+1}, ca_t) \right. \\
& \left. + \mathbf{b}(1-f(ca_{t-1})) V_l(e_{t+1}, ca_t) \right\}, \tag{4.18}
\end{aligned}$$

subject to:

$$\frac{ynt_t}{e_t} + yt + (1+r)b_t - (1+i_t \mathbf{a}) \left(\frac{cnt_t}{e_t} + ct_t \right) - b_{t+1} = 0. \tag{4.19}$$

The first-order conditions from the high rate of devaluation value function, subject to the constraint, with respect to cnt_t and ct_t and the Euler equations are:

$$(cnt_t^m + ct_t^m)^{\frac{1-s-m}{m}} (cnt_t^{m-1}) = \mathbf{b}_h^e \left[\frac{e \mathbf{j} (1 + e^h)}{(1 + \mathbf{j} cnt_t - \mathbf{j} \bar{y})^2} \right] + \mathbf{q} \left(\frac{1 + i_t \mathbf{a}}{e_t} \right), \tag{4.20}$$

$$(cnt_t^m + ct_t^m)^{\frac{1-s-m}{m}} (ct_t^{m-1}) = \mathbf{b}_h^{ca} + \mathbf{q}(1 + i_t \mathbf{a}), \tag{4.21}$$

$$I_h(e_t) = \mathbf{b}_h^e \left(\frac{1 + e^h}{1 + \mathbf{j} cnt_t - \mathbf{j} \bar{y}} \right) - \mathbf{q} \frac{ynt_t}{e_t^2} + \mathbf{q}(1 + i_t \mathbf{a}) \frac{cnt_t}{e_t^2}, \tag{4.22}$$

$$I_h(ca_{t-1}) = -\mathbf{b}_h^{ca} r, \tag{4.23}$$

Dividing equation (4.20) by (4.21), the demand for non-tradables under the high rate regime is:

$$cnt_t = \left[\frac{\mathbf{b}_h^e A + \mathbf{q} \left(\frac{1 + i_t \mathbf{a}}{e_t} \right)}{\mathbf{b}_h^{ca} + \mathbf{q}(1 + i_t \mathbf{a})} \right]^{1/m-1} ct_t, \tag{4.24}$$

where

$$A = \left[\frac{e\mathbf{j}(1+\mathbf{e}^h)}{(1+\mathbf{j}cnt_t - \mathbf{j}\bar{y})^2} \right]$$

The first order conditions from the low rate of devaluation value function, equation 4.18, subject to the constraint, with respect to cnt_t and ct_t and the Euler equations are:

$$\begin{aligned} (cnt_t^m + ct_t^m)^{\frac{1-s-m}{m}} (cnt_t^{m-1}) = \mathbf{b}f(ca_{t-1})\mathbf{I}_h^e \left[\frac{e\mathbf{j}(1+\mathbf{e}^h)}{(1+\mathbf{j}cnt_t - \mathbf{j}\bar{y})^2} \right] \\ + \mathbf{b}[1-f(ca_{t-1})]\mathbf{I}_l^e \left[\frac{e\mathbf{j}(1+\mathbf{e}^l)}{(1+\mathbf{j}cnt_t - \mathbf{j}\bar{y})^2} \right] + \mathbf{q} \left(\frac{1+i_t\mathbf{a}}{e_t} \right), \end{aligned} \quad (4.25)$$

$$(cnt_t^m + ct_t^m)^{\frac{1-s-m}{m}} (ct_t^{m-1}) = \mathbf{b}f(ca_{t-1})\mathbf{I}_h^{ca} + \mathbf{b}[1-f(ca_{t-1})]\mathbf{I}_l^{ca} + \mathbf{q}(1+i_t\mathbf{a}), \quad (4.26)$$

$$\begin{aligned} \mathbf{I}_t(e_t) = \mathbf{b}f(ca_{t-1})\mathbf{I}_h^e \left(\frac{1+\mathbf{e}^h}{1+\mathbf{j}cnt_t - \mathbf{j}\bar{y}} \right) + \mathbf{b}[1-f(ca_{t-1})]\mathbf{I}_l^e \left(\frac{1+\mathbf{e}^l}{1+\mathbf{j}cnt_t - \mathbf{j}\bar{y}} \right) \\ - \mathbf{q} \frac{ynt_t}{e_t^2} + \mathbf{q}(1+i_t\mathbf{a}) \frac{cnt_t}{e_t^2}, \end{aligned} \quad (4.27)$$

$$\mathbf{I}_l(ca_{t-1}) = \mathbf{b}_h^{ca} r \left[\frac{\mathbf{h}e^{ca_{t-1}}}{(1+\mathbf{h}e^{ca_{t-1}})^2} \right] - \mathbf{b}_l^{ca} r \left[1 + \frac{\mathbf{h}e^{ca_{t-1}}}{(1+\mathbf{h}e^{ca_{t-1}})^2} \right], \quad (4.28)$$

Under the low rate regime, the demand for non-tradable goods can be found by dividing equation (4.25) by (4.26), which yields the following:

$$cnt_t = \left[\frac{\mathbf{b}f(ca_{t-1})\mathbf{I}_h^e A1 + \mathbf{b}[1 - f(ca_{t-1})]\mathbf{I}_l^e A2 + \mathbf{q}\left(\frac{1+i_t\mathbf{a}}{e_t}\right)}{\mathbf{b}f(ca_{t-1})\mathbf{I}_h^{ca} + \mathbf{b}[1 - f(ca_{t-1})]\mathbf{I}_l^{ca} + \mathbf{q}(1+i_t\mathbf{a})} \right]^{1/m-1} ct_t, \quad (4.29)$$

where

$$A1 = \left[\frac{e\mathbf{j}(1+\mathbf{e}^h)}{(1+\mathbf{j}cnt_t - \mathbf{j}\bar{y})^2} \right],$$

and

$$A2 = \left[\frac{e\mathbf{j}(1+\mathbf{e}^l)}{(1+\mathbf{j}cnt_t - \mathbf{j}\bar{y})} \right]$$

4.5 Numerical Results

The parameter η , the economic agent's sensitivity to current account changes, is arbitrarily set at 3 for this base case. The rest of the parameters are set as in Chapter 3 to make the model consistent with the structure of the Mexican economy. As before, the economy starts out at the steady-state under the high rate regime. At $t = 0$, the government announces a reduction in the rate of devaluation which is viewed as being non-credible. This time, however, the perceived probability of renegeing changes with the current account. Thus, at $t = 0$ the current account starts at zero, which yields a probability of renegeing of 0.25.

Figures 4.6 to 4.10 show the time paths of the macroeconomic variables under a persistent low devaluation regime with the probability of renegeing as a function of the current account. Because the expected effective price of tradable goods is greater than the current effective price, the agent again begins to inter-temporally substitute in favor of

current consumption by selling bonds. The opposite movement of these two variables leads to a current account deficit. This larger current account deficit then yields a higher perceived probability (and a higher expected effective price) in the subsequent period.

Note that even though there is downward pressure on current consumption from a declining level of bonds, the higher expected effective price forces current consumption of tradables to increase. This continues until the downward pressure from a declining bond level dominates the upward pressure from the higher expected effective price. As a result, consumption of tradables exhibits a prolonged consumption boom, in contrast with the case where the probability is exogenous. Eventually, the level of bonds decreases to the point where a consumption bust ensues, as Figure 4.6 shows.

This smoother transition from a boom to a bust in the consumption of tradables is more in line with the observed facts in the case of Mexico. As described in Chapter 1, consumption growth began to slow down from the second quarter of 1992, turning into a clear recession until the collapse of the stabilization program in 1994. Moreover, even though consumption began to decrease, real appreciation of the exchange rate continued. Mexico's current account deficit worsened at a steady rate, reaching 8 percent of GDP at the end of 1994. This stylized fact is qualitatively illustrated in Figure 4.7, where the current account deficit widens over time.

The time paths for consumption of non-tradables, inflation, and the real exchange rate are similar to those when the agent's beliefs are exogenous except that they do not exhibit such a steep downward trend after the initial increase. This is due to a continued consumption boom in tradables which puts upward pressure on the demand for non-tradables. Furthermore, the initial jump in the demand for non-tradables is not as great as in the prior case due to the fact that the initial probability $f(ca_{t-1})$ is lower, thus yielding a smaller level of inter-temporal substitution. This result, however, is highly susceptible to changes in the parameter h . That is, if agents are very sensitive in their beliefs about how the current account affects the government's decision to renege or not (*i.e.*, a lower

value for η), then the initial level of inter-temporal substitution may be higher, thereby triggering a higher demand for non-tradables. This issue is explored greater in depth in the next chapter by using sensitivity analysis.

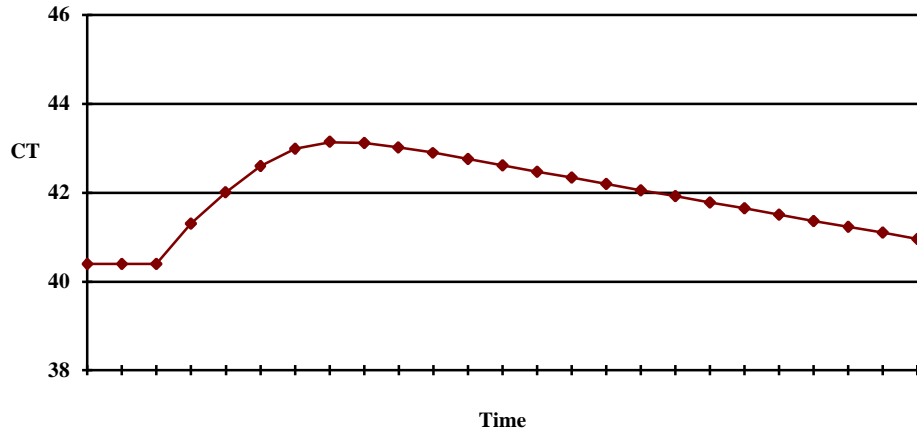


Figure 4.6: Consumption of tradables. Probability of renegeing as a function of the current account.

