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Reducing Inflation: The Chilean Experience

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ABSTRACT

The main purpose of this paper is to analyze the process by which Chile was able to reduce inflation during the 1990s. In this period inflation was gradually reduced from close to 30% per annum in 1990 to only 6% in 1997. The paper concludes that three factors were important in helping to accomplish this performance. First, the independent Central Bank and its tough actions early on -to convey the message that it was ready to stand behind its mandate (to reduce inflation)- helped to shape inflationary expectations and in the process it led to lower wage inflation and ultimately a lower path for core inflation. Second, a restrictive monetary policy, and the foreign exchange intervention policies associated with it, resulted in a trajectory of the nominal exchange rate much below what would have been observed under a PPP rule adjusted for differences in productivity. This result was reinforced by the low credibility of the band reflected in the effect of the location of the exchange rate within the band on the observed rate. Third, the higher rate of growth of labor productivity, given the wage equation, resulted in a lower rate of growth of unit labor cost than otherwise. From these three effects the first effect, the enhanced credibility of the new policy operating through the formation of inflation expectations, was found to be the most important factor behind the success in reducing inflation rate.

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I. INTRODUCTION

Following 40 years of high and variable inflation, during this decade Chile has made major progress reducing inflation towards industrial countries' levels. What is even more remarkable is that the inflation reduction has been achieved without the standard short-term costs in terms of a reduction in output growth or an increase in the unemployment rate. On the contrary, while inflation was been reduced, growth increased and the unemployment rate reached its lowest level in 30 years. Indeed, Chile's economic record over the past ten years has been outstanding. During the 1986-1997 period, the average GDP growth rate reached 7.6% while the average inflation rate reached 17.8%. The unemployment rate was reduced from close to 30% in late 1982 to only 5.3% during the last quarter of 1997. Furthermore, the inflation rate (Dec.- Dec.), that had reached 27,3% in 1990, decreased all throughout the 1990s to reach 6.6% in 1996 and only 6.0% in 1997.

The foundations of Chile's anti-inflationary program were laid down during the 1970s, when the public sector deficit was eradicated. However, it was only in the 1990s, with the creation of an independent Central Bank, when a continuous progress was made on the reduction of inflation. This objective was pursued by a newly established independent Central Bank that had in its charter as its main objective that the main objective to promote the stability of the currency.

It was the historical record of high and variable inflation with its negative effects on the efficiency of resource allocation and in economic growth and the increasingly accepted view that macroeconomic stability was a precondition to sustain high growth what motivated the granting of independence to the Central Bank. An indicator of how widely this view was held is the fact that although the independence of the Central Bank had been approved under the military government it has also been embraced by the center left coalition of parties that have governed Chile during the 1990s. Chilean inflation was an

historic fact and during the past 40 years the record was clearly poor. In the 1960s, inflation averaged 21.1percent per annum. In the early 1970s, under the populist policies of the Allende government, inflation accelerated, reaching an annual rate of approximately 463 percent in August 1973, the month before Allende's fall. Underlying the acceleration of inflation was a consolidated non-financial public sector deficit that by 1973 was close to 25 percent of GDP, deficit that was mainly financed by printing money..

Among the main objectives of the military government that took power in September 1973 was the elimination of the severe and pressing macroeconomic disequilibrium that it had inherited while at the same time also moving fast to reduce microeconomic distortions in relative prices. To achieve this goal, public sector responsibilities had to be revised, and the size of the public sector and its participation in economic activities heavily curtailed.

The newly independent Central Bank, which was created in October 1989 and that began operating in December 1989, only three months before the Presidency was transferred from Pinochet to Aylwin, initiated the second stage of inflation reduction. Although the Central Bank's main objectives were to achieve price stability and to ensure the proper functioning of the domestic and external payment system, the existence of a robust financial system and solid external accounts allowed the Central Bank to concentrate only on reducing inflation.

The purpose of this paper is to study the Chilean stabilization policies. In Section 2, we will discuss the reduction of inflation in the 1975-1989 period, in Section 3, we will revise the experience of the 1990s when inflation was reduced from 26% in 1990 to only 6% in 1997. In Section 4 we will analyze the different factors that were behind the inflation reduction and in Section 5 we present the main conclusions.

II. REDUCING INFLATION: THE FIRST STAGE, 1975-1989.

From the beginning, the new economic authorities appointed by the military government thought that the high fiscal deficit and the required increase in money supply to finance it were at the root of the high inflation. However, they also believed that due to inflation inertia, inflation should be reduced only gradually to avoid a sharp increase in unemployment.

At the same time the overall growth strategy was revised concluding that for the economy to grow on a sustainable basis, export-led growth should be pursued. To achieve this goal, microeconomic distortions had to be reduced and, in particular, the economy had to be increasingly integrated to foreign trade.

At the time, the economy was invaded by a host of microeconomic distortions. Distortions took the form of: multiple exchange rates, a high average and variance of import tariffs, import and export quotas, import prohibitions, a large part of economic activities undertaken directly by public enterprises run with criteria far removed from profit maximization, and widespread price controls.

Reforms were introduced all across the system of incentives. Regarding exchange rate policy, the multiple exchange rate system was reduced to three rates early on: one for copper exports, one for the rest of the trade account, and one for services and financial flows. The unification was accompanied by a large devaluation of the average exchange rate to bring it close to its equilibrium level. The three initial exchange rates were then reduced to a single rate in August 1975.

On the way towards unification, the exchange rate for trade transactions was following a passive crawling peg as a way of protecting the real exchange rate while inflation was running at a three-digit annual level.

A large fiscal adjustment was introduced in 1974, which cut the budget deficit by 21 percentage points of GDP in just one year. At the time it was thought that this fiscal adjustment was going to go a long way towards reducing drastically inflation now that the need for monetization had been eliminated. However, despite the drastic fiscal adjustment inflation in 1974 was still at an annual rate of 369%. Monetary policy during this period was supposed to be geared towards providing enough liquidity to support the price increases resulting from higher production costs to accommodate the wage and exchange rate adjustments.

Early in 1975, there was a change in the stabilization strategy in favor of an urgent reduction in the size of the current account deficit and a less gradual approach to inflation reduction. Two developments prompted this change. First, a drastic worsening of the terms of trade (an almost 50% reduction in the copper price and the persistence of the oil price increase of the previous year) suggested that the resulting current account deficit would be difficult to finance. Second, the slow pace of inflation reduction required finding other ways of reducing inflation. Indeed, monthly inflation even started to accelerate in early 1975, reaching 17% in February and March.

The external shock that Chile suffered in 1975 was severe; the copper price fell 45 percent in real terms and the price of oil rose by a factor of three. As access to international capital markets was all but closed to the Pinochet's government, aggregate demand had to be cut to face an emerging balance of payments crisis. Also, the reduction in domestic spending had to be paired with a real depreciation so as to reallocate resources to tradable sectors while the demand for domestic output was being reduced. To accompany the real depreciation, the rate of crawl of the nominal exchange rate was accelerated.

The new program, announced in April 1975, included also a further fiscal adjustment. This fiscal adjustment included a 10% temporary increase in income taxes; a

10% additional consumption tax on luxury items; a 15 to 25% reduction in budgeted expenditures on goods and services by public entities and public enterprises; and the elimination of all exemptions to the value added tax. Money growth was expected to decelerate along with the reduction in the non-financial public sector deficit.

As a result of a substantial additional fiscal correction, , in spite of a sharp recession, the non-financial public sector deficit was reduced by a further 2.6 percentage points of GDP in 1975. The size of the fiscal correction and the accompanying monetary squeeze in the presence of inflation inertia magnified the effects of the terms of trade drop.

To support the new export-led growth strategy, and as a response to the sharp fall in the terms of trade, these fiscal and monetary corrections were accompanied by an aggressive crawling peg policy geared towards achieving and sustaining a highly competitive real exchange rate. In addition, starting in October 1974, public sector wages were indexed to provide full compensation for the previous period's inflation. At the same time, the government also mandated private sector wage adjustment based upon past inflation. As shown in Corbo and Fischer (1994), these exchange rate and wage adjustment mechanisms built substantial inflationary inertia into the economy. This inertia made any sudden inflation reduction very costly.

It was mainly the significant reduction in domestic aggregate demand in 1975 (20.8 percent in real terms) that caused that year's sharp recession. Part of the slowdown in growth was bound to result anyway from the effects of the orthodox stabilization program to reduce chronic inflation that was being implemented at the time (Corbo and Solimano, 1991; Corbo and Fischer; 1994). The cost of stabilization would have been lower if the fiscal adjustment had been accompanied by a coordinated deceleration in the wage and exchange rate increases. In particular, the backward indexation of public sector wages, introduced in November of 1974, built in inertia. As the coordination of price increases was not brought

about, inflation came down very slowly and with a high cost in terms of rising unemployment.

The current account deficit for 1975, which in early 1975 had been expected to be 2 billion dollars for the year, turned out to be only 492 million dollars at the year's end. However, inflation for that year was 343.3%, only marginally below 1974's 369.2%. The costs of reducing inflation and the external deficit proved very high in terms of the drop in GDP and the resulting increase in unemployment.

After the 1975 recession was left behind, the economy started to grow as the reforms progressed and their credibility was enhanced. GDP growth was 3.5 percent in 1976, 9.9 percent in 1977, and 8.2 percent in 1978. The recovery period lasted until 1981, when a combination of the side effects of a new stabilization program and external shocks once again conspired to generate another sharp recession.

By 1976, unhappy with the progress in reducing inflation, and observing a surplus in the current account of the balance of payments, the Central Bank undertook nominal appreciations of the peso of 10% each in June 1976 and March 1977. As a result of these policies inflation declined fast, but was still 198% in 1976 and 84.2% in 1977. The unemployment rate, which had been 14.8% in 1975, came down to 12.7% in 1976 and to 11.8% in 1977.

Late in 1977, a debate began to emerge in government circles regarding the causes of the slow pace of inflation reduction and of the most appropriate nominal anchor for the inflation rate[1]. At the center of this debate was the role of the active crawling peg exchange rate policy in the perpetuation of inflation. In an influential paper, Barandiarán

[1] The quantity of money and the exchange rate are usually used as the typical anchors, because central banks can, at least during some time, control them.

(1977) questioned the exchange rate policy that was being followed. He recommended the introduction of a passive crawling peg in the form of a forward looking preannounced devaluation schedule at a decreasing rate as a vehicle to shape inflation expectations and provide a nominal anchor for price level evolution. Another group was in favor of moving towards a flexible exchange rate, with aggregate monetary targets.

