EXCHANGE RATE AND PRICE STABILITY IN ARGENTINA:
A GENERAL EQUILIBRIUM APPROACH

By

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DEDICATION

This thesis is dedicated to my dearest parents, Jinquan Wang and Xiaozhu Cui-Wang. For all past years, they have devoted most of their time to taking care of me, to educating me, and to encouraging and helping me to overcome all difficulties in my career. Their experience in life has always been a source of inspiration to me.

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ABSTRACT

Instability and high inflation were two chief features of Argentine economic activity from the mid-1970s to the early 1990s. Several stabilization programs were successively put in practice in this period but without lasting success. This study combines theoretical analysis and empirical research to discuss these issues. The main objective of this study is to construct a computable general equilibrium (CGE) short-run model to describe the functioning of the Argentine economy with focus on the inflationary process. In addition, the estimated structure of the model is used to simulate the impacts of alternative stabilization policies under some postulated structural changes and/or within "possible" environments different from the historical ones.

The short-run CGE model, based on the work of Klein-Ortiz-Rao [1991], is divided into six sectors which include forty nine endogenous variables and sixteen exogenous variables. Two types of inflation propagation mechanisms, namely the non-accelerating mechanism and the accelerating mechanism, are highlighted and described in the specification of the model. It is shown that, under certain conditions, the pressure of inertial inflation can be magnified through the operation of the accelerating mechanism.

Policy simulation experiments, though restricted by the short-run nature of the model, suggest that: (1) the economy could not have been stabilized by using the preannounced devaluation rate during 1978-1981; (2) economic performance could have improved in 1985-1989 under a modified Austral Plan but, with the altered structure, there would still be a severe currency appreciation; (3) the Convertibility Law based program is very successful in arresting inflation and eliminating the budget deficit, but it is by no means free from side effects, such as inducing shortages in the money supply and high interest rates.

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Chapter 1

INTRODUCTION

1.1 An Overview of Post War Argentine Economic Performance

After World War II, Argentina followed a particular pattern of economic development. Internally, investment planning, allocation of natural resources, and the production of public utilities were mostly centralized and controlled by the state. Externally, a set of economic and legal restrictions on foreign trade was put in force to preserve domestic markets and protect local producers - see Alejandro (1970). This model worked satisfactorily until 1975 in regard to capital accumulation and economic growth. But it was certainly unable to provide efficient resource allocation for want of both internal and external competition, which resulted in an imbalance of economic development.

While capital accumulation and economic growth remained at a relatively satisfactory level, inflation worsened. Accumulated structural factors (such as supply inelasticities, relative price oscillations, the conflict over shares of income among sectors, and economy-wide indexation) together with some cost-push and demand-pull factors (such as changes in the money supply and changes in hourly money wage rates) led to an average annual inflation rate of 20% during the period 1944-1954 and nearly 30% in the next two decades.

Starting from the early 1970s, as fiscal discipline deteriorated, inflation took a new path and accelerated quickly to a high level. In 1972, the last year of the Lanusse administration, the government deficit was 4.4% of GDP which was similar to the past several years. But the deficit increased to 6.9% in 1973, the first year of the Peronist administration, to 9.3% in 1974, and to its highest level ever of 14.1% of GDP in 1975. For a long time the government financed its expenditures from four sources: the surplus generated from the social security system, tax receipts, land rents and seigniorage (printing money) - see Canavese (1992). In the mid-1970s, more than half of the deficit was financed by seigniorage. When large and consecutively increasing fiscal deficits were mainly financed by seigniorage, high inflation occurred, which, in turn, eroded tax receipts through fiscal lags and encouraged tax evasion and further deteriorated fiscal discipline. In 1975, the inflation rate reached its peak at a 335% annual rate measured by CPI and 349 % measured by WPI, respectively.

Not only did inflation become more severe in this period, but also the internal and the external sectors performed very poorly. The seasonally adjusted real GDP declined at a quarterly rate of 2.3% in the first quarter, 0.4% in the second quarter, and 3.3% in the third quarter of 1975. In the external sector, there was a balance-of-payments crisis in 1975 with a deficit of 1,881 millions of US dollars on the current account which, although the capital account still retained a small surplus, caused a sharp decline in the official foreign reserves. This trend of economic worsening continued throughout 1975 and into early 1976 when the Peronist administration was ousted by a military coup.