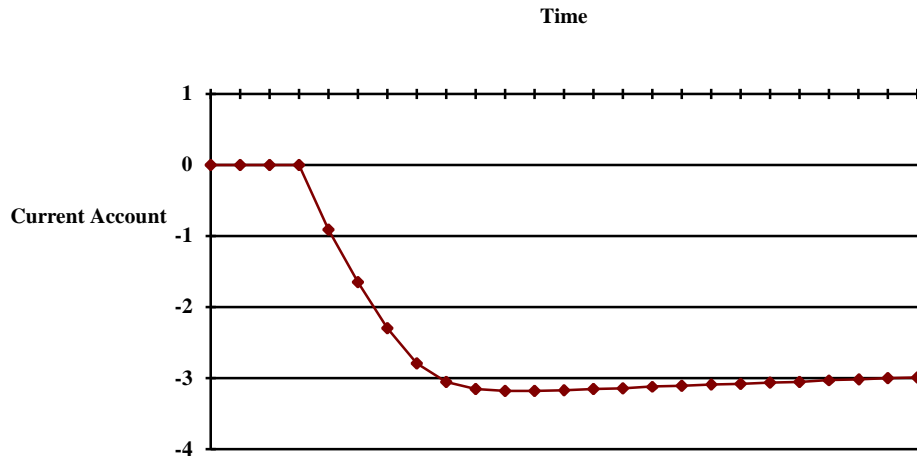


Figure 4.7: Current account. Probability of renegeing as a function of the current account.

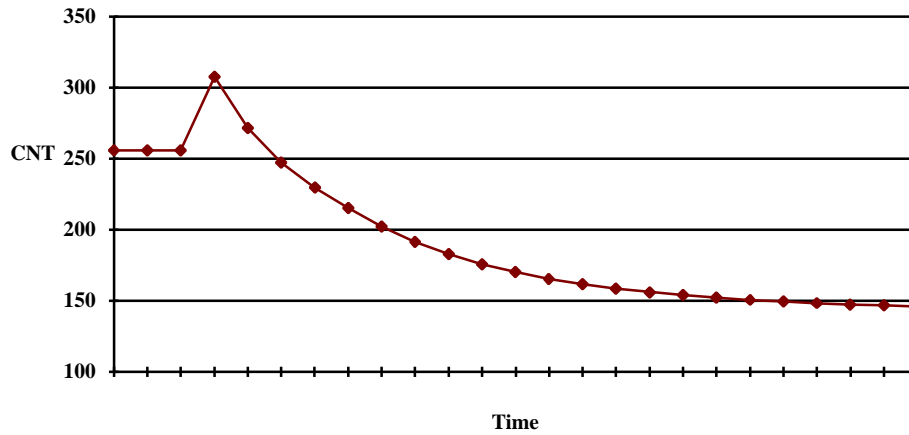


Figure 4.8: Consumption of non-tradables. Probability of renegeing as a function of the current account.

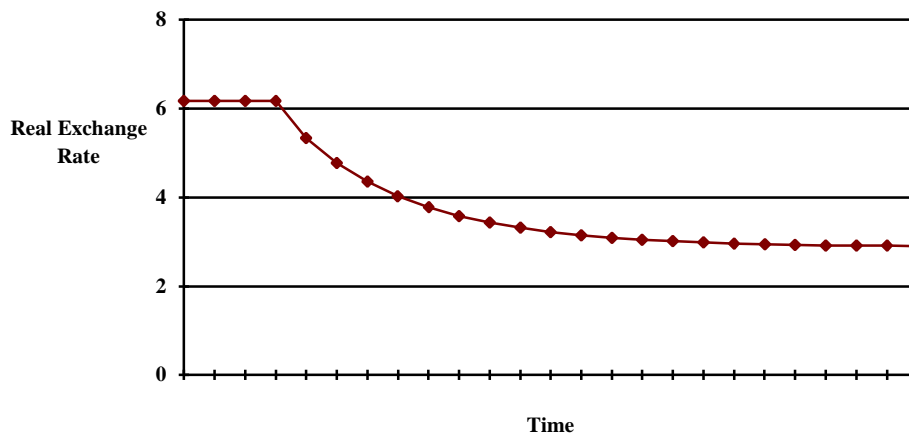


Figure 4.9: Real exchange rate. Probability of renegeing as a function of the current account.

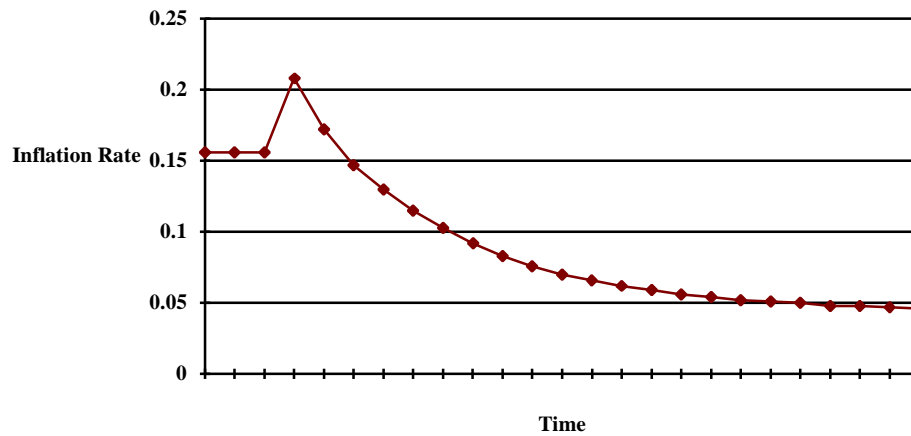


Figure 4.10: Inflation rate. Probability of reneging as a function of the current account

4.6 Conclusions

The dynamic model is capable of predicting some of the empirical regularities of the Mexican exchange-rate stabilization program introduced at the end of 1987. In particular, the model is consistent with a real appreciation of the exchange rate, the deterioration of the current account and the observed consumption boom followed by a post-boom recession.

In order to compare exogenous versus endogenous policy credibility, the model was simulated first under the assumption that the probability of reneging is fixed and then by allowing this probability to be a decreasing function of the current account. When the agents' beliefs about the credibility of government announcements are fixed at some arbitrary level, the model shows that a boom in consumption occurs, as agents substitute current consumption for future consumption in expectation of higher effective prices in

the future. However, a fixed probability means a fixed expected price which, in conjunction with a constant elasticity of substitution, means that the percentage change of substitution is constant as well. Thus, a consumption boom for more than one period is not sustainable, as future permanent income level decreases. These results do not match the prolonged trend in the consumption boom observed in Mexico from 1987 to 1992.

By allowing agents to update their beliefs about policy announcements, the expected price shifts upward after the initial jump in consumption of tradables, thus triggering a higher percentage change in the level of inter-temporal substitution. As long as this effect outweighs the downward pressure from a decline in bond levels, the consumption boom will continue. Finally, as the level of bonds becomes "too small", a consumption bust must ensue. Under this assumption, the model replicates more closely the observed extended consumption boom followed by a post boom recession.

While the model was calibrated and simulated to capture roughly the policy stance of Mexico's 1987-1994 stabilization program, it is acknowledged that the observed consumption cycle may have been caused by several factors in addition to policy credibility, which is the only driving force in the model. The endogenous credibility model strongly suggests, however, that economic agents were basing their beliefs about policy announcements on economic information readily available to the public. Thus, although the true decisionmaking process of the government may have been unknown to the Mexican people, simple facts such as a persistent current account deficit may have been used as a predictor of the government renegeing on its announcement.

The dynamic model with endogenous credibility captures the idea that a lack of policy credibility can jeopardize the entire stabilization program and explain, in part, the 1994 Mexico's economic crisis. The success or failure of the *Pacto* depended on credibility gains and the model gives us useful insights on this matter. Specifically, it is highly sensitive to certain parameters such as the inter and intra-temporal elasticities of substitution and the sensitivity of private agents' confidence to observe changes in the

current account. In order to understand more completely how these variables affect the behavior of the model, the next chapter is devoted to the task of sensitivity analysis.

CHAPTER 5

SENSITIVITY ANALYSIS

So far, key differences between a policy environment with exogenous or endogenous credibility system have been investigated. In particular, the previous chapter showed that when private agents attach some constant probability to the possibility of the government abiding to its announcement, the economic system does not sustain a prolonged consumption boom after the announcement of a permanent decrease in the rate of devaluation of the domestic currency. Since this prediction does not accurately recreate the behavior of private consumption in Mexico prior to the 1994 economic crisis, the chapter supported the hypothesis that credibility about government policy is instead endogenous in an economic system where private agents revise their beliefs as the current account adjusts over time.

Under this scenario, the dynamic model developed in this dissertation was able to replicate a prolonged consumption boom followed by subsequent bust, which are more in line with the stylized facts surrounding Mexico's stabilization program. In addition, the results of the dynamic model also showed a reduction of the inflation rate, a real appreciation of the exchange rate and a large deficit in the current account, all of which are also consistent with the experience of the Mexican economy during this period.

The purpose of this chapter is twofold. First, the dynamic model will be simulated under several values of the key parameter η to gauge the reaction of the economic system to the announcement of a reduction in the rate of devaluation. The model is highly sensitive to this parameter, which reflects how sensitive economic agents are to observed changes in the current account. This parameter is, therefore, a proxy for the degree of policy credibility. Under full credibility, current account changes should not lead to

behavior changes. In contrast, when the policy is not credible, economic agents monitor the current account as a proxy for the probability of the government renegeing on its announcement. These changes in behavior further deteriorate the current account, making the policy unsustainable.

Second, the events leading up to the 1994 economic crisis will be linked to key parameters of the model. This, in turn, will provide several additional scenarios from which we analyze individually how each event may have weakened (or strengthened) the credibility of the government's policy and contributed to the subsequent economic crisis.