Corbo (1985b) and Corbo and Fischer (1994) show that the backward indexation of wages and the nominal exchange rate had created by then a dynamic of inflation where there was almost full inertia for the price level, inflation being approximately equal to previous period inflation plus a random term. They also show that the elimination of inertia emerging from the exchange rate still left substantial inertia in aggregate inflation.

An important shift in stabilization policy in Barandiarán's direction occurred in February 1978 when the government instituted a system of preannounced rates of peso devaluation at a decreasing rate. This policy culminated in June 1979 with a fixed exchange rate of 39 pesos per dollar, a rate that was maintained until June 1982. But at the time of the exchange rate fixing, domestic inflation was still 30 percent per year, which together with backward wage indexation was bound to result in a sharp real appreciation. The government believed that this exchange rate policy would reduce inflation both by shaping inflation expectations and through the direct influence of tradable goods (import competing and exportable goods) prices on all domestic prices.

However, as the indexation system for wages and financial contracts was not modified at the time of the change in exchange rate policy, the stage for a sharp real appreciation was set. Since October 1974, wages had been indexed to past inflation with full compensation for increases in the CPI. The new labor code of 1979 also ensured that, for workers subject to collective bargaining, the lowest wage offered would be equal to the previous wage augmented by the CPI change since the last wage contract. Full indexation

to the CPI applied also, on a voluntary basis, to financial and house rental contracts, as to many other private contracts. This extensive indexing, in the context of declining inflation with a fixed exchange rate, was bound to result in a slow pace of inflation reduction and an appreciation of the real exchange rate.

Another side effect of the exchange rate fixing, in the presence of substantial inertia and a poorly regulated and supervised financial system, was the large increase in capital inflows. Thus, following the introduction of the forward looking devaluation schedule, the initial spread between the domestic interest rate and the foreign interest rate --adjusting for the expected rate of devaluation -- increased the incentives to bring capital into Chile. Weak financial regulations and institutions, in the presence of full deposit insurance, resulted in undue risk taking by the financial system. The final result was -- as elsewhere in Latin America and in Asia in 1997-- large capital inflows, an expenditure boom, and a sharp real appreciation. Lax lending practices by the private financial system financed an expenditure boom that resulted in a trade balance deficit of 10.3% of GDP in 1981.

This was also a year in which the public sector had a surplus of 0.8% of GDP, down from a surplus of 4.5% of GDP in 1980. The decline in the public sector surplus was due mostly to the transitory cost of a change in the social security system from a pay-as-you go to an individual capitalization system.

After three years with a fixed exchange rate, inflation declined to a one digit annual level in 1981. But this achievement, which brought with it a 25 percent real appreciation and a current account deficit of 14% of GDP, did not last long. When external financing was drastically reduced in 1982, the economic authorities decided to use a hands-off policy to allow the textbook automatic adjustment mechanism to accommodate domestic expenditures to a much-reduced level of foreign financing in a fixed exchange rate framework.

The reduction in expenditures required a large real depreciation to avoid a substantial increase in unemployment in the nontradable sector. With the a fixed nominal exchange rate, this adjustment could be made only through deflation. The combination of a fixed exchange rate with backward wage indexation made the downward adjustment of domestic prices very slow resulting in a major impediment to achieve the real depreciation. Thus, in what was a major policy mistake, the authorities allowed the automatic adjustment mechanism to work under a fixed exchange rate, but without room for a real depreciation, as the system of backward wage indexation remained intact[2]. Unsurprisingly, the result was a sharp increase in unemployment and a large recession[3].

As the method selected to adjust the external account became very costly, the private sector started to anticipate that the benefits of keeping the exchange rate fixed were beginning to be overtaken by the rising cost of unemployment. As a result, the stage was set for a speculative attack on the fixed exchange rate (Krugman, 1997). The increasing gap between domestic and foreign interest rates provides evidence that economic agents started to anticipate the eventual abandonment of the fixed exchange rate. As the speculative attack intensified, and the unemployment rate was on the rising, the fixed exchange rate was finally abandoned on June 1982 but by then also a major crisis was unfolding. GDP dropped 14.1% in 1982, and the unemployment rate increased 8.3 percentage points between 1981 and 1982.

Much has been written on the causes of the 1982-83 recession that almost derailed the whole adjustment effort of the previous 7 years. In particular, some analysts have

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2 The fixing of the exchange rate with backward indexation of wages also exacerbated the standard expansionary effects associated to exchange rate based stabilization but we think that part of this expansion was bound to result anyway from the increasing access to foreign capital.

3 For an early warning that this problem was about to emerge see Corbo and Edwards (1981).

blamed the exchange rate stabilization program for the crisis. We briefly review these explanations below.

First, a premature domestic financial without an appropriate regulatory and supervision system led to an expenditure boom, facilitated by weak banks that undertook undue risk, making the economy as a whole vulnerable to external shocks (Arellano, 1983; Zahler, 1985; Corbo, 1985a; De la Cuadra and Valdés-Prieto, 1992).

Second, the exchange rate based stabilization program (ERBSP) with backward CPI wage indexation with a rate of nominal devaluation much below the existing inflation rate, encouraged an expenditure boom above the normal one associated to a typical ERBSP (Corbo, 1985a; Edwards and Cox-Edwards, 1987). An alternative explanation is that the coexistence of a fixed exchange rate and backward wage indexation created difficulties for labor market adjustment, while the structural reforms were being implemented. These difficulties were especially notorious when aggregate expenditures had to be reduced through the macroeconomic adjustment mechanism in late 1981 and early 1982 (Corbo 1985a; Edwards and Cox-Edwards, 1987; Meller, 1996).

Third, the liberalization of the capital account and the sudden increase in the amount of capital inflows through its expenditure effect created a sharp real appreciation and fueled the large increase in the current account deficit (Harberger, 1985; Edwards, 1986; Morande, 1988).

Fourth, a complete disregard for the size of the current account deficit created a very vulnerable external situation (Corbo, 1985a; Edwards and Cox-Edwards, 1987; Meller, 1996). When an external shock hit in 1982, the sudden reversal in capital inflows created an Asian 1997-type recession and a destruction of the financial system.

Each of these factors played a role in the crisis, although some more significantly than others. As most deep crises, including that of Asia in 1997-98, the Chilean 1981-1983 crisis cannot be attributed to one main cause. In fact, all four factors mentioned above played a role. It is possible, however, to highlight two factors as those that played a key role. First, a premature domestic financial liberalization while there was inadequate financial supervision and regulation by the authorities led to undue risk taking and related lending fueling a boom in assets pricing and domestic expenditures. Second, the introduction of an ERBSP in the presence of backward looking wage indexation and financial contracts was bound to result in a temporary sharp appreciation which together with pourly regulated banks encouraged large capital inflows fueling a sharp increase in expenditures and in the current account deficit.

After the crisis was left behind and the banking system was rebuild, Chile learned its lesson and built a modern banking regulation. At the same time Chile selected a much more flexible exchange rate system and provided much more room for adjustment in the real exchange rate. Wage indexation was lifted in June 1982.

After the devaluation of June 1982, there was much experimentation with the exchange rate policy, going all the way from a fixed exchange rate to an active crawling peg, to a floating rate and to a dirty float, to switch again, starting in 1985, to a passive crawling band.

The sharp recession proved to be too much for the poorly regulated financial system. As a major financial crisis unfolded early in 1983, the government had to intervene to rescue the financial system, to support financially distressed firms and households, and to support the unemployed. As a result, there was a large increase in the public sector deficit inclusive of the quasi-fiscal deficit of the Central Bank.

Once the financial crisis was under control, Chile faced the problem of achieving a trade surplus while creating the conditions for sustainable growth. By 1984, the non-financial public sector deficit had reached 4.3% of GDP while Central Bank losses incurred to support the financial system and private borrowers were estimated at another 4.8% of GDP (Larrañaga, 1989).

The stabilization program established in 1985 was part of a broader structural adjustment program. The latter was aimed at restoring the trade balance to a sustainable level and at maintaining the microeconomic and institutional reforms introduced in the previous ten years. The program included a sharp fiscal adjustment assisted by an exchange rate policy that facilitated the increase in the real exchange rate towards its higher equilibrium level. The exchange rate policy introduced was again a crawling peg, but now passive and ex post, adjusting the exchange rate for the differential between domestic and foreign inflation. This system is similar to the one that existed up to February 1978; however, some additional flexibility was built in with the introduction of an exchange rate band around the target exchange rate. The diagonal band allowed for a fluctuation in the exchange rate of .5% in both directions. It was then broadened to 2% in both directions in June 1985, to 3% in January 1988, and to 5% in June 1989.

During the second half of the 1980s, the economy became quite indexed again and as a result, inflation had much inertia. Not surprisingly, annual inflation fluctuated from 12.7 percent (1988) to 27.3 percent (1990).

III. STABILIZATION POLICY IN THE 1990's

During the 1990s, monetary policy has been geared towards reducing inflation with the ultimate objective of achieving price stability. The new Central Bank Charter of 1989, that made the Central Bank independent, has provided the institutional setting for the design of monetary policy during the 90s. The charter establishes that the main objectives of monetary policy should be "the stability of the currency and the normal development of the internal and external payment systems".

In the current literature on Central Bank independence, the Central Bank of Chile is organized in accordance with Rogoff's "Conservative Central Banker" model (1985)[4]. Chilean law gives the Central Bank independence to set its own target as well as to choose the instruments that it judges pertinent to achieve this target. Furthermore, in what is an important difference with other independent Central Banks that have been created recently, the Central Bank of Chile is also responsible for the exchange rate system and for exchange rate policy.

The Central Bank has the objective of achieving a gradual inflation reduction towards industrial countries' levels while keeping a current account deficit that will not jeopardize the stability of the external payment system. The latter has been spelled out, by the Central Bank, as having an upper bound limit for the current account deficit of 4% of GDP, with absorption and national disposable income measured at "normal" terms of trade levels. The meaning of the word normal has not been clearly spelled out. But whenever the

[4] In this model, the Central Bank board behaves as minimizing a quadratic loss function in which the arguments of the function are the departure of the inflation rate from its target and the departure of the current account deficit from its target (or the unemployment rate from its target in Rogoff's model). But *de facto*, the Central Bank has been giving the largest weight to the inflation term resulting in a conduct similar to the one of the "Conservative Central Banker" of Rogoff.

two objectives enters into conflict, like it was the case in 1996 and as it is the case again today, the inflation target has taken prominence.