Stabilization Program and Economic Performance between 1976-1982[1]

Reducing inflation without a decline in production and employment, limiting government intervention and transforming the economy by opening it to foreign trade were the major economic goals of the military government. It was in this context that the stabilization program was put in place during this period.

The economic team represented by Economy Minister Martinez de Hoz strongly believed that short-run inflation

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[1] The major references for the review of this period are the following: Fernández (1985), Petrei and Tybout (1985), Dornbusch and Fischer (1986), Heymann (1985), and Cumby and Wijnbergen (1989).

rates were to a great extent determined by expectations. The traditional stabilization tools, such as monetary and fiscal policies, though effective in the medium and long runs, led to a recessionary cycle so that only expectations management could defeat high inflation while avoiding a trade-off between inflation and unemployment. During this period, two approaches to expectations management were adopted. The first approach to expectations management, applied between 1976 and 1978, was through exchange rate intervention, income policies and a voluntary 'price agreement'. When the government discovered that expectations management could not be carried on with persuasive talks due to lack of public confidence, the second approach, scheduling a table of preannounced exchange rate crawl (the 'tablita'), was applied between the end of 1978 and early 1981. According to the tablita, the forward daily exchange rates would follow a preannounced rate of crawl. In addition, to enhance the credibility of the program, the rate of crawl was announced several months in advance. Detailed discussions concerning this stabilization program can be found in a number of articles, for example, Fernández (1985), and Petrei and Tybout (1985).

To achieve other goals, which were not totally independent of fighting high inflation, the military government also introduced a series of reforms aimed at removing or reducing a number of controls imposed on the economy. Among these were the reform of the financial system, the gradual removal of capital controls, the freeing of interest rates and some reduction in tariffs. The financial reform decentralized deposits and allowed banks and other financial institutions to administer deposits under a system of market determined interest rates. During 1976-1978, the government reduced tariffs to open the economy and announced at the end of 1978 a program consisting of a schedule of further reductions in tariffs for the next five years. The government, during the same period, also adopted three measures to improve the fiscal situation. First, all tax payments and fiscal debts were indexed and taxation was made proportional instead of lump-sum. Second, the income tax administration was simplified. The minimum nontaxable income was raised in real terms, and the average tax was cut substantially. To avoid taxation of nominal profits, fiscal balances were allowed to be adjusted for inflation. In addition, discrimination against foreign enterprises was eliminated. Third, the value-added tax was generalized to eliminate tax exemptions (see Fernández (1985)).

Macroeconomic responses to the stabilization program were mixed. Real gross domestic product fluctuated from year to year and recorded, on average, a negative growth rate during this period. The statistics showed that the annual growth rates were -3.3%, 5.2%, -3.4%, 6.7%, 0.7%, -6.2%, -5.3% for the years 1976 to 1982 respectively, which yielded an average annual growth rate of -0.8% for the whole period. The rate of inflation, measured by the percentage change of CPI, travelled along a V-shaped path during this period, reaching its minimum in 1980 but remaining at high levels in other years. The annual rates of inflation were 440.0%, 176.0%, 175.5%, 159.5%, 100.8%, 104.6% and 164.8% respectively from 1976 to 1982. Nominal interest rates followed inflation, though not very closely, after the financial reform of 1977. The average yearly borrowing rate was 172% in 1978 while the average deposit rate was 130%. In 1979, the nominal borrowing rate fell to 135%, which generated a negative real interest rate. In 1980, nominal rates continued to fall but the real rates were positive due to the relatively low inflation rate. The nominal interest rate started to increase sharply in 1981 and the first half of 1982 and then it was fixed by the Central Bank at levels substantially lower than the inflation rates, thereby creating negative annual real interest rates of almost 40% for the borrowers. The balance of payments improved between 1976-1979 and became worse afterwards due to the large current account deficit which was 4,774, 4,712 and 2,477 millions of US dollars in 1980, 1981 and 1982 respectively. As a result of the fiscal reform, the government deficit was reduced to 12.9% of GDP in 1976 and 11.9%, 10.1%, 9.0%, 11.3% for the following years up to 1980, and then increased to 16.4% and 17.2% in 1981 and 1982.