5.1 Sensitivity of the Model to the Degree of Policy Credibility

Recall the initial condition of the economy in the model. Initially, the economy is at a steady-state in a high rate regime, where the government's policy announcement has been considered by private economic agents to be fully credible. In this case, since there is no expectation of a change in the effective price of consumption, private agents do not engage in any inter-temporal substitution. Then, at $t = 0$, the government announces a reduction in the rate of devaluation which is viewed as non-credible. Private agents will base their beliefs on the degree of credibility of the government's policy on the behavior of the current account. The larger the current account deficit, the greater will be the belief held by private agents that the government will change its policy and return the rate of devaluation back to its initial higher level.

In this case, as the current account deficit gets larger, the probability of renegeing, \mathbf{g} approaches one. Given these assumptions, the probability of renegeing as a function of the current account, ca , was written as $\mathbf{g} = f(ca_{t-1}) = \frac{1}{1 + \mathbf{h}e^{ca_{t-1}}}$ (equation 4.15), where \mathbf{h} was interpreted to reflect the economic agent's sensitivity to changes in the current account.

When the sensitivity parameter h was arbitrarily set at 3 (the baseline), the economic system experienced a prolonged consumption boom with a smooth transition to a consumption bust. To show how the economic system reacts under different values of h , the dynamic model was run under $h = 135, 9, 1.5,$ and 0.1 . The values for h greater than 3 represent situations where the government's announcements are viewed as being relatively more credible, while values for h less than 3 represent relatively less credibility. Note that moving from 9 to 135 and from 0.1 to 1.5 represents in both cases a 15 fold increase in the sensitivity parameter. This is done in order to gauge how the model reacts to changes in h of the same magnitude.

The results of the sensitivity analysis are shown in Figures 5.1 to 5.4, which represent the time-paths of consumption of traded goods, the current account, the inflation rate and the probability of renegeing as a function of the current account. When the government's announcements are considered to be relatively more credible than the baseline, (*i.e.*, for $h = 135$ and 9), the change in the level of consumption of tradables is initially small and this variable declines slowly toward the steady-state level throughout the entire time-path. This is due to the fact that lower initial probabilities of renegeing yield lower expectations about the future effective price which, in turn, offer little incentive for inter-temporal substitution. Moreover, since the current account deficit remains relatively small, the probability of renegeing remains low, as well, throughout the entire time-path (see Figure 5.4).

In contrast, less credibility (*i.e.* $h = 1.5$ and 0.1) yields a much steeper initial increase in consumption of tradable goods and a subsequent larger current account deficit, as shown in Figures 5.1 and 5.2. Note that the initial boom in consumption of tradables is significantly greater when h is equal to 0.1 than when it is equal to 1.5. This shows that the model is more sensitive to changes in the level of credibility as h decreases. In both cases, a higher level of consumption of tradables puts greater pressure on the government to move back to the high devaluation rate regime and fuels private

agents' fears of higher effective prices for tradable goods in the subsequent period. Moreover, the results are consistent in that, as credibility decreases, the probability of renegeing, \mathbf{g} approaches one. Thus, lack of credibility induces behavior that results in a self-fulfilling prophecy of the government renegeing.

Notice also that the length of the consumption boom decreases as \mathbf{h} decreases from the baseline value of 3. For example, when $\mathbf{h} = 3$, the boom lasts for five periods, while when $\mathbf{h} = 1.5$ and 0.1, the booms last for only 3 and 2 periods, respectively. This is due to the fact that a higher initial consumption of tradables is financed by a larger sale of foreign bonds, which puts more downward pressure on future levels of inter-temporal substitution.

In all cases, the inflation rate converges to the devaluation rate, set at 0.046 (see Figure 5.3). The initial jump in the inflation rate is higher, however, when government announcements are less credible, as higher expected effective prices lead to higher excess demand for non-tradable goods. This initial difference between the devaluation rate and the inflation rate causes an appreciation of the real exchange rate. This appreciation is relatively greater in the case where $\mathbf{h} = 0.1$, and it contributes to the larger current account deficit.

These scenarios demonstrate the importance of the degree of policy credibility. In particular, a fifteen fold loss of credibility of policy announcements can jeopardize the stabilization program more than an equal increase in credibility can support it. The results of the simulations suggest that when policy announcements are less credible, private agents engage to a greater extent in inter-temporal substitution, leading to larger current account deficits and, therefore, the government faces greater pressure to renege on its policy.

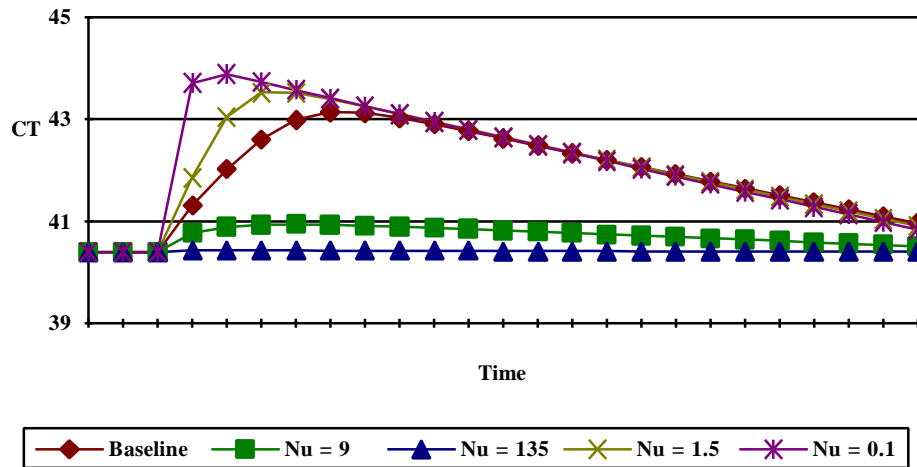


Figure 5.1: Sensitivity of consumption of tradables to changes in h .

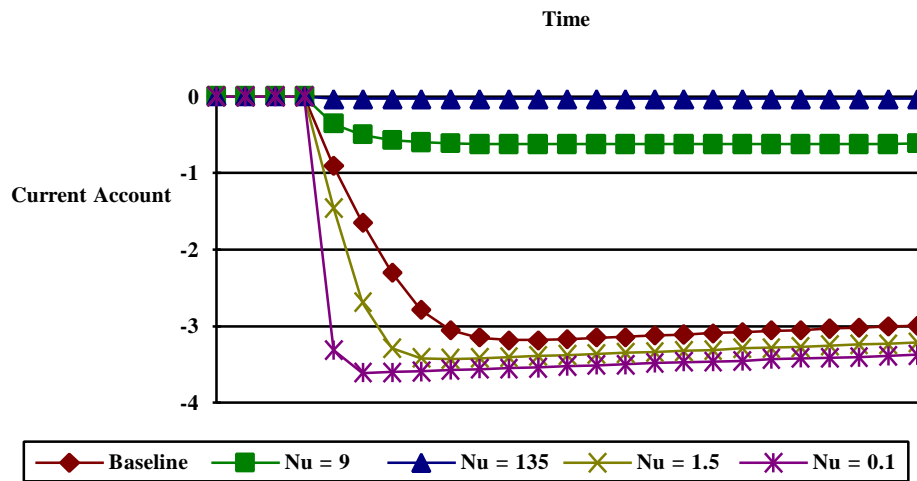


Figure 5.2: Sensitivity of the current account to changes in h .

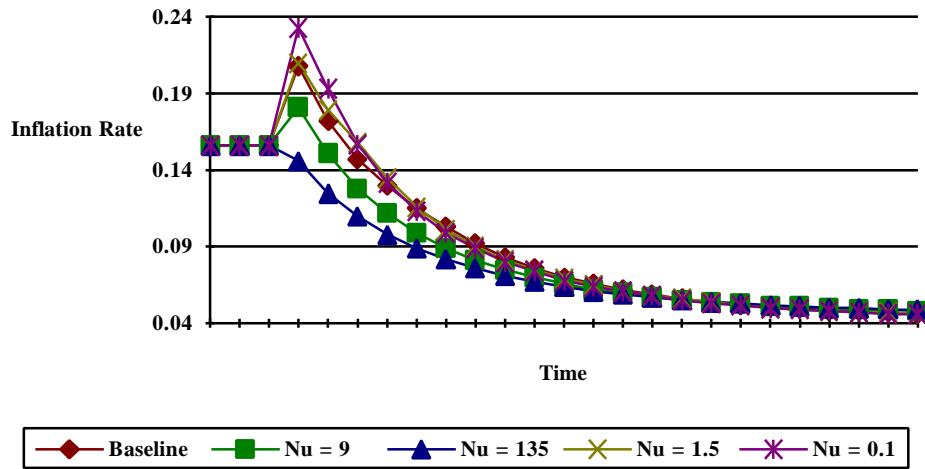


Figure 5.3: Sensitivity of the inflation rate to changes in h .

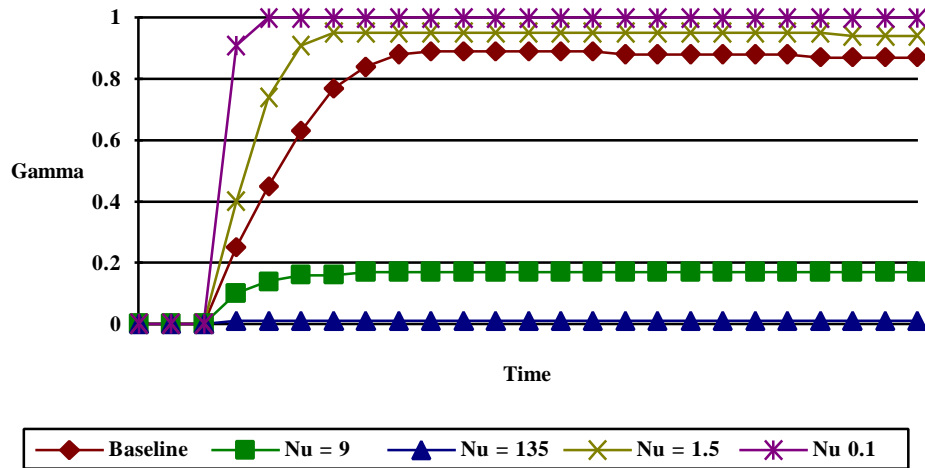


Figure 5.4: Probability of reneging as function of the current account.