The inflation objective for the upcoming year is chosen by the Central Bank, and announced to the Congress and to the country during the first fifteen days of September of every year. The inflation objective was initially stated in terms of a range for the CPI inflation rate for the period Dec-Dec of the upcoming year, then starting in September 1994, the Central Bank moved towards setting a point estimate for the inflation objective. Thus, the Central Bank uses a framework of inflation target to conduct its monetary an exchange rate policy. The inflation target is the ultimate objective of policy, an inflation forecast, not made public is the intermediate objective and the interest rate is the main instrument.

Stating the objective of monetary policy in terms of an inflation target is increasingly becoming the policy of a number of industrial countries (New Zealand, Canada, U.K., Sweden, Finland, Australia and Spain). However, in a major departure with the practice followed in industrial countries, the Chilean authorities announce a point estimate, while the industrial countries announce a range[5]. This is not a trivial difference. As monetary policy works with a substantial lag, to pre-commit an unconditional inflation target -independently of changes in external factors that do affect the inflation rate- could be costly. In particular, to achieve the target could require an over-restrictive monetary policy or a sharp appreciation of the currency, in the process building distortions in relative prices or increasing output volatility.

A current account deficit target, at normal terms of trade, has been set by the Central Bank at less than 4 percent of GDP. In practice, this target has been expressed as a loose commitment to a competitive real exchange rate. As the real exchange rate has

5 For a review of the international experience with inflation targeting see Leiderman and Svensson (1995).

appreciated during the 1990s, a conflict between the inflation and the real exchange rate objectives has appeared many times and although the inflation objective has taken priority, the Central Bank has struggled to avoid an excessive real appreciation. For the latter purpose, it has intervened in the exchange rate market with an aggressive and costly policy of foreign reserve accumulation, accompanied by sterilization of the monetary effects of exchange rate accumulation.

The problem of pursuing an inflation and an exchange rate target, at the same time, is well known. Given the exchange rate system, as long as the observed value of the exchange rate is well within the band, the uncovered interest rate parity condition provides a link between the interest rate and the exchange rate. In particular, as long as the exchange rate is within the band, any adjustment in the domestic interest rate results in a movement in the nominal exchange rate. Therefore, for all practical purposes there has not been an independent exchange rate policy[6]. Also conflicts with the Ministry of Finance have arisen when, as a result of an increase in domestic interest rates, there has resulted a sharp nominal and real exchange rate appreciation. In that cases, it is correctly argued that such an appreciation could result in reduced exports and eventually damage the long-term sustainability of the current account and the Chilean export-led growth model itself.

In practice, the Central Bank started by controlling monetary aggregates, it then shifted to the use of the interest rate as its main instrument for achieving the inflation

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6 During the 1990s, the exchange rate system has been maintained as a diagonal exchange rate band. The central parity of the band is adjusted passively, on a daily basis, by the difference between the domestic and international inflation of the previous month[6]. The width of the band was increased to 10 percent on both sides of the central parity in January 1992. Up to July 1992 the central parity was established in terms of the value of the US dollar but since then, it has been set in terms of a basket of currencies. In addition, starting in November 1995, a further 2 percent per year has been subtracted from the central parity to accommodate an estimate for trend appreciation of the equilibrium real exchange rate.

target[7]. Through the use of monetary policy, the Central Bank controls the evolution of actual inflation. Some times it appears that the inflation forecast-that it is used as an intermediate target- is closely related to the gap between domestic expenditures and GDP, and it is through this gap that it tries to avoid the build up of inflationary pressures that could endanger the inflation target. The Minister of Finance can then use supply side fiscal policy to increase capacity output and to reduce the natural unemployment rate.

Recognizing the slowness with which the rate of change of nominal wages and prices adjusts in a fully indexed economy as the Chilean one, the Central Bank of Chile defined a policy aimed at achieving gradual inflation reduction. When the board of the newly independent Central Bank took office in December 1989, following the expansionary macroeconomic policies of 1989, the 12-month inflation rate (November 1988 to November 1989) was 21.1% and it was accelerating (See table 1). One of the first measures adopted by the board was to introduce a sharp increase in real --CPI indexed-- interest rates on Central Bank bills. The overnight real interest rate on the 10-year Central Bank bond was raised by 280 base points, from 6.9 to 9.7 percent per year. In paralel, the rate on the 90-day --CPI indexed—Central Bank bond was raised from 6.8 to 8.7 percent per year. However, in a world of increasingly integrated capital markets, the high real interest rate policy pulled in foreign capital, which in turn led to an appreciation of the real exchange rate[8]. Not surprisingly, in 1990 the value of the peso appreciated up to the lower limit of the exchange rate band. To defend the band, the Central Bank had to intervene in the foreign exchange market, in the process, accumulating US $ 2.43 billion of additional foreign reserves in that

7 This shift is, indeed, consistent with a world of continuous financial innovation whereby the link between the growth in monetary aggregates and inflation or the growth in nominal income is too fragile to be the cornerstone of stabilization policy.

8 The exchange rate policy of the 1990s has been of the exchange rate band type with the central parity adjusted on a daily basis by the past difference between domestic and foreign inflation. For details of the exchange rate policy see table III:1 in Corbo and Desormeaux (1996).

year alone, an 82.3% increase in the stock of foreign reserves. This massive exchange rate accumulation points to a significant exchange rate intervention. But as Central Bank authorities wanted to gain credibility on their anti-inflationary stance, they accompanied the exchange rate accumulation with an aggressive sterilization policy run in parallel.

IV. ACCOUNTING FOR THE REDUCTION OF INFLATION IN THE 90s

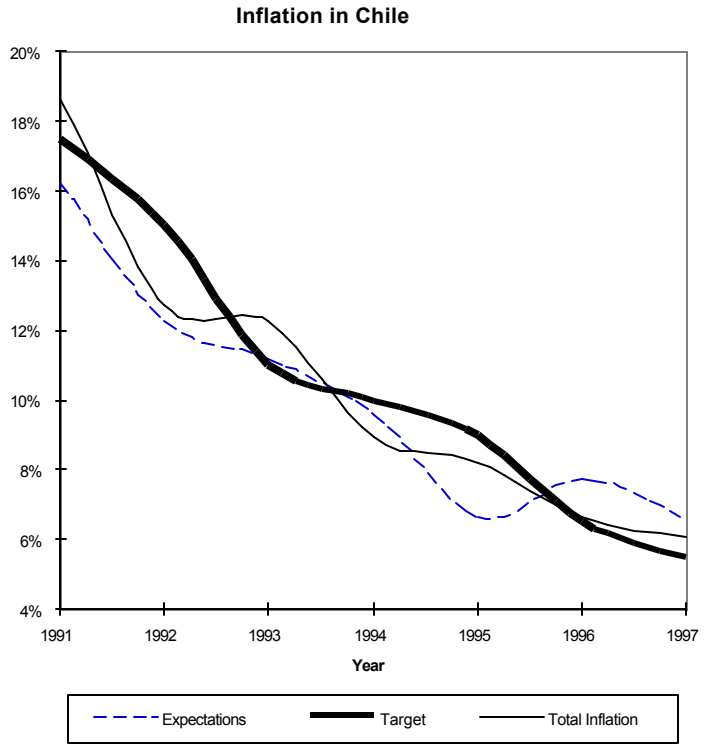
The newly established independent Central Bank has achieved an impressive record in gradually but continuously reducing inflation and in achieving a level of inflation close to the target. In the process, it has gained credibility on its stabilization policy. In turn, most likely through its effect in the wage setting process, the increased credibility of its policies has reduced the short-term costs of gradual inflation reduction. This could explain the apparent low cost of the inflation reduction policy. But the process has not been easy.

A comparison between actual inflation and the inflation target is presented in Table #1 and in figure # 1. In the same diagram, we also present an estimate of expected inflation obtained by comparing ex-ante values of nominal and real interest rates of comparable liabilities for commercial banks.

TABLE Nº 1: ACTUAL AND TARGET INFLATION

Year	Actual	Target
1991	18.70%	17.50%
1992	12.70%	15.00%
1993	12.20%	11.00%
1994	8.90%	10.00%
1995	8.20%	9.00%
1996	6.60%	6.50%
1997	6.00%	5.50%

FIGURE Nº 1: ACTUAL, EXPECTED AND TARGET

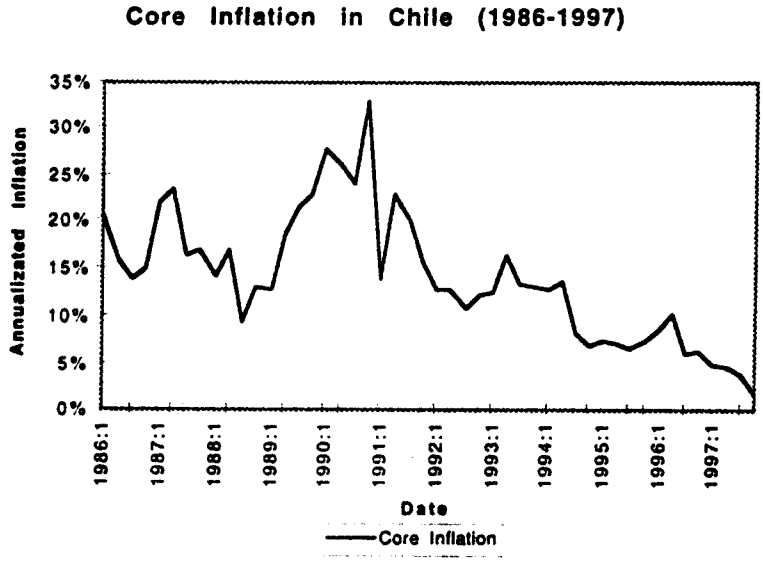


INFLATION

Now we will study the process of inflation reduction. We will set the hypothesis that the main channels through which the new strategy worked were: (1) changing the process of formation of expectations regarding future inflation; (2) generating a trajectory of real exchange rate appreciation as a side effect of the combination of monetary and fiscal policies; and (3) slowing down the rate of growth of the unit cost of labor as a result of the effect of the economic reforms in average labor productivity. The first channel investigates if the increasing credibility of the Central Bank inflation target changed the process of formation of inflation expectations. If this is the case, these expectations directly affect the dynamics of wages and indirectly affect those of the inflationary process. The second channel, the appreciation of the real exchange rate, works through the effects of the trajectory of the nominal exchange rate in the price dynamics of tradable goods and ultimately of inflation. Finally the third channel, the increase in average labor productivity reduces the unit cost of labor and it works through the price of non-tradables.