Why were macroeconomic responses to the stabilization program unfavourable in this period and why did the Martinez de Hoz stabilization plan finally fail? One of the direct causes, which has been discussed at length in all the relevant economic literature, is the continuing real appreciation of the domestic currency followed by a sharp devaluation on the one hand and the unremoved large fiscal deficits on the other.[2] The tablita was initiated in 1978 and it was hoped that by gradually reducing the rate of devaluation to zero, Argentine inflation would converge to the inflation rates of her major trade partners. Inflation was indeed reduced but both price and wage increases slowed down less rapidly than the exchange rate. Therefore, a real appreciation of the domestic currency occurred and continued. The cumulative real appreciation, on the one hand, led to an adverse speculation which was facilitated by the liberalization of capital flows, and on the other hand, led to an accumulation of external debt. Banks and the government under this circumstance had to borrow abroad to finance private capital outflows. But when the external credit disappeared and large foreign debt was incurred in the early 1980s, a substantial depreciation of

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[2] Throughout this study, the exchange rate is defined as units of the domestic currency per unit of foreign currency. For example, if 0.9 peso equals 1 dollar, the exchange rate is 0.9/1=0.9, not the other way around. So an increase in the exchange rate means a depreciation of the domestic currency.

domestic currency became unavoidable. Meanwhile, the fiscal deficit, although reduced to a certain extent since the stabilization plan was initiated, still remained at a very high level. The sustained large deficit together with a financial crisis in 1980, when two major banks in Argentina bankrupted, resulted in a decline in confidence in the stabilization program. The public strongly doubted if the government was able to keep the forward exchange rates according to the tablita when it had to finance a large deficit and make payments on foreign debt. The erosion of public confidence was reflected in an increase in interest rates on peso deposits relative to foreign interest rates, adjusted for the announced devaluation, and in large reserve losses. At the end of 1980, President-designate General Viola made it clear to the general public that Martinez de Hoz's economic program would not be continued. Following this, the devaluation rate started accelerating in early 1981, which signalled the collapse of the stabilization program.

Some efforts were still made during 1983-1984 by the authorities to stabilize inflation but without success. The annual rate of CPI rose to 380% in 1983, 659% in 1984 and 847% and 993% in the first two quarters of 1985. By this time the Argentine economy had moved into a stage of hyperinflation.

Stabilization Program and Economic Performance between 1985-1989

During the period of 1985-1989, three major stabilization programs were implemented in Argentina. They were the Austral Plan from 1985 to 1987, the Primavera Plan in 1988 and the BB plan in 1989. A number of research articles and monographs have been published to discuss these programs and their successes and failures. Among them, Dornbusch and Fischer (1986), Dornbusch (1988), Canavese and Di Tella (1988), Machinea and Fanelli (1988), Cardoso (1989), and Canavese (1992) are used as major references in reviewing the stabilization programs and economic performance in this period.

In the spring of 1985, shifts in Argentine economic polices became urgent since the economy was well on its way to hyperinflation. The loss of confidence in the gradualist policy adopted in 1984 by the Alfonsin government, which came into power in December 1983, and an unwillingness to accept the austerity measures suggested by the IMF, led to the Austral Plan, which was aimed at stopping hyperinflation and stabilizing the economy without large costs in foregone output and employment.

The Austral plan was a consistent mix of the orthodox (monetary and fiscal policies) and the unorthodox (incomes policies). The important features of the plan were the following: (1) Preceding the implementation of the plan, an increase in public utilities prices together with a sharp devaluation was imposed by the government with a view to aligning key relative prices prior to the freeze. The government also imposed export tariffs and import duties to increase budget revenues. (2) Following these adjustments, temporary wage-price controls and a fixed exchange rate (to US dollar) were imposed to remove the economy-wide indexation and to eliminate the inertial component of inflation. (3) A time table was announced to adjust outstanding contracts for the immediate and unanticipated drop of inflation. (4) A new currency, the Austral, was introduced. On the 14th of June 1985, the Austral Plan went into effect.