5.2. Simulation of the Events before the 1994 Economic Crisis

As the simulations above have demonstrated, the dynamic model captures the idea that lack of credibility can jeopardize the entire stabilization program. For this framework to provide further useful insights about the 1994 economic crisis, however, it is essential to pinpoint major events that might have contributed to a change in the beliefs of economic agents.

In particular, it may be argued that, although the Mexican authorities initially made a strong credible commitment to abide by their promise of not devaluing, the series of political and social shocks that occurred in 1994 put greater pressure on the government to devalue, which may have forced economic agents to re-evaluate their views on the sustainability of the stabilization program.

The aim of this section is to interpret the events of 1993 and 1994 as shifts in certain parameters in the model in order to determine their individual effects on the economic system and on the government's ability to abide by its word. In contrast to the previous section, where h was allowed to differ with each scenario at the *beginning* of the government's announcement to move the devaluation rate to a lower level, in this section the shifts in the parameters will occur towards the end of the consumption bust, in order to more closely mimic the state of the economy at the beginning of 1994.¹⁸

The analysis focuses on three shocks experienced by the Mexican economy before the December 1994 crisis, which are widely viewed as having affected the credibility of the government's policy. These are: (1) the passage of NAFTA by the US Congress in November 1993 (the NAFTA shock); (2) the assassination of Donaldo Colosio, the Mexican presidential candidate, in March 1994 (the Colosio shock); and (3) the decision by the US Federal Reserve in February 1994 to increase US interest rates in an attempt to cool down inflationary pressures (the world interest rate shock).

¹⁸ The Mexican economy had been experiencing a consumption bust since the middle of 1992, which lasted until the end of 1993 (See Figure 1.5).

5.2.1 The NAFTA Shock

As is well known, during the late-1980s, Mexico introduced major economic reforms which included privatization, deregulation and trade liberalization. In particular, the signature of NAFTA was of great importance, since 80 percent of Mexico's trade is with the US.. Moreover, the passage of NAFTA was a way of regaining continuous access to world private capital markets. From this perspective, in the model this event can be interpreted as an increase in policy credibility. That is, the ability of the Mexican authorities to maintain a low exchange rate would be viewed as being more credible, as NAFTA signaled a new era of lower trade barriers and new investment opportunities.¹⁹

The model was run with the sensitivity parameter h changing from 3 to 9, after a prolonged period of a consumption bust. As shown in Figure 5.4, this represents a significant increase in policy credibility relative to the baseline. Figures 5.5 through 5.8 show that, when the government's policy gains more credibility with private economic agents, the economic system moves towards a position (current account) where the sustainability of the exchange rate program increases as well.

That is, an exogenous upward shift in h decreases the expected future effective price of tradable goods which lowers the incentive to inter-temporally substitute. As a result, the current account deficit improves, which reduces the pressure on the government to devalue. Furthermore, this improvement continues as long as h stays at its higher value. This suggests that, even after several years of current account deficits, which exerted pressure on the government to devalue, the improvement of the policy's credibility allowed the authorities to move the economy to a more stable position. This was accomplished by reducing the reliance on highly liquid capital inflows, as NAFTA induced direct foreign investment, thus reducing the vulnerability of the economy.

¹⁹ The positive impact from the approval of NAFTA can explain a large capital inflow of 9.8 billion dollars in the first quarter of 1994 (Banco de Mexico, 1995).

As described in Chapter 1, current account deficits in Mexico were financed in large part by highly volatile portfolio investments, which were quickly reversed at the beginning of the crisis. Thus, while inducing an increase in the credibility of the government, which created a sustained improvement in the current account deficit, NAFTA had the added bonus of decreasing reliance on highly liquid foreign inflows of capital.

Unfortunately, the consumption patterns of late 1993 and 1994 do not longer show the behavior predicted by this scenario in the model. In fact, Figure 1.5 shows that actually consumption modestly increased during this time period. This does not necessarily mean that the passage of NAFTA should be not considered a positive political shock, which increased credibility. Rather, it is more likely that in 1994 other events overshadowed any credibility gains the government obtained as a result of this trade agreement. In particular, after a period of strong capital inflows in late 1993 and early 1994, market confidence was shaken by a series of adverse political shocks, the most important of which was the assassination of presidential candidate Colosio in mid-March of 1994.

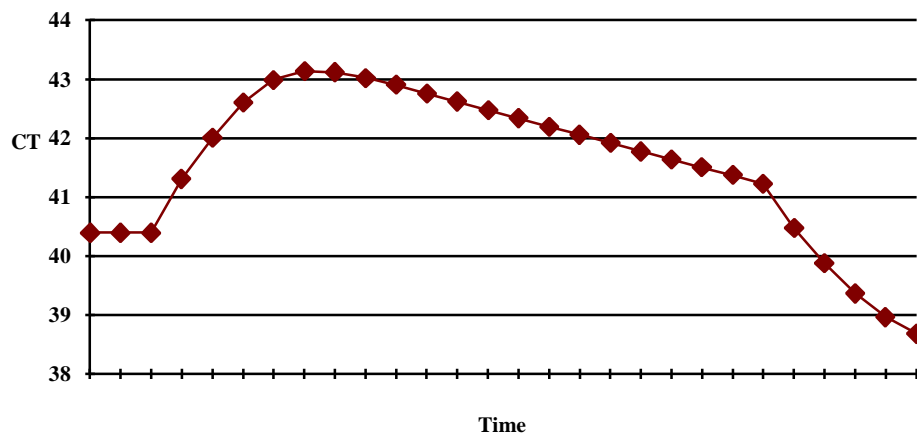


Figure 5.5: Consumption of tradables. The NAFTA shock.

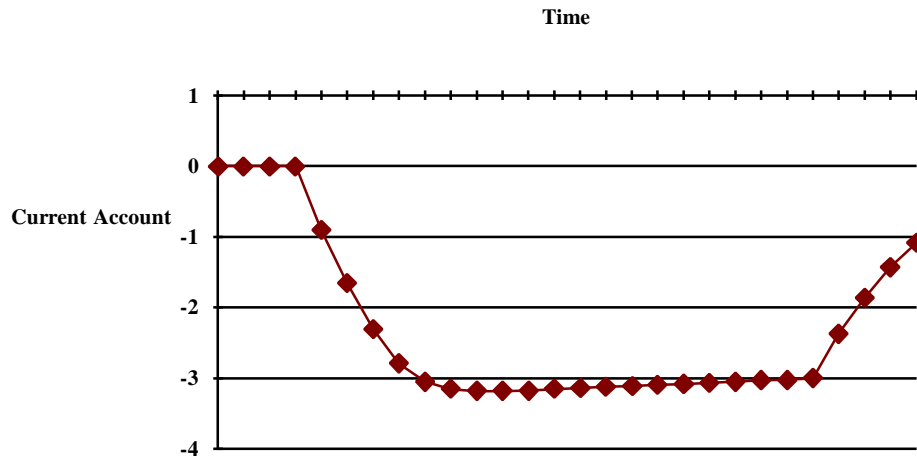


Figure 5.6: Current account. The NAFTA shock.

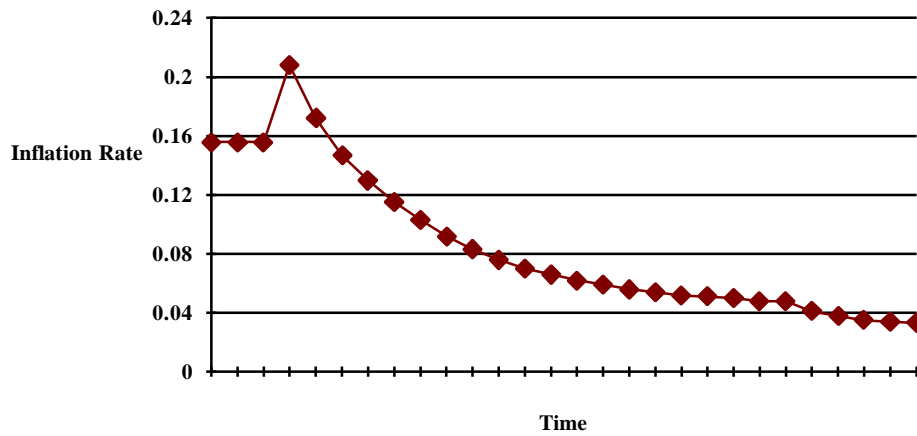


Figure 5.7: Inflation rate. The NAFTA shock.

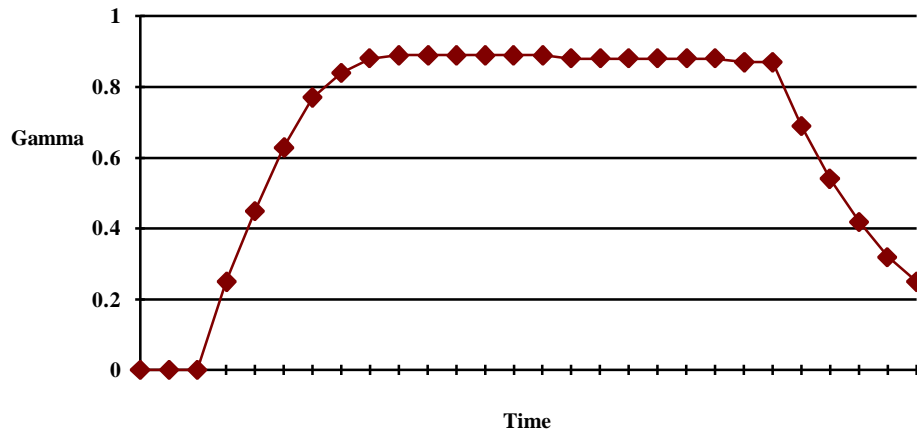


Figure 5.8: Probability of reneging. The NAFTA shock.