Before proceeding to study the dynamics of Chilean inflation, we will examine the behavior of inflation during the last ten years. Figure #2 presents the evolution of the quarterly core inflation rate, expressed at an annual rate, from the first quarter of 1986 up to the last quarter of 1997.

FIGURE N°2: CORE INFLATION: 1986.1 TO 1997.4



It can be observed from the above figure that annualized core inflation reached a peak in the last quarter of 1990, when it reached an annual rate of 32.9%. It then started to decrease continuously from there on, reaching an annual rate of only 1.7 % in the last quarter of 1997.

The dynamic of inflation can be studied using a simple structure as done in Dornbusch and Fischer (1993) and Burton and Fischer (1997). They write the inflation rate as the weighted average of the rate of change in the prices of tradable and non-tradable goods and services. Then, to complete the simple structure, they assume that the rate of change in the price of non-tradable goods is given by the rate of change of wages. While the rate of change in the price of tradable goods is given by the sum of the rate of change of external prices and the rate of change in the exchange rate. In our case,

we start with this simple model but we write the price of non-tradable goods as the rate of change in the unit labor cost.

That is, we start from the following model:[9]

$$\pi^S_t = \alpha\,(\omega_t - q_t) + (1-\alpha)\,(\pi^*_t + e_t)$$

where π^S is the core inflation, ω is the rate of change of wages, q is the rate of change of average labor productivity, π^* is world inflation and e is the rate of depreciation of the local currency.

Adding and subtracting π^S_{t-1}, we obtain:

$$\pi^S_t = \pi^S_{t-1} + \alpha\,(\omega_t - q_t - \pi^S_{t-1}) + (1-\alpha)\,(\pi^*_t + e_t - \pi^S_{t-1});$$

From the above expression it is observed that inflation can be reduced when the rate of change of unit labor cost is below the previous period inflation rate and when the rate of change in the price of tradable ($\pi^*_t + e_t$) is below last period inflation.

Downward pressure on the first term, ($\omega_t - q_t - \pi^S_{t-1}$) was exercised through the effect of the increasing credibility of the stabilization policy on the trajectory of ω_t, through the effect of the gradual reduction of inflation on the behavior of nominal wages, and through the positive effect of the structural reforms on average labor productivity.

Now we examine the second term. The second term can also be written as:

($\pi^*_t + e_t - \pi^S_t$) + ($\pi^S_t - \pi^S_{t-1}$). The first term is the rate of change of the real exchange rate and the second term is the first difference on the inflation rate. The first term is negative

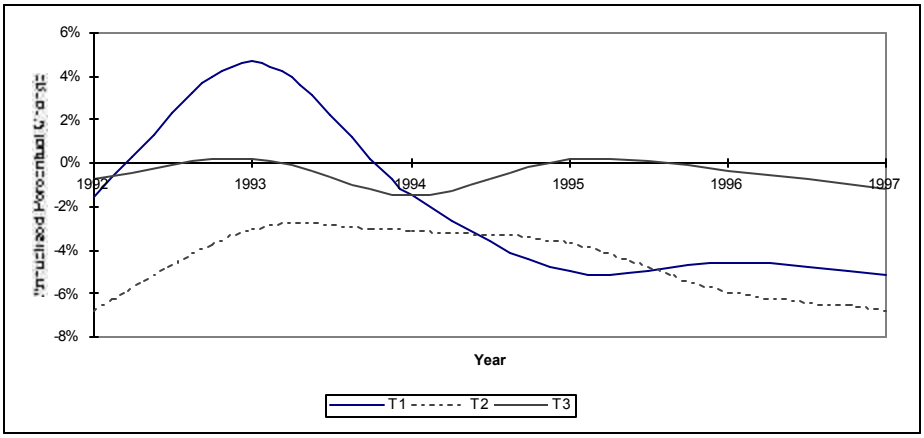
9 The variables are expressed as quarterly rates of change.

when the real exchange rate appreciates and the second term is negative when macroeconomic policies are oriented towards achieving a gradual reduction of inflation. It is clear that this term is negative as long as the real exchange rate appreciates or the core inflation is being gradually reduced.

In figure#3, we plot the three terms that appear on the right hand side of the inflation equation. We label the term T1= $(\omega_t - q_t - \pi^S_{t-1})$, T2= $(\pi^*_t + e_t - \pi^S_t)$, and

T3= $(\pi^S_t - \pi^S_{t-1})$. From observing the figure, it is clear that since1994, both T1 and T2 made an important contribution to the reduction of inflation.

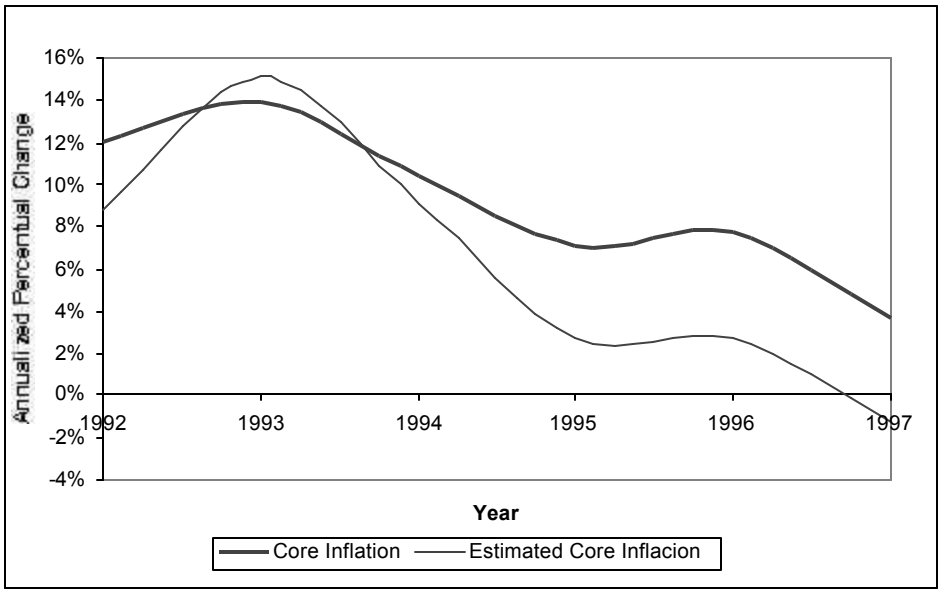
FIGURE Nº 3: THE SOURCES OF INFLATION



Using the above model and a value of $\alpha = 0.59$, we obtain an inflation estimate[10]. In figure # 4, we plot actual core inflation and the core inflation estimated through the simple model presented above.

10 This estimate of α is obtained from a simple regression of the above price equation.

FIGURE Nº 4: ACTUAL CORE INFLATION AND ESTIMATED CORE INFLATION (SIMPLE MODEL)



We proceed further now by estimating a model of inflation extending the simple model presented above. The main extensions are the introduction of structural equations to describe the dynamic of core inflation, wages and the nominal exchange rate. There is a long literature on the modeling inflation in Chile[11]. We will concentrate on open economy type models that have been studied during the last fifteen years. Corbo (1985b) built a model of Chilean inflation to study inflation dynamics up to the early 1980s using a reduced form of the Salter-Swan-Dornbusch dependent economy model. Corbo and

11 For earlier models of the Chilean inflation see Harberger (1963) and Corbo (1974). For a review of inflation models for moderate inflation countries see Dornbusch and Fischer (1993).

Solimano (1991) investigated the dynamics of Chilean inflation up to the late 1980s using a small structural model. Edwards (1993) examined the question of Chilean inflation dynamics and inertia in the context of the use of the exchange rate as a nominal anchor for the 1974 to 1982 period. He also used a reduced form of the Salter-Swan-Dornbusch dependent economy model. In the reduced form of his model, inflation is a function of lagged inflation (which comes from the wage and exchange rate equations of his structural model), foreign inflation, and the rate of change in domestic credit. He also introduced a dummy variable, that takes the value of one during the fixed exchange rate period and zero otherwise. The dummy variable interacts with the coefficient of the lagged inflation variable to allow for inertia reduction following the fixing of the exchange rate. The estimation results led Edwards to conclude that the dynamic of inflation displayed considerable inertia during this period.

Corbo and Fischer (1994) estimated, using monthly data for the 1974.2 to 1982.1 period, a small structural model like that used in Bruno (1978), Corbo (1985b), Bruno (1991) and Corbo and Nam (1992). Solving the structural model, they also found that during the 1980s there was substantial inertia. Finally, Corbo and Piedrabuena (1995) estimated a structural version of the dependent economy model with quarterly data for the 1983.I to 1994.I period.

We are interested in accounting for the reduction of Chilean inflation in the 1990s. For this purpose, we also need a model to be able to separate the contribution to the reduction of inflation of the three factors individualized above. The model that we use is similar to the one used by Corbo and Fischer (1994), Edwards (1993) and Edwards (1996). The model takes the following form:[12]

$$(1) \qquad \pi^S_t = \alpha_0 + \alpha_1 \omega_t + \alpha_2 e_t + \alpha_3 \pi^*_t + \alpha_4 q_t + \alpha_5 GAP_{t-2}$$

12 The variables are measured as rate of change with respect to the previous quarter.

(2) $\omega_t = \beta_0 + \beta_1 \pi^E_{t-1} + \beta_2 \pi_{t-2} + \beta_3 1/U_t + \beta_4 q_t$

(3) $e_t = \gamma_0 + \gamma_1 \pi^*_{t-1} + \gamma_2 \pi_{t-1} + \gamma_3 \Delta RIN_t + \gamma_4 I_{t-1} + \gamma_5 PER_t + \gamma_6 PER_{t-1}$

Where

π^S	=	Core Inflation. (Consumer price index excluding perishables and oil products).
π	=	Actual Inflation (Overall consumer price index).
π^E	=	Expected Inflation.
ω	=	Rate of Change of the Average Wage Rate.
π^*	=	External Inflation in Dollars.
e	=	Rate of Change of the Exchange Rate, in Pesos per dollar.
q	=	Rate of Change of the Average Labor Productivity.
GAP	=	Log of (GDP/Potential GDP).
ΔRIN	=	Change in Foreign Reserves, in US dollars.
I	=	Quarterly Change in GDP.
PER	=	Percentile within the band where is located the exchange rate in that quarter.