The macroeconomic responses to this stabilization program were very impressive in the first nine months (from July of 1985 to March of 1986) after the plan was launched, so these nine months could be viewed as the first stage.

Success was mainly represented by a fall in inflation rates. The monthly inflation rate measured by CPI dropped sharply from 30.5% in June 1985 to 6.2%, 3.1%, 2.0%, 1.9%, 2.4%, 3.2%, 3.0%, 1.7% and 4.7% from July 1985 to March 1986, yielding a monthly average of 3.1% for this period.[3] GDP, on the other hand, fell 4.4% in the first quarter after the implementation of the plan but soon recovered with growth rates of 10.4% and 1.4% in the following two quarters. The balance of payments had a surplus in the last two quarters of 1985 while a deficit occurred in the first quarter of 1986. More precisely, the current account recorded 109.9, -469.8, -810.7 millions while the capital account recorded 1138.6, 672.0 and 375.7 millions, all in current US dollars. The fiscal deficit was also sharply reduced, although it still remained at 3.0%, 2.2%, and 4.3% of GDP in same three quarters. The regulated monthly nominal interest rate was 5.0% for July, August and September of 1986 and was 4.5% for the following months to March of 1986. The free monthly nominal interest rates, on the other hand, fluctuated in the range of 4.3% to 8.7% during the same nine months. The real interest rate was positive for most months in this period due to the low inflation rates.[4] Unfortunately, this nine-month honeymoon did not continue further. After March 1986, the economy went into the second stage.

[3] The inflation rate is usually measured on the annual base in normal economies. But in the high inflation countries, such as Argentina, the inflation rate is generally measured on the monthly base because inflation grows fast from month to month so that the accumulated annual inflation rate is dramatically high. For example, a constant monthly inflation rate, say 10%, for 12 months will yield a 214% annual rate.

[4] The statistics used here are from Canavese and Di Tella (1988), and Machinea and Fanelli (1988). The growth rate GDP is computed from the statistics.

The pressure of demanding higher nominal wages, which already existed in the first stage, became stronger and the domestic currency, the Austral, became overvalued in terms of dollars, similar to the case in 1979 and 1980. The deficit in the external trade balance in the first quarter of 1986 was large. All these factors led to the end of the freeze on wages, prices and the exchange rate. The formal ending of the freeze took place on the 4th of April 1986. Following this date, the government attempted to control inflation with administered prices in an easy monetary policy environment. This resulted in the re-adoption of a crawling peg, an acceleration of inflation, a fall in the monetary coefficient as indicated by the decline in the demand for real balances, and reindexation of the economy. The average monthly inflation rate rose to 4.4% and 7.6% in the next two quarters following the end of freeze.

Between October 1986 and February 1987, the authorities tried restrictive monetary policies hoping to control the renewed inflationary process but unfortunately the policies did not yield the anticipated results. The monthly inflation rate, from 5.3% in November and 4.7% in December 1986, rose to 7.6% in January 1987. Meanwhile, the situation on the fiscal front worsened. Growing inflation encouraged tax evasion. The Olivera-Tanzi effect, which worked in reverse in the early period, appeared stronger in this period and eroded the real value of fiscal receipts.[5] The budget deficit rose again to 7.6% of GDP in the last quarter of 1986. In the period of March 1987 to June 1987, the government introduced a new wage and price freeze with a moderate crawling peg. But the consequences of this freeze were different from those which followed the first attempt. These two periods could be considered as the third and fourth stages of the economy following the Austral Plan.[6]

Argentine experiences during this period (July 1985 to June 1987) clearly verified that the traditional monetary and fiscal approaches were unable to stabilize inflation without the cost of an economic recession in the Argentine economy in which the sustained high inflation, large fiscal deficit and huge foreign debt had coexisted for so long. The combined orthodox and unorthodox measures could attack hyperinflation and inertial inflation but were still unable to eliminate inflation without undertaking structural reforms.

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[5] The Olivera-Tanzi effect refers to the effect of high inflation and fiscal lags on tax collection. High inflation, combined with lags in tax collection, imply that the real value of government tax receipts will be lower the higher the inflation rate. For example, if income taxes were to be paid one year later and the annual inflation rate were 100% in the year, then the government would find itself with only half of the real value of taxes it would receive without inflation and lags. See Olivera (1967) and Tanzi (1977).