5.2.2 The Colosio Shock

In March of 1994, the presidential candidate for the ruling party (PRI), Donaldo Colosio, was assassinated. For Mexico, a country used to having one single party controlling the presidency for more than 70 years, the death of its major candidate created great uncertainty in its political future. Shaken by this event, investors reacted accordingly and this resulted in massive capital outflows. Moreover, markets began to increasingly focus on the widening current account deficit, and there were growing expectations of a realignment of the existing exchange rate system (OECD, 1995). Thus, in terms of the model, this can be interpreted as a large negative shock to the government's credibility, as private agents reacted in response to increased political

uncertainty with increasing doubts about the government's ability to sustain the exchange rate regime.²⁰

The model was run with the sensitivity parameter $h = 0.1$, which represents the lowest policy credibility in Section 5.1. In contrast to the NAFTA positive shock, figures 5.9 through 5.12 show that, when the government loses the credibility of its announcement, the system moves towards a more precarious position, where the sustainability of the exchange rate program is put at even further risk.

That is, an exogenous shift to a lower value for h further increases the expected future effective price of tradable goods, which increases the incentive to inter-temporally substitute. As a result, after several periods of a consumption bust, a small consumption boom occurs after the shock (see Figure 5.9). This, in turn, increases the current account deficit thereby exerting further pressure on the government to devalue. Accordingly, the simulations show that, after several periods of a constant probability of renegeing, g approaches one, indicating that private agents believe almost with certainty that the exchange rate regime is not longer sustainable (see Figure 5.12).

These results suggest that a loss in credibility, especially after a prolonged period of current account deficits, can put the government in a difficult position, where a significant policy adjustment has to take place in order to defend the exchange rate system. Larger current account deficits and a public confident that a devaluation must occur curtail the government's capacity to adhere to its nominal anchor. Moreover, as the model shows, the increase in the inflation rate, due to the adverse shock, is only marginal (see Figure 5.11). This simulation is consistent with the historical facts, since the inflation rate showed a downward trend all along the stabilization program.

²⁰ The uprising in Chiapas in January, 1994 would have similar effects in the model.

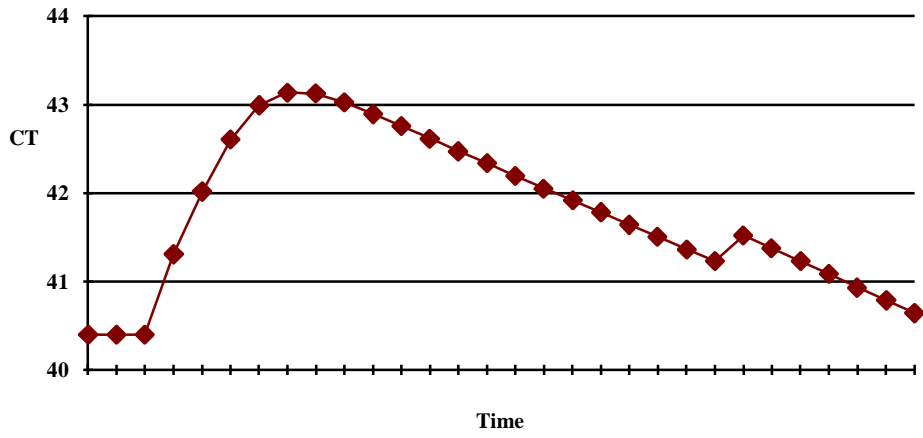


Figure 5.9: Consumption of tradables. The Colosio shock.

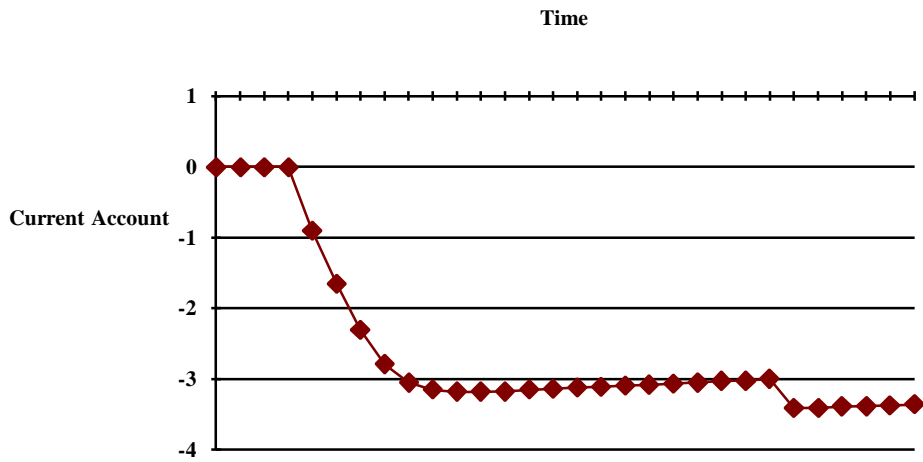


Figure 5.10: Current account. The Colosio shock.

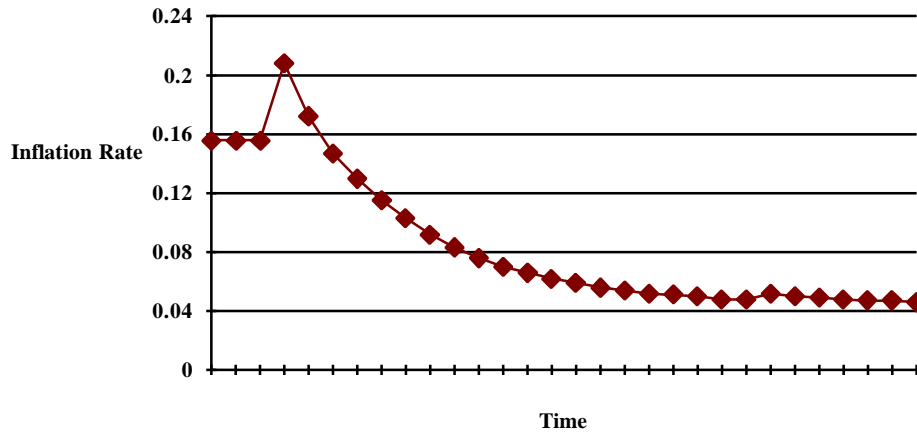


Figure 5.11: Inflation rate. The Colosio shock.

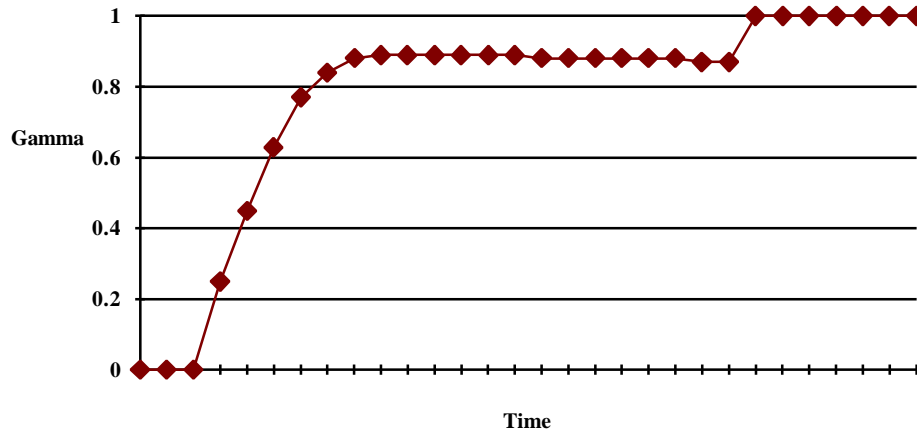


Figure 5.12: Probability of renegeing. The Colosio shock.

5.2.3 The World Interest Rate Shock

In February of 1994, the US Federal Reserve decided to increase interest rates in an attempt to cool down inflationary pressures. An increase in the US interest rate

created an incentive for investors to move their financial assets out of Mexico. Thus, the exchange rate reached the upper limit of the fluctuation band, a sign of devaluation expectations, and the domestic interest rate increased consequently (Banco de México, 1994). Although this may be evidence of a deterioration in the confidence on the exchange rate system, this shock does not necessarily affect the credibility parameter because it shows the ability of the system to adjust according to the interest rate parity. Therefore, this event is interpreted in the model solely as an increase in the world interest rate. This allows us to analyze the sensitivity of the system to an increase in this variable.

The model was run with the real interest rate jumping from 4.0 percent (the baseline) to 4.5 percent during the consumption bust. Figures 5.13 to 5.16 show the results of the simulations. By the capital mobility equation, an exogenous upward shift in r increases the domestic interest rate. Since economic agents view the change in the real interest rate as permanent, the higher rate penalizes present and future consumption equally. Therefore, the percentage change in the effective prices between today and tomorrow actually decreases, causing a slight downturn in consumption, almost at the end of the bust (see Figure 5.13). In other words, since the percentage difference in prices is smaller, economic agents have less incentive to inter-temporally substitute.

Interestingly, although consumption actually decreases, the current account deficit increases slightly towards the end of the time path, as shown in Figure 5.14. This is because, at this point in the consumption path bonds are negative. As such, when the world interest rate increases, private agents are forced to pay more on their foreign debt, which increases the current account deficit. Finally, this slight increase in the current account deficit is also reflected in a small upward movement in the probability of renegeing (see Figure 5.16).²¹

²¹ It is important to mention that the model was also run with an increase of the world interest rate from 4 to 10 percent, and the simulation results are qualitatively similar as to those with $r = 4.5$ percent, which shows that the model is not highly sensitive to increases in the world interest rate.