Equation (1) is the price equation for core inflation and it is obtained as the weighted average of the price equations for tradable and non-tradable goods and services. Equation (2) is the wage equation where lag inflation enters through explicit indexation schemes in wage payments and the expected inflation enters through the adjustment of wages in contracts that are forward looking. Equation (3) describes the evolution of the nominal exchange rate within the band. Before estimating the equations, we have to study the time series characteristics of the variables to avoid the possibility of estimating spurious relations. For this purpose, we study the order of integration of the variables that

enter in the model[13]. The results of the test indicate that some variables are I(0) and

13 The results of the test for the order of integration of the variables are presented in the appendix

others are I(1), and therefore we cannot estimate the regressions directly and we need to determine first if the variables are cointegrated. We use the Johansen procedure to test for cointegration of the variables and the results are presented in the appendix. We proceed one equation at a time. From the staudy of cointegration we conclude that the three structural equations cointegrate. As the structural equations have in the right hand side endogenous variables we estimate them using the Stock and Watson (1993) methodology that correct the estimates of the standard errors of the coefficients to correct for the simultaneous equation problem.We proceed now to study the results for the estimations of the equations.

The price equation that we estimate is given by:

$$(1) \qquad \pi^S_t = \alpha_0 + \alpha_1 \omega_t + \alpha_2 e_t + \alpha_3 \pi^*_t + \alpha_4 q_t + \alpha_5 GAP_{t-2} + \alpha_6 D874881 + \alpha_7 D9123$$

Where D874881 and D9123 are dummies that take a value of one for periods in which there was a change in the tax law.

The results of the estimation are presented in the table below:

Coefficient	Value	Probability
α_o	0.0041	0.2922
α_1	0.5244	0.0004
α_2	0.3076	0.0034
α_3	0.1437	0.0001
α_4	-0,0737	0.0041
α_5	0,1294	0.0001
α_6	-0,0111	0.0003
α_7	0,02847	0.0000
R^2	0.9553	
Adjusted R^2	0.8622	
DW	2.71	
Period of Estimation	1987:3 a 1996:4	

In the price equation, the external inflation rate and the rate of change of the exchange rate should have the same coefficient, as the relevant variable in the equation for the price of tradables is the external rate of inflation expressed in local currency. However, the rate of change of the exchange rate could also enter through expectations. Therefore, we do not impose the restriction $\alpha_3 = \alpha_4 + \alpha_5$ but rather we test for it using a Wald test. The result of the Wald test indicates that the null hypothesis is rejected with a probability of 0.0423 (the p-value associated to the χ^2).

We proceed further and we test for homogeneity of degree one of the price equation in all the nominal variables. For this purpose, we test the null hypothesis that, in an equation where foreign inflation and the rate of change of the exchange rate enters with the same coefficient, the following restriction should be fulfilled: $\alpha_1+\alpha_2+\alpha_3=1$. The Wald test in this case has a p-probability of 0.6615 and therefore the null hypothesis cannot be rejected. The results for the restricted model were the following:

Final Price Equation:

Coefficient	Value	Probability
α_o	0.0030	0.2703
α_1	0.5484	n.a.
α_2	0.3049	0.0024
α_3	0.1467	0.0000
α_4	-0.0701	0.0022
α_5	0.1296	0.0001
α_6	-0.0112	0.0001
α_7	0.0281	0.0000
R^2	0.9552	
Adjusted R^2	0.9465	
DW	2.74	
Period	1987:3 a 1996:4	

This regression is the price equation that we use in the rest of the model for the simulation experiments.

4.1. The Wage Equation:

In Chile there is a long history of wage indexation, up to 1982 by law and since then as part of the normal process of collective bargaining in an economy with a long history of high and variable inflation. Therefore, we specify a wage equation where wages respond to both lag inflation, expected inflation, the rate of growth of average labor productivity and quarterly dummies. The wage equation that we estimate is given by:

The initial wage equation that we estimate is given by:

$$(2) \qquad \omega_t = \beta_0 + \beta_1 \pi^E_{t-1} + \beta_2 \pi_{t-2} + \beta_3 1/U_t + \beta_4 q_t + \beta_5 D1 + \beta_6 D2 + \beta_7 D3$$

Where D1, D2 and D3 are dummies for first and second quarter.

Before estimating this equation we must first discuss the measurement of inflation expectations. Fortunately, in Chile we have deposits of the same maturity offered in nominal and real terms. Thus, we use a market reading of inflation expectations by comparing the interest rate of nominal and indexed 90 to 365 days deposits in the banking system, both expressed at an annual rate[14].

The results of the estimation for the equation are presented below:

14 It should be mention that we are not adjusting for inflation risk as the difference between the nominal and the real return for a deposit of the same maturity also includes an inflation premium. Our procedure implicitly assumes that this inflation premium is a constant that enters through the constant of the regression.

Coefficient	Value	Probability
β_o	0.0091	0.4465
β_1	1.0142	0.0000
β_2	0.0074	0.1331
β_4	-0.0041	0.3905
β_5	-0.0014	0.8928
β_6	0.0646	0.2151
β_7	-6.77E-06	0.9116
R^2	0.8177	
Adjusted R^2	0.7604	
DW	1.42	
Period of Estimation	1986:2 a 1997:4	

In this equation, we observe that some of the coefficients are not statistically significant. We proceed now to test for homogeneity of degree one on the inflation variable that appear on the right hand side. The result of the Wald test for the null hypothesis that $\beta_1 = 1$ indicates that the null hypothesis cannot be rejected with a probability of 0.9122 (the p-value associated to the χ^2) leading us not to reject the restriction. The estimates for the restricted final model are presented below:

Restricted Wage Equation:

Coefficient	Value	Probability
β_o	0.0062	0.0000
β_1	1.0000	N/A.
β_2	0.0159	0.0000
R^2	0.7958	
Adjusted R^2	0.7659	
DW	1.61	
Period	1986:1 a 1997:4	

4.2. Exchange Rate Equation:

Now we will study the trajectory of the rate of change in the nominal exchange rate. As discussed above, the exchange rate is restricted by a diagonal exchange rate band with a width of 5 percent in both directions of the central parity up to January 1992, 10 percent up to January 1997, and 12.5 percent for the rest of the sampling period. Also starting in July 1992 the central parity started to be set in terms of a currency basket instead of the US dollar. Then in November 1994 and again in January 1997 the currency composition of the basket was changed. All along the central bank authority were struggling to leave room for the real appreciation required by the restrictive monetary policy.

The general equation from where we start is of a type similar to the one studied by Magendzo, Rojas y Vergara (1996). In this specification, the rate of nominal depreciation is given by the following equation:

$$e_t = \gamma_0+\gamma_1 \pi^*_{t-1}+\gamma_2\pi_{t-1}+\gamma_3\Delta RIN_t+\gamma_4 I_{t-1}+\gamma_5 PER_t+\gamma_6 PER_{t-1}$$

Where PER is the percentile of the exchange rate band where the exchange rate is located.

The results obtained from the equation estimation are presented below:

Coefficient	Value	Probability
γ_0	-0.0061	0,4730
γ_1	-0.2835	0.0480
γ_2	0.9513	0.0001
γ_3	-1.25E-05	0.0432
γ_4	-0.1605	0.0354
γ_5	0.0456	0.0408
γ_6	-0.0374	0.0354
R^2	0.6598[15]	
Adjusted R^2	0.5350	
DW	2.02	
Period	1987:2 a 1997:3	

We have completed the estimation of the structural model of inflation, but before carrying out the simulations of alternative policies, we need to endogenize the formation of expectations.

4.3. Completing the Model.

To model inflation expectations, we allow for two different regimes. For the period 1986.1 to 1991.4 period, we assume that inflation expectations are a function of a moving average of inflation of the four previous quarters. Then for the period after 1991, when the Central Bank was following an inflation target policy, we make inflation

15 The low R^2 is an old fact in exchange rate equations. For Chile, see Cowan and De Gregorio (1996) where the estimated equations explains between 52 and 59 per cent, for monthly observations between 1990 amd 1996.

expectation a function of the inflation target and the past difference between the inflation target and the actual inflation rate. The latter variable represents the effect on expectations of the degree of fulfillment of the target.

The estimation of the equations for expected inflation yields the following results:

Equation for the period 1986.1 to 1991.4:

$\pi^{\varepsilon}_{\tau}=\varphi_0+\varphi_1((\pi_\tau+\pi_{\tau-1}+\pi_{\tau-2}+\pi_{\tau-3})/4)$

The results for the estimation of this equation are given below.

Coefficient	Value	Probability
φ_o	0.0029	0.7098
φ_1	0.9286	0.0000
R^2	0.7659	
Adjusted R^2	0.6255	
DW	2.28	
Period	1987:4 a 1991:4	

One would expect the coefficient of moving average of inflation in the above equation to have a value of one. When we test this hypothesis using a Wald test, the p-value of the probability of a type one error is 0,7296. Therefore, we cannot reject the null hypothesis. We impose this restriction and again estimate the above model, obtaining the following results:

Coefficient	Value	Probability
φ_o	-0.0004	0.7768
φ_1	1.0000	n.a.
R^2	0.7653	
Adjusted R^2	0.6586	
DW	2.30	
Period	1987:4 a 1991:4	

The model for the second period (when the Central Bank was following an inflation target) is given by:

$$\pi^{\varepsilon}_{\tau} = \chi_0 + \chi TAR_{\tau+4} + \chi_2(((\pi_{\tau-1} + \pi_{\tau-2} + \pi_{\tau-3} + \pi_{\tau-4})/4) - \pi^{\varepsilon}_{\tau-5})$$

Where TAR is the inflation target of the Central Bank converted from an annual base to a quarterly base.

The estimated model yields the following results:

Coefficient	Value	Probability
χ_0	0.0033	0.7098
χ_1	1.0133	0.0002
χ_2	0.3443	0.0060
R^2	0.7621	
Adjusted R^2	0.4714	
DW	2.17	
Period	1992:1 a 1997:4	

We then test to determine if the coefficient of TAR_{t+4} is equal to one. The Wald test for this null hypothesis yields a p-value of 0.945, leading us to not reject the null hypothesis. This finding leads us to conclude that during this period, the inflation target has played a key role as the anchor for the expected rate of inflation.