[6] Canavese and Di Tella (1988) provided a detailed description and analysis of these four stages.

In August 1988, the Primavera Plan (or Spring Plan) was announced. In the centre of this plan was the adoption of a new dual exchange rate regime. Export transactions, especially agriculture goods, were subject to the official pegged exchange rate while imports and financial transactions were quoted at the free exchange rate determined in the market. The gap between the two rates was an implicit tax on exports. The fiscal efforts included a reduction of the value added tax - see Canavese (1992).

Responding to the implementation of the plan, the inflation rate decreased to 5.7% in November 1988 but climbed up again in later months. The quarterly growth rate of GDP was -7.7% in the third quarter and 5.5% in the fourth quarter of 1988, but was negative again at -2.7% and -4.2% in the first two quarters of 1989. The budget deficit was not reduced but, instead, increased, leading to a larger domestic debt and higher nominal interest rates. The economic agents, in this situation, lost confidence and began to shift their financial portfolios from domestic to foreign assets, which led to a huge loss of foreign exchange reserves. An effort was made in January 1989 to reduce the money supply in the hope that the increasing demand for foreign assets could be stopped. But this attempt immediately failed. The economy became extremely unstable and quickly entered the path of hyperinflation. The monthly inflation rate accelerated from 8.9% in January to

9.6% in February, 17.0% in March, 33.4% in April, 78.5% in May and finally 114.5% and 196.6% in June and July respectively. Nominal interest rates followed inflation and reached 138.7% in June 1989.

In July 1989, the BB plan was implemented by Carlos Menem's new government. Structural reforms, including a new tax package, a "law of economic emergence" and privatization of state companies constituted the important components of this plan. In addition, the plan also included a freeze of the exchange rate (previously devaluated) and public sector prices (previously increased).

The initial macroeconomic responses to the BB plan were mixed. The monthly inflation rate dropped to 37.9% in August and further to 9.4% in September following the plan. The nominal interest rate also dropped to 12.7% in August. GDP continued to fall in the third quarter but grew suddenly in the last quarter of 1989. Meanwhile, the fiscal sector improved. A budget surplus appeared in the second half of 1989 due to improved tax collection methods. However, the implementation of the BB plan did not improve the external sector. When the gap between the official and parallel exchange rates turned out to be big, large capital outflows took place in the last quarter of 1989 while the current account retained a big deficit. At the end of 1989, the BB plan was finally stopped by the new economic team. The price-exchange rate control was also abandoned. This time not only the prices of tradable goods but also the prices of nontradable goods became dollarized since the floating exchange rate went totally out of control. The economy became worse and the deterioration continued to the end of 1990, when hyperinflation took place again.

Convertibility Program and Economic Performance 1991-1993[7]

On April 1, 1991, the government of Argentina introduced the Convertibility Law as the cornerstone of a program to arrest inflation and initiate a comprehensive structural reform. According to this law, the monetary base must be fully backed by foreign reserves at a fixed exchange rate of 10,000 Australes per US dollar;[8] indexation was prohibited; and contracts could be made and legally enforced in foreign currencies. The convertibility program re-emphasized two concepts that had been set aside: first, a budget restriction on the public sector and second, a stable local currency that would give priority to the proper functioning of the economy.

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[7] The major references for the review of this period are: Canavese (1992), Smith, Acuña, and Gamarra (1994). The statistics used in this part are from The Argentine Economy, Investment Opportunities and Trade Relations with Canada, Embassy of the Republic of Argentina and Department of Foreign Affairs and International Trade - Canada, April 1994.

[8] On January 1, 1992 the currency was changed back to the peso and 10,000 australes were converted into one peso, and the fixed exchange rate became approximately one peso per dollar.

Meanwhile, policies aimed at liberalizing foreign trade were also implemented. Export taxes were removed while import tariffs were reduced on average for all finished goods, and capital goods imports were not subject to duties. The government also abandoned all non-tariff barriers. The objective of liberalizing foreign trade and opening the economy was to recreate competitive markets to promote efficient resource allocation and to integrate Argentina into the world economy.