These results suggest that changes in the world interest rate by themselves do not significantly affect the levels of consumption nor the current account. As such, the small increase in consumption observed at the end of 1994 cannot be attributed to the Federal Reserve's increase in the interest rate. Rather, the model suggests that only an adverse shock to the credibility parameter h , such as the Colosio shock, could have caused the consumption pattern observed in 1994.

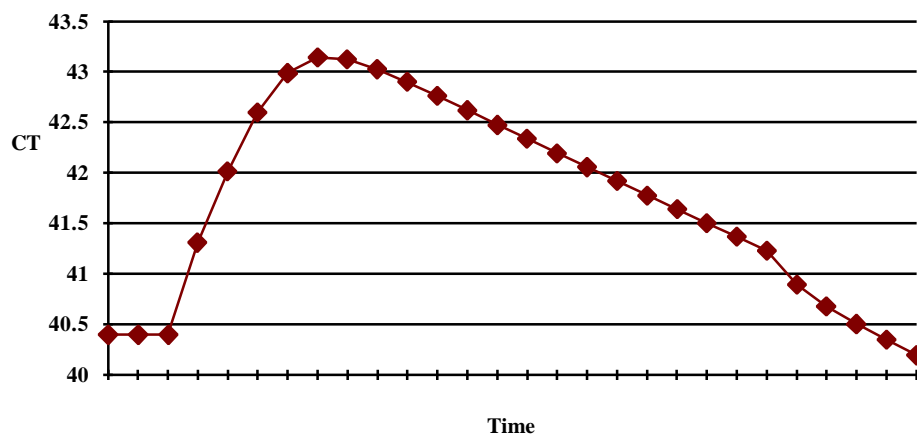


Figure 5.13: Consumption of tradables. The world interest rate shock.

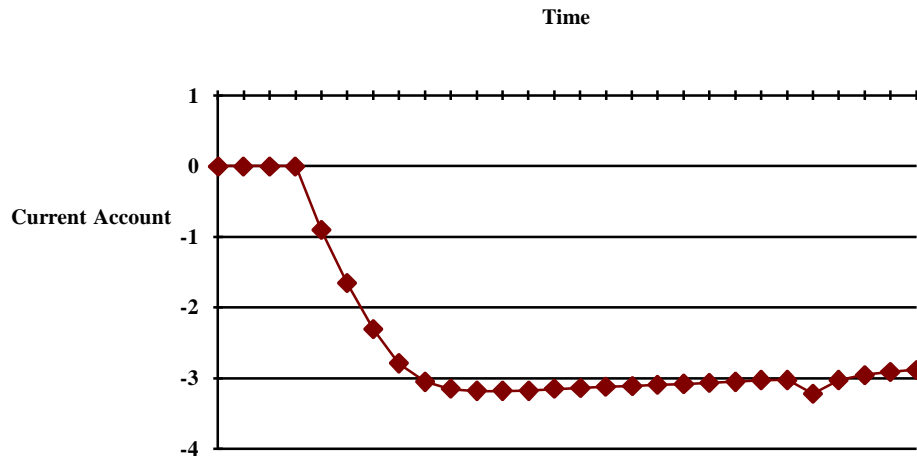


Figure 5.14: Current account. The world interest rate shock.

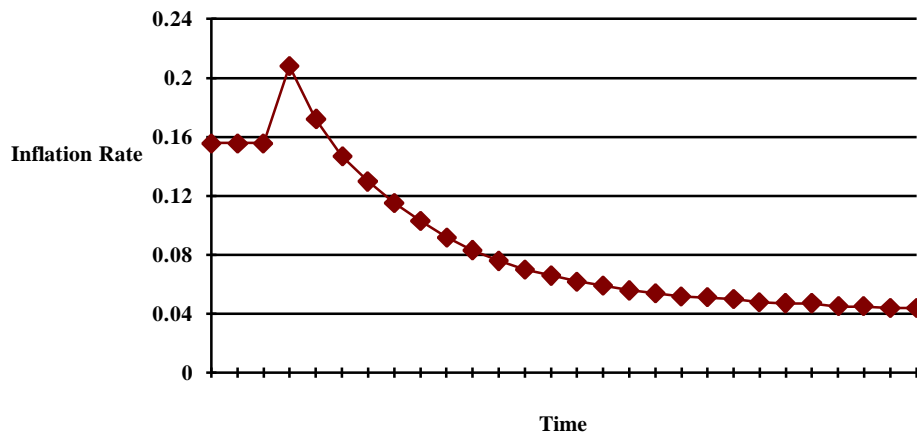


Figure 5.15: Inflation rate. The world interest rate shock.

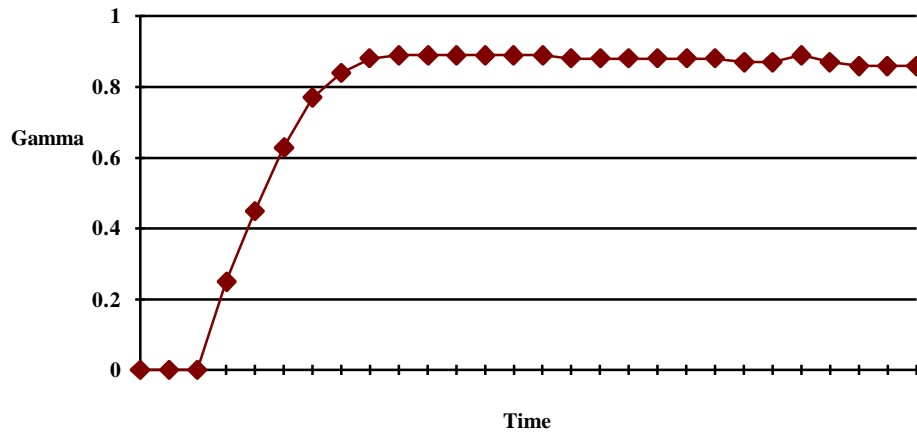


Figure 5.16: Probability of reneging. The world interest rate shock.

5.3 Conclusions and Policy Lessons

No single factor can explain the severity of the economic crisis of 1994. The simulation results suggest, however, that lack of credibility can jeopardize the entire stabilization program. Summing up, the following observations follow from the sensitivity and simulation results:

(i) The degree of policy credibility is of great importance. In particular, when policy announcements are relatively less credible, private agents engage in higher levels of inter-temporal substitution and, consequently, higher current account deficits occur. Therefore, the government faces a higher pressure to renege on its policy. Furthermore, any loss of credibility can jeopardize the stabilization program more than an equal increase in credibility can support it.

(ii) An exogenous upward shift in h during the consumption bust, like the NAFTA shock, decreases the expected future effective price of goods, which lowers the incentive to inter-temporally substitute. As a result, the current account deficit improves,

which reduces the pressure on the government to devalue. Furthermore, this improvement continues as long as policy credibility is enhanced by a positive external shock.

(iii) An adverse political shock, like the assassination of the presidential candidate, is represented by an exogenous downward shift in h during the consumption bust. Simulation results show a small consumption boom after several periods of a consumption bust, a higher current account deficit, and a continuous downward trend in the inflation rate. These simulation results are more in line with the observed facts. As confidence in the exchange rate regime deteriorated and economic agents began to increasingly focus on the widening current account deficit, the Mexican government faced the difficult task of regaining the public's confidence.

(iv) An exogenous increase in the world interest rate does not have a significant effect on the level of inter-temporal substitution, as the percentage change in the effective price of consumption changes only slightly. As such, by itself, an increase in the world interest rate cannot explain the small consumption boom observed at the end of 1994.

Simulation results show that when credibility is largely weakened by an exogenous adverse shock, the inflation rate still shows a downward trend. This is consistent with historical evidence, since when the adverse shocks occurred, the inflation rate was already at low levels and there was no immediate danger to the inflation target, even after the death of the presidential candidate, yet there was substantial pressure on the exchange rate regime. Evidence of this is that the exchange rate remained pegged to the top of the exchange rate band, signaling devaluation expectations (OECD, 1995).

The problem of renegeing on the announcement refers to the policy dilemma of how and when to move towards an increased exchange rate flexibility without provoking inflationary expectations, which would jeopardize the achievements of the *Pacto*. Some policy options are to let the exchange rate float and at the same time adopt an official

inflation target.²² Another option is to maintain the exchange rate commitment, by either using the stock of international reserves or tightening monetary conditions, to the extent necessary to defend the exchange rate. It could be argued that the Mexican government made it clear that it would abide by its announcement and that its main policy objective was to minimize exchange rate fluctuations and maintaining the nominal exchange rate anchor. As it is known, the strategy chosen was to defend the exchange rate band as long as capital flows continued. With a finite stock of foreign reserves, this strategy proved costly as capital flows reversed and the deficit in current account became unsustainable.

Up to this date, much of the debate in Mexico about the 1994 crisis has been about whether or not the government should have devalued the currency. The authorities claimed that the "*Pacto* [exchange rate] band was credible for most of the period under analysis [December, 1991 to January , 1994], excepting very few periods in 1992" (Schwartz, 1994). Additionally, they argue that the economic crisis was solely due to political shocks: "[They] affected expectations in the same way that an external shock would, similar to a drastic fall in the terms of trade, and led to the crisis that began with the devaluation of December 1994" (Gil-Díaz, 1995).

The dynamic model with endogenous credibility suggests, however, that the exchange rate regime implemented after 1987 was not perceived as a fully credible policy. The reduction in the expected relative price of present *versus* future consumption provided an incentive for the rise in consumption experienced by the Mexican economy. Additionally, as simulation results show, the negative external shocks during 1994 may have weakened further the level of credibility. Thus, credibility issues could be one more factor in explaining one of the worst economic crisis of Mexico.