The final model with the restriction imposed is given by:

Coefficient	Value	Probability
χ_o	0.0035	0.0010
χ_1	1.0000	n.a.
χ_2	0.3463	0.0000
R^2	0.7621	
Adjusted R^2	0.5242	
DW	2.17	
Period	1992:1 a 1997:1	

4.4. Simulating the Effect of Policy on Inflation.

Now we will carry out three experiments. First, we will simulate the effect of the target inflation announced by the independent Central Bank on the expectations of inflation and through this effect its final impact on the observed trajectory of inflation. (Simulation 1). Second, we will simulate the trajectory of the inflation rate if the exchange rate policy had been a crawling peg accommodating a real appreciation of 2 percent per annum (Simulation 2). Third, we will simulate the rate of inflation for the case when the average rate of productivity for the period 1991-1997 is set equal to its value for the period 1970-1990. Finally, we simulate the cumulative effect of both changes taken together (Simulation 3).

To facilitate the discussion we first present the full model used for the simulations.

(1) $$\pi^S_t = \alpha_0 + \alpha_1 \omega_t + \alpha_2 e_t + \alpha_3 \pi^*_t + \alpha_4 q_t + \alpha_5 GAP_{t-2} + \alpha_6 D874881 + \alpha_7 D9123$$

(2) $$\omega_t = \beta_0 + \beta_1 \pi^E_{t-1} + \beta_2 D1$$

(3) $e_\tau = \gamma_0 + \gamma_1 \pi^{\varepsilon}_{\tau-1} + \gamma_2 \pi_{\tau-1} + \gamma_3 \Delta RIN + \gamma_4 I_{\tau-1} + \gamma_5 \varpi_\tau + \gamma_6 \varpi_{\tau-1}$

(4) $\pi^{\varepsilon}_\tau = \varphi_0 + \varphi_1((\pi_\tau + \pi_{\tau-1} + \pi_{\tau-2} + \pi_{\tau-3})/4)$ for the period 1986.1 to 1991.4

(5) $\pi^{\varepsilon}_\tau = \chi_0 + \chi TAR_{\tau+4} + \chi_2(((\pi_{\tau-1} + \pi_{\tau-2} + \pi_{\tau-3} + \pi_{\tau-4})/4) - \pi^{\varepsilon}_{\tau-5})$ for the period 1992.1 to 1997.4

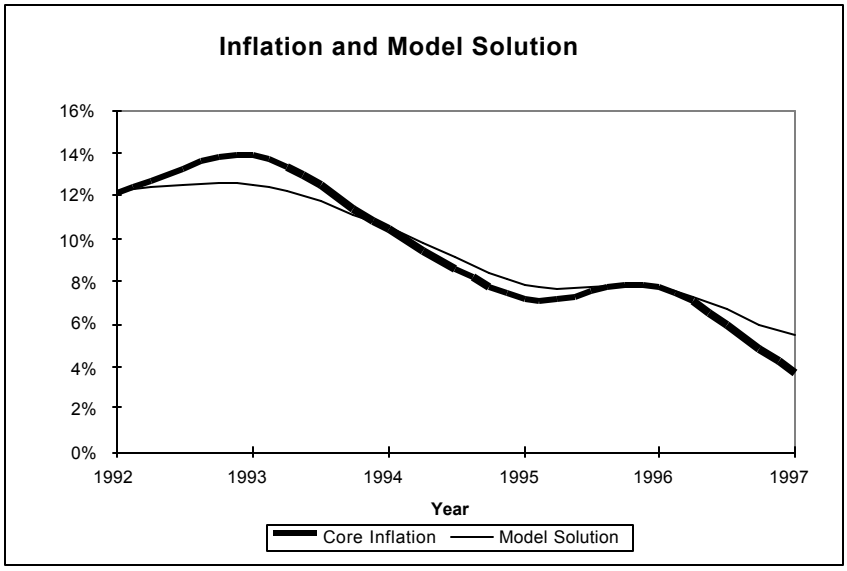
(6) $\pi^{s}_t = \pi_\tau$[16]

Before analyzing the simulations we simulate the complete model for the 1992.1 to 1997.4 period. The simulated values from the model will be used to analyze the effects of the different simulations studied below.

As shown below, the comparison of the actual and simulated values for the core inflation, on an annual basis, is very favorable to the model. The exception is 1997 when the reduction of inflation is much higher than what is explained by the model.

Year	Core Inflation	Model Solution
1992	12.10%	12.15%
1993	13.90%	12.51%
1994	10.39%	10.50%
1995	7.17%	7.80%
1996	7.72%	7.68%
1997	3.70%	5.39%

16 This equality is utilized in the simulations to take into account the effect of a change in the observed rate of inflation.



Simulation 1: The effect on the reduction of inflation of the inflation target

To carry out this simulation, we start by building a counter-factual where the expectations of inflation in the second period are driven by the same equation that explains them in the first period. That is, we assume that in the second period the expectation of inflation is explained by equation (4) above. As a summary, we compare the simulated trajectory if expectations had continued to be formed based upon past inflation with the model solution that uses equation (5) for the period 1992.1 to 1997.4.

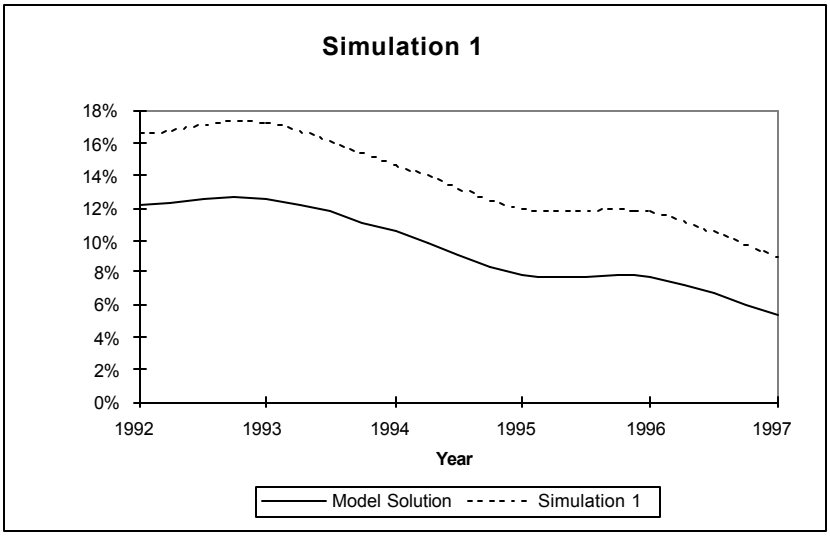
On an annual basis, the difference between the actual and the estimated core inflation would have been the following trajectory:

SIMULATION Nº 1: THE EFFECT OF THE INTRODUCTION OF AN INFLATION TARGET ON INFLATION EXPECTATIONS

Year	Simulation 1	Model Solution
1992	16.49%	12.15%
1993	17.21%	12.51%
1994	14.66%	10.50%
1995	11.95%	7.80%
1996	11.68%	7.68%
1997	8.91%	5.39%

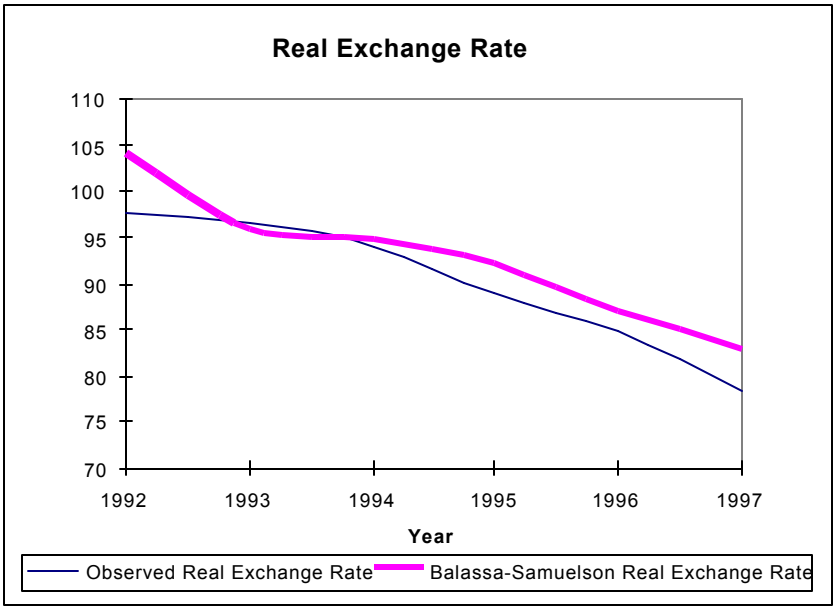
From the results presented in this table, we can observe that the change in the formation of expectations played a central role in the reduction of inflation all through the period.

The difference in the trajectory of core inflation on a quarterly basis is presented in the diagram below:



Simulation 2: The effect of the Exchange Rate Trajectory.

In this simulation, inflation expectations are still modeled by equation 5 and we change only equation (3) by a real exchange rate rule. For the exchange rate rule, we assume that the real exchange rate appreciates 2% per year to accommodate the effect on the equilibrium real exchange rate of the Samuelson-Balassa effect. The comparison of the trajectory of the observed and simulated real exchange rate presented below indicates that the real exchange rate appreciated quite substantially in the latter part of the sample



In our model, the appreciation above the two percent per annum rate helped to reduce inflation. Of course, it could be claimed that the equilibrium real exchange rate appreciated much more than what is assumed in our 2% per year rule. The larger appreciation could be explained by other real factors. However, the sharp reduction in growth of export volumes of recent years provides some evidence that the real appreciation went too far.