Clearly, with the convertibility law in place, the monetary base could expand only if there was an increase in foreign reserves. The government was not allowed to have a budget deficit unless the deficit could be fully financed by borrowing from domestic and/or from foreign countries since financing by money creation became impossible under the law. These factors, together with the opening of Argentina's markets to the rest of the world, were expected to reduce inflation on par with the international level.

The actual economic performance has been very impressive since the implementation of the convertibility program. There is no doubt that the Argentine economy has entered a path towards recovery. GDP grew by 8.9%, 8.7% and 6.5% in 1991, 1992 and 1993 respectively. The annual inflation rate dropped to 84%, 17.5% and 7.4% in these three years from 4923% in 1989 and 1343% in 1990. It is reported that a budget surplus was generated in this period from restrictions on expenditures of the public sector and improvement in tax collection, although there are still no accurate data available at present. In the external sector, following economic stabilization and the opening up of markets, capital inflows dramatically increased in this period though large trade deficits of 2637 and 3596 millions of US dollars appeared in 1992 and 1993 due to large increases in imports.

Although the overall macroeconomic performance was very good in these three years, it does not mean there are no problems other than the trade deficit, which may lead the economy to a reverse path in the future. Two issues, among others, should be raised.[9] First, the problem of relative prices. The convertibility program, similar to the other stabilization plans, included a sharp corrective adjustment upward of public sector prices before the exchange rate was fixed. This produces a relative price shock which could soon be translated into general price and wage pressures through indexation. The convertibility law prohibits such an explicit indexation, but implicit indexation may still occur. Moreover, with a fixed exchange rate, the price of tradable goods will

[9] Further discussions about the problems of the convertibility and the fixed exchange rate are given in Chapters 4 and 5.

converge to the US price level in general, but the domestic price of nontradable goods is still unconstrained and may continue to increase due to the inertial effects. In a long term, this will probably cause the domestic inflation rate to rise above the US rate, which leads to an overvaluation of the peso. Consequences which occurred following the appreciation of domestic currency in the periods of the Martinez de Hoz plan and the Austral Plan may appear in the economy again. The second is the monetary problem. Under the convertibility law, expansion of monetary base is fully endogenized and determined by the change in foreign exchange reserves. This reduces government power to use monetary policy to help the economy. But a more serious problem comes from this: in an expanding economy with, presumably, a continuous equilibrium in the balance of payments, the increase in demand for money balances may cause some liquidity problems since the monetary base is allowed to expand only as foreign reserves increase. Any shocks to the financial system will possibly lead to overheated speculative behaviour which may harm or destroy the integrity of credit systems. Of course, it has been less than four years since the convertibility program was launched. We will have to wait to see the economic performance in the coming years before we can make further evaluations of this stabilization program.

1.2 Objective of the Study

Instability and high inflation coupled with very slow growth were the cardinal features of Argentine economic activity from the mid-1970s to the early 1990s. Several stabilization programs were successively put in practice in these two decades but the success was limited and even that limited success did not last for a long period. This particular case has created a great interest among many economists and policy makers not only in Argentina but also in other countries. A number of research articles and monographs have been published and many theoretical and empirical contributions have been made. However, most studies have discussed the overall macroeconomic performance in a descriptive manner with a light emphasis on quantitative analysis, while some quantitative studies have focused on specific issues with a light emphasis on the whole economy.

This study is intended to combine theoretical analysis and empirical research to discuss some general issues in the Argentine economy. The objective of this study, thus, is to construct a computable general equilibrium (CGE) short run model to describe the functioning of the Argentine economy, with focus on the inflationary process. In addition. the estimated structure is used to simulate the impacts of alternative stabilization policies under some postulated structural changes. To this end, an effort is made to found the model on theoretical grounds while capturing the essential traits of the Argentine economy.

The specification of the model is based on the research contribution made by Klein, Ortiz, and Rao (1991), who adopted the general equilibrium approach to analyze Argentine inflation and stabilization through a CGE model. In the specification of the model, special attention is given to the inter-relationships among important macroeconomic variables, especially to the interaction between general prices and the exchange rate, which is viewed as one of the key relationships in the economy responsible for inflation and instability.