It is beyond the scope of this dissertation to analyze the inadequate policy responses of the Mexican government to the several adverse shocks that occurred in

²² Britain, Finland, and Sweden adopted this policy option after the European currency crisis in September 1992 (Leiderman and Svensson, 1995).

1994. However, the authorities seemed to have been reluctant to accept that each negative shock reduced the level of a sustainable current account deficit. Moreover, economic agents reckoned that steady and substantial inflows of foreign capital were actually needed to finance the large current account deficit of 1994, a significant challenge itself. Therefore, there was an underlying pressure to devalue the currency and the source of this pressure was, as the simulations suggest, a lack of confidence in the ability of the government to abide by its announcement.

The exchange rate commitment had been used over a long period of time as a tool for disinflation. The *Pacto* was already successful in that it had lowered the inflation rate from three to single digits. Additionally, it was an error to think that an exchange rate adjustment was incompatible with the ongoing economic reforms. However, any adjustment to the exchange rate regime had to be managed very carefully. Therefore, it is our view that the Mexican government had the option of taking advantage of a positive shock, such as the passage of NAFTA, when policy credibility was at a high level, and could have "sold" any adjustment to the exchange rate regime as part of the ongoing reforms. As simulation results suggest, gains from increased credibility are harder to obtain than losses from a decrease in credibility. As such, the credibility of the government's commitment to defend the exchange rate was an important asset that should not have been discarded lightly.

CHAPTER 6

CONCLUSIONS

6.1 Overview

The objectives of this study were fivefold. First, by examining the macroeconomic performance of Mexico prior to the economic crisis of 1994, the proper historical background was set for a discussion about the credibility of policy announcements made by the Mexican government. In particular, it has been argued that credibility about future change in the course of policy may be able to reduce the costs of disinflation directly by changing inflationary expectations. Historical evidence described in Chapter 1, however, suggests that previous mismanagement of the economy by the Mexican government may have seriously undermined the credibility of its announcements. The exchange rate-based stabilization program implemented at the end of 1987 must have appeared credible to the public for the government to reduce inflationary expectations effectively. Therefore, the announcement of the predetermined rate of devaluation, within the framework of the *Pacto*, was a way to constrain the government's ability to surprise the economic agents by unexpected devaluations.

In December 23, 1994 the peso suffered strong speculative attacks and the Mexican authorities reneged on its commitment to defend the exchange rate and allowed the currency to float. As a result, the peso experienced a strong depreciation, by about 50 percent against the U.S. dollar, leading to the worse economic crisis in the modern history of Mexico.

Although the Pacto did bring down the inflation rate from close to 160 percent in 1987 to 8 percent in 1993, several empirical irregularities arose after the implementation of the stabilization program that called into question its effectiveness. In particular, while it was expected that the inflation rate would quickly converge to the devaluation rate, such convergence was never achieved. Since the depreciation of the peso against the dollar was below Mexico's inflation rate, the country's real exchange rate appreciated greatly during the *Pacto* period. This real appreciation was not due to higher inflation rates for tradable goods, but to persistent high inflation rates in non-traded goods. Furthermore, although export growth showed good performance during the *Pacto*, imports increased even faster as the real appreciation in the exchange rate made imports cheaper relative to exports. As a consequence, the current account surplus experienced during the early 1980s turned into a large deficit. Moreover, the deteriorating current account was the result of a consumption boom driven by the private sector.

Second, a survey of theories on policy credibility was presented and their theoretical and conceptual problems were explored. Until recently, most macroeconomic theory accepted policy rules as exogenous, ignoring the possibility that the government may change these policies sometime in the near future. With the introduction of rational expectations theory, the analysis was extended to include the interdependence between private, forward looking agents, and policymakers.

Some models examined policy credibility in the context of a game between policymakers and the private sector. Barro and Gordon (1983), for example, model this relationship as an infinite number of one shot games where the policymaker and the private sector minimize their loss functions. Central to this paper was the assumption

that policymakers could influence output by engineering inflationary surprises. Furthermore, benefits accrue to policymakers from surprise inflation, via proceeds from inflationary finance and depreciation of government liabilities fixed in nominal terms. As a result, there was an incentive for the policymakers to renege on their commitment to low inflation, even though overall welfare is superior. In response to this lack of credibility on the part of policymakers, the private sector could adopt a punishment strategy by expecting high inflation in subsequent periods, which drives up wages and fuels inflation that increases the policymaker's loss function. Other papers followed this approach very closely with the major differences being the assumption of asymmetric information. Results from these papers varied according to each player's information set.

Other models focused on the use of the exchange rate as an anchor for the domestic price level and the government's commitment to defend the parity. Horn and Persson (1988), for example, developed a model very similar to Barro and Gordon's (1983), but related it to credibility in an exchange rate system. Again, the results from the various models that focus on exchange rate credibility depend strongly on the assumptions about each player's information set.

It was shown, however, that these models had several problems. Arbitrary specifications about social welfare and multiple equilibria were just some of the many problems associated with these models. In addition, game theoretic models do not lend themselves well to empirical studies. Punishment mechanisms, timing, and degree of aversion to inflation are all very difficult to measure. The few models which did attempt to model credibility empirically suffered from several problems, such as the inability to differentiate a shift in policy regimes from other factors not explicitly considered in the

regression and *ad hoc* assumptions on private sector beliefs. Most importantly, none of the empirical models could get past Lucas' critique to econometrics.

Third, private agent's consumption behavior was modeled using dynamic optimization methods. In chapter 3, it was assumed that the exchange rate regime was fully credible. Under this scenario, private agents do not inter-temporally substitute since there is no expectation of some higher future prices due to the government renegeing on its announcement. As a result, inflation quickly moved to the rate of devaluation with no deterioration of the current account. The results of the model under this assumption clearly show that using the exchange rate as a nominal anchor can work to stabilize prices if the government policy enjoys full credibility.

In the next chapter, the assumption was at first made that private agents believe with some fixed probability that the government will renege on its promise and devalue the local currency sparking higher prices. Because the expected future prices were higher than the present prices, consumers began to inter-temporally substitute in favor of present consumption by selling foreign assets. This led to a current account deficit and chronically high inflation much like what was seen in the case of Mexico. However, the consumption boom lasted only one period as foreign assets immediately decreased forcing down future permanent income. Given that the consumption boom actually lasted several years, this result was not very satisfactory. Thus, a new assumption was made whereby private agents update their beliefs about the government every period based upon the current account. Higher current account deficits signaled an inability to defend the exchange rate regime. Under this assumption, the consumption boom lasted several periods as greater current account deficits increased future price expectations

yielding higher levels of inter-temporal substitution. Eventually, foreign asset holdings decreased to the point that present consumption came down even though future expected prices were higher. These results closely simulated the macroeconomic performance of Mexico during the *Pacto* including a deteriorating current account, a real appreciation of the exchange rate, and a consumption boom followed by a post-boom recession.

Fourth, a contribution to policy analysis was made which did not have many of the problems associated with earlier empirical studies. In particular, since dynamic optimization methods allow the private agent some view on the future path of relevant variables, this model did not suffer from Lucas' critique. As a result, the investigation into policy evaluation which flowed from sensitivity analysis, as well as the simulation of certain events leading up to the crisis of 1994 in chapter 5, is more reliable than in previous studies.

Fifth, this dissertation added to our understanding of how a lack of credibility of government policy may have contributed to the 1994 Mexican economic crisis. Namely, if a government's exchange rate policy is not considered to be credible, this may lead to a self-fulfilling prophecy as private agents inter-temporally substitute in favor of present consumption. This leads to a deterioration of the current account that undermines the government's ability to sustain their policy. Private agents, understanding that the government is less able to defend their policy, engage in even more inter-temporal substitution adding further pressure on the government to devalue the currency.

6.2 Limitations and Future Directions

The model presented in this dissertation marks a clear contribution to the study of policy credibility. There are, however, some limitations that should be recognized. One problem is that government behavior is assumed to be exogenous in the model. As such, no inferences can be made concerning how the government's own behavior changes over time in response to private agent's actions. On the one hand, not including government behavior in the model avoids the problems associated with earlier game theory models mentioned above. It is important to recognize, however, that the government is a key player in the economy. A model, which could more accurately express the government's decision making process in response to the adverse shocks that occurred in 1994, would be of great interest.

Another problem is that, according to this model, the consumption boom and bust observed in Mexico during the *Pacto* can be attributed totally to an exchange rate regime that was not fully credible. It is acknowledged, however, that the observed consumption cycle may have been caused by several factors in addition to policy credibility. First, the private sector may have revised upward its expected permanent income due to NAFTA, as new business opportunities arose. Second, with the new economic reforms, Mexico regained access to international capital markets that may have partially reduced previous liquidity constraints. Third, the Mexican economy may have been affected by random shocks that reflect "fundamental" uncertainty regarding real variables such as productivity or the terms of trade.

Finally, dynamic models suffer from the "curse of dimensionality" (Bellman, 1957). That is, the computational effort required to solve the dynamic model is highly sensitive to the dimensionality of the state and action space. In particular, the

computational effort grows exponentially, not linearly, with the dimensionality of the state and action space. Thus, although other factors may have affected private agent's beliefs and behavior, it was necessary to keep the dynamic model as simple as possible.