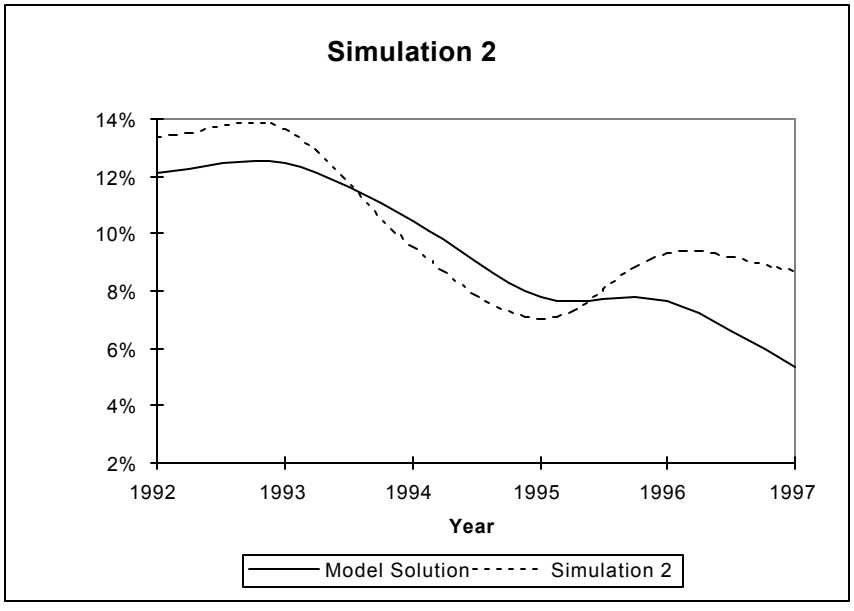
On an annual basis, the difference between the base core inflation and the inflation rate simulated with the assumed real exchange rate rule is presented below:

Simulation # 2: The Effect of a Real Appreciation larger than 2% per year

Year	Simulation 2	Model Solution

1992	13.38%	12.15%
1993	13.67%	12.51%
1994	9.49%	10.50%
1995	7.04%	7.80%
1996	9.30%	7.68%
1997	8.69%	5.39%

Thus we observe that if the real exchange had appreciated 2% per year then inflation would had been reduced much more slowly all through the period. Furthermore, the difference between the model solution and the simulated one is especially large in 1997, the year when the real appreciation was the largest. Thus, the sharp real appreciation of 1997 played a central role in the reduction of inflation of that year.



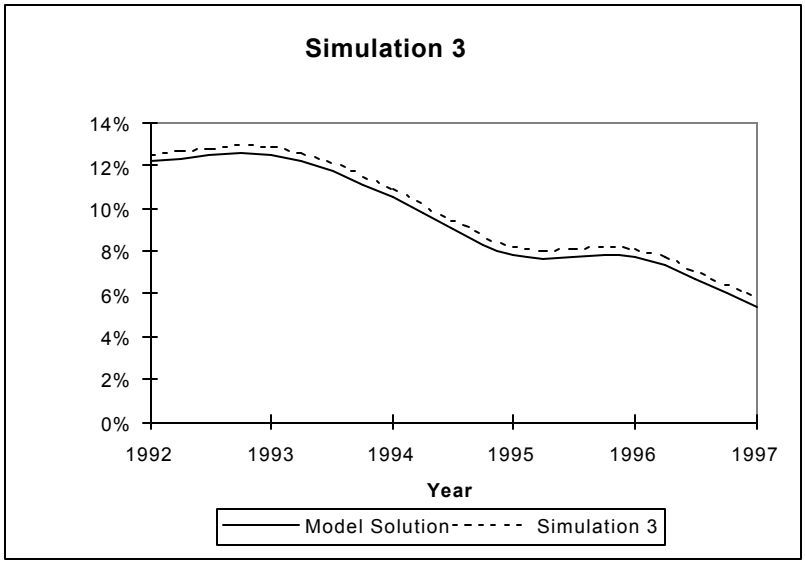
As it can be observed from the simulation results, the effect of the real exchange rate appreciation above 2 percent per annum has been an important contributor to the reduction of inflation of the last two years.

Simulation 3: The effect on the reduction of inflation of the increase in average labor productivity

In this simulation we assume that during the period 1992.1 to 1997.4 the rate of change of average labor productivity was in average equal to 1.96% per year, rate that it is equal to the average rate of growth of productivity during the period 1960-1980. The results of the simulation are presented below. As it can be observed this effect explains a reduction of close to half of a percentage point on the annual rate of inflation.

Simulation # 3: The effect on the reduction of inflation of the increase in average labor productivity

Year	Simulation 3	Model Solution
1992	12.49%	12.15%
1993	12.92%	12.51%
1994	10.91%	10.50%
1995	8.19%	7.80%
1996	8.07%	7.68%
1997	5.77%	5.39%



Simulation 4: The effect on the reduction of inflation of the credibility of the inflation target, of the appreciation of the real exchange rate and of the increase in productivity

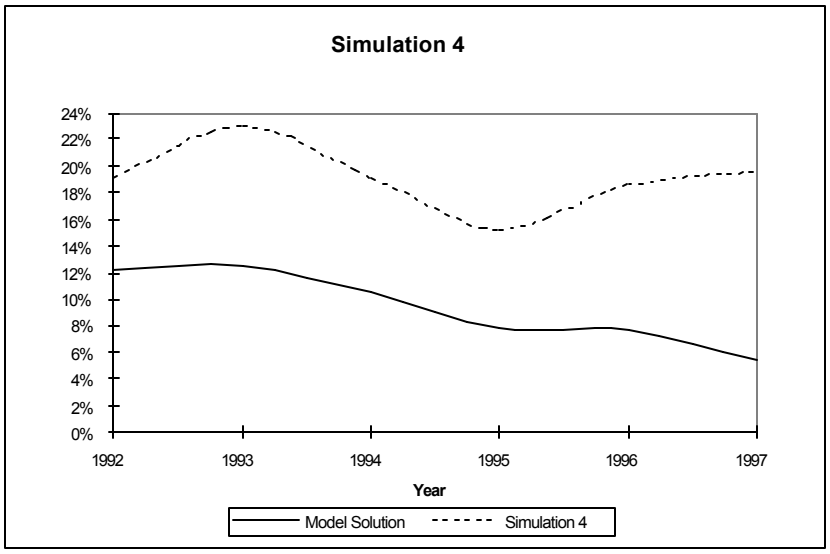
In this simulation, we combine the effect of the three previous simulations. The difference in trajectory comes to the following:

Year	Simulation 4	Model Solution
1992	19.14%	12.15%
1993	22.97%	12.51%
1994	19.11%	10.50%
1995	15.26%	7.80%
1996	18.53%	7.68%
1997	19.61%	5.39%

The accumulative effect of the three simulations shows that if it were not for the change in the formation of inflation expectations, for the appreciation of the real exchange

rate above two percent per annum and for the increase in labor productivity above its average value for the period 1960-1980, the core inflation rate in 1998 would had been close to four times its observed value.

Finally the difference in trajectory, for quarterly inflation, is presented below:



Summary of Results

Year	Core Inflation	Model Solution	Simulation 1	Simulation 2	Simulation 3	Simulation 4
1992	12.10%	12.15%	16.49%	13.38%	12.49%	19.14%
1993	13.90%	12.51%	17.21%	13.67%	12.92%	22.97%
1994	10.39%	10.50%	14.66%	9.49%	10.91%	19.11%
1995	7.17%	7.80%	11.95%	7.04%	8.19%	15.26%
1996	7.72%	7.68%	11.68%	9.30%	8.07%	18.53%
1997	3.70%	5.39%	8.91%	8.69%	5.77%	19.61%

V. CONCLUSIONS

After 40 years of high and variable inflation, Chile has made major progress during this decade in reducing inflation towards industrial countries' levels. What is even more remarkable is that the reduction of inflation was without short-term cost. While inflation was reduced, growth increased and the unemployment rate reached its lowest level in 30 years. Thus, Chile's economic record over the past ten years has been remarkable. During the 1986-1997 period, the average GDP growth rate reached 7.6% while the average inflation rate reached 17.8%. The unemployment rate that had reached close to 30% in late 1982 was only 5.3% during the last quarter of 1997. Furthermore, the inflation rate (Dec.- Dec.), that had reached 27,3% in 1990, decreased all through the 1990s reaching 6.6% in 1996 and 6.0% in 1997.

It appears that three factors were important in helping to accomplish this performance. First, the independent Central Bank and its tough actions early on to convey the message that it was ready to stand behind its mandate (to reduce inflation) helped to shape inflationary expectations and in the process it led to lower wage inflation and ultimately a lower path for core inflation. Second, restrictive monetary policy and the

foreign exchange intervention policies associated with it resulted in a trajectory of the nominal exchange rate much below what would have been observed under a PPP rule adjusted for differences in productivity. This result was reinforced by the low credibility of the band reflected in the effect of the location of the exchange rate within the band on the observed rate. Third, the higher rate of growth of labor productivity, given the wage equation, resulted in a lower rate of growth of unit labor cost than otherwise. From these three effects the first effect, the enhanced credibility of the new policy operating through the formation of inflation expectations, was the most important factor behind the success in reducing inflation rate.

Finally, the question left is how to continue reducing inflation now that the rate of growth of average labor productivity has stabilized and that the real exchange rate appreciation has started to be reversed.

APPENDIX: TESTING FOR THE ORDER OF INTEGRATION OF THE VARIABLES

In this appendix, first we apply standard test to evaluate the order of integration of the different variables that enter the model used in the paper. And second, we apply Johansen's methodology to evaluate the cointegration of the different equations that enter the model.

TABLE A.1
UNIT ROOT TESTS FOR INFLATION VARIABLES
(1986:1 - 1997:4)

Variable	ADF Test	5% Critical Value	D. of Integration
Core Inflation (π^S)			
No Intercept or Trend	-0.98	-1.95	I (1)
External Inflation (π^*)			
No Intercept or Trend	-2.26	-1.95	I (0)
Wages (ω)			
No Intercept or Trend	-1.01	-1.95	I (1)
Exchange Rate (e)			
No Intercept or Trend	-1.79	-1.95	I (1)
Average Productivity (q)			
No Intercept or Trend	-1.14	-1.95	I (1)
Gap			
Intercept and Trend	-4.61	-3.51	I (0)
Expected Inflation (π^ε)			
Intercept and Trend[17]	-2.94	-1.95	I (0)
Change in International Reser. (ΔR)			
Intercept and Trend	-4.44	-3.51	I (0)
Actual Inflation (π)			
No Intercept or Trend	-1.31	-1.95	I (1)
Exchange Rate Percentile (PER)			
No Intercept or Trend	-1.51	-1.95	I (1)
GDP Growth (I)			
No Intercept or Trend	-0.67	-1.95	I (1)
Target Inflation (TAR)			
Intercept and Trend	-5.04	-1.96	I (0)

17 In this case, the critical value is equal to the normal distribution in accordance with the methodology of Enders (1995). (See page 257)

TABLE A.2
JOHANSEN(1991) COINTEGRATION TEST FOR EQUATIONS[18]

A. Price Equation:

Sample: 1985:1 1997:4
Included observations: 43
Test assumption: Linear deterministic trend in the data
Series: π^S_t ω_t e_t π^*_t q_t GAP_{t-2}
Lags interval: 1 to 3

Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.821099	160.3392	94.15	103.18	None **
0.558409	86.33961	68.52	76.07	At most 1 **
0.513258	51.19262	47.21	54.46	At most 2 *
0.266204	20.23169	29.68	35.65	At most 3
0.136295	6.922142	15.41	20.04	At most 4
0.014352	0.621612	3.76	6.65	At most 5

*(**) denotes rejection of the hypothesis at 5%(1%) significance level.
L.R. test indicates 3 cointegrating equation(s) at 5% significance level.