LIST OF REFERENCES

- Agénor, Pierre-Richard (1994). "Credibility and Exchange Rate Management in Developing Countries," *Journal of Development Economics*, Vol. 45, pp. 1-16.
- _____ and Mark P. Taylor (1992). "Testing for Credibility Effects," *IMF Staff Papers*, Vol. 39, No. 3., pp. 545-571.
- _____ and Paul R. Masson (1995). "Credibility, Reputation, and the Mexican Peso Crisis," IMF, *mimeo*.
- Alesina, Alberto and Laurence H. Summers (1993). "Central Bank Independence and Macroeconomic Performance," *Journal of Money, Credit and Banking*, Vol 25, No. 2, May, pp. 151-62.
- Andersen, Torben M. (1986). "Rules Versus Discretion in Monetary Policy: The Case of Asymmetric Information," *Journal of Economic Dynamics and Control*, Vol 10, p.169-174.
- _____ and Ole Risager (1991). "The Role of Credibility for the Effects of a Change in the Exchange-Rate Policy," *Oxford Economic Papers*, Vol. 43, pp. 85-98.
- Aspe Armella, Pedro (1992). "Estabilización Macroeconómica y Cambio Estructural. La Experiencia de México (1982-1988) in Bazdresch, C. *et al.*, eds., *México, Auge, Crisis y Ajuste*, México, D.F.: Fondo de Cultura Económica.
- _____ (1993). *El Camino Mexicano de la Transformación Económica*, México, D.F: Fondo de Cultura Económica.
- _____ (1995). "México en 1994: Las razones de la política cambiaria," *Reforma*, July 15.
- Backus, David and John Driffill (1985). "Inflation and Reputation," *The American Economic Review*, Volume 75, No. 3, pp. 530-38.
- Banco de México (1994), (1995). *Informe Anual*, México, D.F.
- Barro, Robert J. (1983). "Inflationary Finance under Discretion and Rules," *Canadian Journal of Economics*, January.
- _____ (1986). "Reputation in a Model of Monetary Policy with Incomplete

- Information," *Journal of Monetary Economics*, Vol. 17, pp. 3-20.
- _____ and David B. Gordon (1983). "Rules, Discretion and Reputation in a Model of Monetary Policy," *Journal of Monetary Economics*, Vol. 12, pp. 101-121.
- Baxter, Marianne (1985). "The Role of Expectations in Stabilization Policy," *Journal of Monetary Economics*, Vol. 15, pp. 343-62.
- Bellman, Richard E. (1957). *Dynamic Programming*, Princeton, NJ.: Princeton University Press.
- Blackburn, Keith and Michael Christensen (1989). "Monetary Policy and Policy Credibility: Theories and Evidence," *Journal of Economic Literature*, Vol. XXVII, March, pp.1-45.
- Calvo, Guillermo A. (1978). "On the Time Consistency of Optimal Policy in a Monetary Economy," *Econometrica*, Vol. 46, No.6, November, pp. 1411-28.
- _____ (1983). "Staggered Prices in a Utility-Maximizing Framework," *Journal of Monetary Economics*, Vol. 12, September, pp. 383-98.
- _____ (1986). "Temporary Stabilization: Predetermined Exchange Rates," *Journal of Political Economy*, Vol. 94, pp. 1319-29.
- _____ (1987). "On the Costs of Temporary Liberalization/Stabilization Experiments," in Michael Connolly and Claudio Gonzalez-Vega, eds., *Economic Reform and Stabilization in Latin America*, New York: Praeger.
- _____ and Carlos Végh (1993). "Exchange Rate-Based Stabilization Under Imperfect Credibility," in Frisch, H. and A. Worgotter, eds., *Open-economy Macroeconomics*, New York: St. Martin's Press.
- _____ and Enrique Mendoza (1995). "Reflections on Mexico's Balance-of-Payments Crisis: A Chronicle of a Death Foretold," University of Maryland, *mimeo*.
- Cárdenas, Enrique (1996). *La Política Económica en México 1950-94*, México, D.F.: Fondo de Cultura Económica y el Colegio de México.
- Christensen, Michael (1987). "Disinflation, Credibility and Price Inertia," *Applied Economics*, Vol 19, October, pp. 1353-66.
- Dornbusch, Rudiger (1993). "Mexico: Stabilization, Debt and Growth" in Dornbusch, R., *Stabilization, Debt, and Reform*, Englewood Cliffs, NJ.: Prentice Hall Inc.

- _____ and S. Edwards (1993). "Macroeconomic Populism" in Dornbusch, R., *Stabilization, Debt, and Reform*, Englewood Cliffs, NJ.: Prentice Hall Inc.
- _____ and Alejandro Werner (1994). "Mexico: Stabilization, Reform, and No Growth," *Brookings Papers on Economic Activity*, 1: pp. 253-97.
- _____, I. Goldfajn and R.O. Valdés (1995). "Currency Crisis and Collapses," *Brookings Papers on Economic Activity*, 2: pp. 219-70.
- Feenstra, Robert (1985). "Anticipated Devaluations, Currency Flight, and Direct Trade Controls in a Monetary Economy," *The American Economic Review*, Volume 75, No. 3, pp. 386-401
- Fischer, Stanley (1980). "Dynamic Inconsistency, Cooperation and the Benevolent Dissembling Government," *Journal of Economic Dynamics and Control*, 2, pp. 93-109.
- Giavazzi, Francesco and Marco Pagano (1988). "The Advantage of Tying One's Hands: EMS Discipline and Central Bank Credibility," *European Economic Review*, Vol. 32, June, pp. 1055-1082.
- Gil Díaz, Francisco (1995). "A Comparison of Economic Crisis: Chile in 1982, Mexico in 1995," Paper presented at the Forum for Managed Futures and Derivatives, Chicago, July 14.
- _____ and Raul Ramos Tercero (1988). "Lessons from Mexico" in Bruno, M *et al.*, eds., *Inflation Stabilization*, Cambridge, MA.: The MIT Press.
- Gujarati, Damodar N. (1995). *Basic Econometrics*, New York: McGraw-Hill.
- Hahn, Frank (1982). *Money and Inflation*, Oxford: Blackwell.
- Horn, Henrik and Torsten Persson (1988). "Exchange Rate Policy, Wage Formation and Credibility," *European Economic Review*, Vol. 32, October, pp. 1621-1636.
- Judd, Kenneth L. (1991). *Numerical Methods in Economics*, Hoover Institution, Stanford University, *mimeo*.
- Kiguel, Miguel A. and Nissan Liviatan (1992). "The Business Cycle Associated with Exchange Rate-Based Stabilizations," *The World Bank Economic Review*, Vol. 6, No.2, pp. 279-305.
- Kremers, Jeroen M. (1990). "Gaining Policy Credibility for a Disinflation," *IMF Staff Papers*, Vol. 37, March, pp.116-45.

- Kydland, Finn and Edward C. Prescott (1977). "Rules rather than Discretion: The Inconsistency of Optimal Plans," *Journal of Political Economy*, June, 85(3), pp. 473-91.
- Lane, Timothy and Liliana Rojas-Suárez (1992). "Credibility, Capital Controls and the EMS," *Journal of International Economics*, Vol. 32, May, pp. 321-338.
- Leiderman, L. and Leo Svensson, eds., (1995). *Inflation Targets*, London: CEPR.
- Levine, Paul (1990). "Monetary Policy and Credibility," in Bandyopadhyay, T. and S. Ghatak, eds., *Current Issues in Monetary Economics*, New York: Barnes and Noble.
- Lucas, Robert E. (1976). "Econometric Policy Evaluation: A Critique," *Journal of Monetary Economics*, Supplementary Series, pp. 19-46.
- Macro Asesoría Económica (1993), (1995). *Realidad Económica de México*, México, D.F.: Grupo Editorial Iberoamericana,
- Mendoza, Enrique G. (1995). "The Terms of Trade, the Real Exchange Rate, and Economic Fluctuations," *International Economic Review*, Vol. 36, No. 1, February, pp.101-137.
- _____ and Martin Uribe (1997). "The Syndrome of Exchange Rate-Based Stabilizations and the Uncertain Duration of Currency Pegs," Discussion Paper Series, Research Department, Federal Reserve Bank of Minneapolis, Minneapolis, MN.
- Nacional Financiera (1995). *La Economía Mexicana en Cifras*, México, D.F.
- OECD (1992), (1995). *Mexico*, Economic Survey.
- Oks, Daniel and S. van Wijnbergen (1995). "Mexico after the Debt Crisis: Is Growth Sustainable?" *Journal of Development Economics*, Vol. 47, pp. 155-178.
- Persson, Torsten (1988). "Credibility of Macroeconomic Policy: An Introduction and a Broad Survey," *European Economic Review*, Vol. 32, pp. 519-532.
- _____ and Guido Tabellini (1990). *Macroeconomic Policy, Credibility and Politics*, Chur, Switzerland: Harwood Academic Publishers.
- Petit, Maria Luisa (1990). *Control Theory and Dynamic Games in Economic Policy Analysis*, New York, NY.: Cambridge University Press.

- Reinhart, Carmen M. and Carlos A. Végh (1995). "Nominal Interest Rates, Consumption Booms, and Lack of Credibility: A Quantitative Examination," *Journal of Development Economics*, Vol. 46, pp. 357-78.
- Rogoff, Kenneth (1985). "The Optimal Degree of Commitment to an Intermediate Monetary Target," *Quarterly Journal of Economics*, November, pp.1169-1189.
- Ros, Jaime (1994). "Financial Markets and Capital Flows in Mexico" in Ocampo, J.A. and R. Steiner eds., *Foreign Capital in Latin America*, Inter-American Development Bank, Washington, D.C.
- Sachs, Jeffrey, A. Tornell, and A. Velasco (1995). "The Collapse of the Mexican Peso: What Have We Learned?" Harvard University Press, *mimeo*.
- Schelling, Thomas C. (1982). "Establishing Credibility: Strategic Considerations," Papers and Proceedings, *The American Economic Review*, Vol. 72, No. 2, May, pp. 77-80.
- Schwartz, Moisés (1994). "Exchange Rate Bands and Monetary Policy: The Case of Mexico", *Economía Mexicana, Nueva Epoca*, Vol III, No. 2, pp. 287-317.
- Taylor, John B. (1982) "Establishing Credibility: A Rational Expectations Viewpoint," Papers and Proceedings, *The American Economic Review*, Vol. 72, No. 2, May, pp. 77-80.
- Végh, Carlos A. (1992) "Stopping High Inflation", *IMF Staff Papers*, Vol. 39, No. 3., pp. 626-695.