18 To choose the length of lags that enter in the cointegration test we use the Akaike information criterion (AIC).

B. Wage Equation:

Sample: 1985:1 1997:4
Included observations: 48
Test assumption: Linear deterministic trend in the data
Series: ω_t π^E_t
Lags interval: 1 to 2

Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.368648	23.38017	15.41	20.04	None **
0.026829	1.305373	3.76	6.65	At most 1

*(**) denotes rejection of the hypothesis at 5%(1%) significance level.
L.R. test indicates 1 cointegrating equation(s) at 5% significance level.

C. Exchange Rate Equation:

Sample: 1985:1 1997:4
Included observations: 42
Test assumption: Linear deterministic trend in the data
Series: e_t π^*_t π_t ΔRIN_t I_{t-1} PER_t
Lags interval: 1 to 1

Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.888234	186.8818	94.15	103.18	None **
0.675063	94.84515	68.52	76.07	At most 1 **
0.459506	47.63198	47.21	54.46	At most 2 *
0.260943	21.79056	29.68	35.65	At most 3
0.131384	9.090607	15.41	20.04	At most 4
0.072803	3.174738	3.76	6.65	At most 5

*(**) denotes rejection of the hypothesis at 5%(1%) significance level.
L.R. test indicates 3 cointegrating equation(s) at 5% significance level.

D. Expectations Equations (1986 to 1991)

Sample: 1985:1 1991:4
Included observations: 17
Test assumption: Linear deterministic trend in the data
Series: π^{ε}_{τ} $((\pi_{\tau} + \pi_{\tau-1} + \pi_{\tau-2} + \pi_{\tau-3})/4)$
Lags interval: 1 to 2

Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.870730	40.22884	15.41	20.04	None **
0.274249	5.449316	3.76	6.65	At most 1 *

*(**) denotes rejection of the hypothesis at 5%(1%) significance level.
L.R. test indicates 2 cointegrating equation(s) at 5% significance level.

E. Expectations Equations (1992 to 1997)

Sample: 1992:1 1997:4
Included observations: 24
Test assumption: Linear deterministic trend in the data
Series: π^{ε}_{τ} TAR_{τ} $((\pi_{\tau-1} + \pi_{\tau-2} + \pi_{\tau-3} + \pi_{\tau-4})/4)$
Lags interval: 1 to 4

Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.678775	49.17217	29.68	35.65	None **
0.483190	21.91743	15.41	20.04	At most 1 **
0.223646	6.075526	3.76	6.65	At most 2 *

*(**) denotes rejection of the hypothesis at 5%(1%) significance level.
L.R. test indicates 3 cointegrating equation(s) at 5% significance level.

REFERENCES

Arellano, J.P. (1983) “De la Liberalización a la Intervención: El Mercado de Capitales en Chile”, Colección de Estudios CIEPLAN 11, Santiago, December.

Barandiarán, E. (1977) “Una Nota sobre Política Cambiaria”, Documento 50: Departamento de Estudios Empresas, Banco Hipotecario de Chile.

Bruno, M. (1978) "Exchange Rates, Import Costs, and Wage-Price Dynamics", Journal of Political Economy 86 (June) pp. 379-403.

Bruno, M., (1991). "High Inflation and the Nominal Anchors of an Open Economy" Princeton Essays in International Finance 183. International Finance Section, Princeton, N. J. : Princeton University. Processed.

Bruno, M. and S. Fischer, (1986). "The Inflationary Process: Shocks and Accommodations." In Y. Ben-Porath, (ed.). The Israeli Economy: Maturing Through Crises. Cambridge, Mass.: Harvard University Press.

Bruno, M., G. Di Tella, R. Dornbursch, and S. Fischer, eds. (1988). Stopping High Inflation. Cambridge, Mass.: MIT Press.

Bruno, M., S. Fischer, E. Helpman, and N. Liviatan, with L. Meridor. (1991) (eds.), Lessons of Economic Stabilization and Its Aftermath. Cambridge, Mass.: The MIT Press.

Burton,D. and S Fischer (1997). “Ending Moderate Inflation”, mimeo, International Monetary Fund.

Central Bank of Chile.(1991) .”Evolución de la Economía en 1991 y Perspectivas para 1992”. Septiembre.

Central Bank of Chile.(1992) .”Evolución de la Economía en 1992 y Perspectivas para 1993”. Septiembre.

Central Bank of Chile.(1993) .”Evolución de la Economía en 1993 y Perspectivas para 1994”. Septiembre.

Central Bank of Chile.(1994) .”Evolución de la Economía en 1994 y Perspectivas para 1995”. Septiembre.

Central Bank of Chile.(1995) .”Evolución de la Economía en 1995 y Perspectivas para 1996”. Septiembre.

Central Bank of Chile.(1996) .”Evolución de la Economía en 1996 y Perspectivas para 1997”. Septiembre.

Corbo, V. (1974). Inflation in Developing Countries. Amsterdam: North Holland Publishing Co.

Corbo, V., (1985). "International Prices, Wages and Inflation in Open Economy" Review of Economics and Statistics 67 (November): pp. 564-73.

Corbo, V. y Edwards, S. (1981) “ El Rol de una Devaluación en la Economía Chilena Actual”, mimeo, Departamento de Estudios, Banco Hipotecario de Chile, June.

Corbo, V. and A. Solimano, (1991). "Chile's Experience with Stabilization Revisited". In M. Bruno et al. (eds.), Lessons of Economic Stabilization and Its Aftermath, Cambridge, Mass.: The MIT Press

Corbo, V. and S. Nam (1992). "Recent Experience in Controlling Inflation" In V. Corbo and S. Suh, (eds.), Structural Adjustment in a Newly Industrialized Country: The Korean Experience. Baltimore: Johns Hopkins University Press.

Corbo, V. and S. Fischer (1994). "Lessons from the Chilean Stabilization and Recovery", in B. Bosworth et al (eds.), The Chilean Economy: Policy Lessons and Challenges. Washington, DC: Brookings Institution.

Corbo, V. and B. Piedrabuena(1995). "La Dinámica de la Inflación Chilena". In F. Morandé and F. Rosende (eds). Estudios de la Inflación Chilena. CEP/ILADES.

Corbo, V. and J. Desormeaux (19960 "Capital Flows and Financial Integration: The Case of Chile", mimeo.

Cowan, K. y De Gregorio, J. (1996) "Exchange Rate Policies and Capital Account Managment: Chile in the 1990s", mimeo, Ministery of Finance, december.

De La Cuadra, S. y S. Valdés-Prieto (1992) "Myths and Facts about Financial Liberalization in Chile: 1974-83", in P. Brook (ed.) If Texas Were Chile , ICS Press: San Francisco

Dornbusch, R. and S. Fischer (1993). "Moderate Inflation". World Bank Economic Review. Vol. 7, #1. (January), pp. 1-44.

Edwards, S. (1986). "Monetarism in Chile, 1973-1983: Analytical Issues and Economic Puzzles", Economic Development and Cultural Change 33, April.

Edwards, S. (1993). "Exchange Rates, Inflation and Disinflation: Latin American Experiences", NBER Working Paper No. 4320 (April).

Edwards, S. (1996). "Exchange Rate Anchors, Credibility, and Inertia: A Tale of Two Crises, Chile and Mexico", American Economic Review (May).

Edwards, S. y Cox-Edwards, A. (1987) Monetarism and Liberalization.. The Chilean Experience, Cambridge, Ma: Ballinger.

Enders, W. (1995) *Applied Econometric Series* , John Wiley & Sons, Inc.

Fischer, S. (1988). "Real Balances, the Exchange Rate, and Indexation: Real Variables in Disinflation". Quarterly Journal of Economics 103 (1): pp. 27-50.

Fischer, S. (1994). "Modern Central Banking" in The Future of Central Banking. Eds. Capie, F., Goodhard C., Fischer S. and Schnadt N., Cambridge University Press: Cambridge UK.

Fischer, S.(1995). "Central Bank Independence" in American Economic Review, (May).

Fischer, S.(1996). "Why are Central Banks Pursuing Long-run Price Stability". revised version of paper presented at the Symposium, Achieving Price Stability, Jackson Hole, Wyoming, August 29-31.

Goodhard, C. A. E. (1994). "Presentation". in The Future of Central Banking. Eds. Capie, F., Goodhard C., Fischer S and Schnadt N. Cambridge University Press: Cambridge, UK. 1994.

Hamilton, J. (1994) *Time Series Analysis* , Princeton University Press.

Harberger, A. (1963) "The Dynamics of Inflation in Chile", in C. Christ (ed.) Measurement in Economics, Standford University Press.

Harberger, A. (1985) "Observations on the Chilean Economy, 1973-1983", Economic Development and Cultural Change 33, April.

Hargreaves, S. (1994). Non-Stationarity Time Series Analysis and Cointegration, (ed.). Oxford: Oxford University Press.

Johansen, S. (1991) "Estimation and Htpothesis of Cointegrating Vectors in Gaussian Vector Autoregressive Models", Econometrica 59, November.

Krugman, P. (1997) "Currency Crises", mimeo.

Larrañaga, O. (1989) El Déficit del Sector Público y la Política Fiscal en Chile, 1978-1987 Santiago:ECLA.

Leiderman, L. and L. E. O. Svensson (1995). Inflation Targets. London: CEPR.

Magendzo, I., P. Rojas, y R. Vergara (1996) "Bandas Cambiarias: Experiencia Chilena 1990-1994", in Análisis Empírico del Tipo de Cambio en Chile. Eds. Morandé, F. y Vergara, R. CEP- ILADES.

Meller, P. (1996) Un Siglo de Economía Política en Chile (1890-1990) Editorial Andrés Bello: Santiago.

Morandé, F. (1988) "Domestic Currency Appreciation and Foreign Capital Inflows. What Comes First ? (Chile,1974-1982)", Journal of International Money and Finance 7, December.

Rogoff, K. (1985) " The Optimal Degree of Commitment to an Intermediate Monetary Target", Quarterly Journal of Economics 100, November.

Stock,J. y Watson, M. (1993) "A Simple Estimator of Cointegrating Vectors in Higher Order Integrated Systems", Econometrica 61.

Zahler, R. (1985) "Las Tasas de Interés en Chile: 1975-1982", mimeo, January.