Although it is a short-run model, economic dynamics are emphasized. By introducing lags, the model is allowed to exhibit the dynamic behaviour of some key variables and important relationships among them. However, an important limitation of the model, which should be pointed out here, consists in not taking explicitly into account the relationship between inflation and/or stabilization policies on the one hand, and capital accumulation and growth on the other. Therefore, long-run growth and stability considerations are not included in this study.

1.3 Outline of The Study

The study consists of five chapters. In Chapter 2, we construct a computable general equilibrium short-run model for the Argentine economy between the late 1970s and the early 1990s. With reasonable assumptions, the model is divided into six sectors which contain forty nine endogenous variables and sixteen exogenous variables. The theoretical underpinnings of the equations of the model are also discussed. Two types of inflation propagation mechanisms, namely the non-accelerating mechanism and the accelerating mechanism, are highlighted and described in the chapter.

Chapter 3 reports the estimated structure of the model. Moreover, the interaction between prices and the exchange rate will be further discussed with the help of empirical results. An important conclusion about the role of the price of nontradables in the inflationary process will be made from the theoretical and empirical studies.

Chapter 4 is devoted to reporting the results of policy simulation experiments. The model is validated and assessed first, based on the usual econometric criteria. Three policy simulation packages will be designed and experimented. These policy simulations should be viewed as *counterfactual* experiments because each of them is conducted either under certain postulated structural changes or within "possible" environments different from the historical ones. From these simulation experiments, some important findings will be made, regarding the past economic performance of the Argentine economy. Policy implications will be summarized at the end of the chapter.

The last chapter is devoted to summarizing this study. This is followed by a brief discussion about the fixed exchange rate and the convertibility requirement. Finally, directions for future research in this area are also indicated.

Chapter 2

THE MODEL

2.1 Introduction

In this chapter, a short-run general equilibrium model is specified with the purpose of using it to analyze the Argentine macroeconomic performance between the late 1970s and the early 1990s and to simulate the effects of different stabilization policies with postulated structural changes. The domestic price level and the exchange rate are the two key variables which locate in the centre of this model. The model consists of six sectors, namely, 1. supply sector, 2. expenditure, 3. external sector, 4. fiscal sector, 5. financial sector, and 6. prices, wages and expectations. In specifying the model, the Argentine economy is viewed as a small open economy with its own special characteristics.

In this study, all goods and services produced in Argentina are aggregated into two categories: tradables and nontradables. Domestic private consumption includes tradables, nontradables and imported goods and services while a portion of tradables produced in the economy is for export. It is assumed that the residents in the economy rationally allocate their expenditures between tradables (including imported goods) and nontradables to maximize utility. Government consumption includes both tradables and nontradables as well as imported goods. It is assumed that government also behaves in the same manner as its private counterpart does in allocating its expenditures among the various goods and services it consumes. However, the government does not have to balance its budget within a period due to its ability to print money or to borrow from domestic residents. Borrowing from foreign countries to finance a government deficit will not be considered in specifying the model since the external credit disappeared at the beginning of the 1980s.

A few words regarding the notation adopted in specifying the equations of the model are in order. In the model, real variables are denoted by a string of lower case letters whereas the corresponding string of upper case letters denote the same variables in nominal terms. Asterisked variables represent foreign variables, which are all assumed to be exogenous. For example, IR^* represents the nominal interest rate abroad. Variables which are subscripted by (t-1) denote one period lagged values of the corresponding variables. For example, IR_{t-1} denotes the nominal interest rate in the last period. Finally, the operations of multiplication and exponentiation are denoted by a single asterisk (*) and double asterisk (**) respectively.

2.2 Supply Sector

Since the model focuses on the short-run aspect, the capital stock is assumed to be constant. In other words, net real investment is assumed to be zero. However, due to the existence of some unemployed productive resources, short-run supply is allowed, to a certain extent, to respond to changes in market signals, such as prices and demand. The productive resources include capital, labour, and imported inputs which, in the Argentine case, constitute an important component of production costs.

Producers in the tradables sector are assumed to operate in a flex-price market. Accordingly, the domestic price of tradables is formed by converting the foreign price using the exchange rate plus taxes. The supply function of tradables is derived from profit maximization based on price-taking behaviour and Cobb-Douglas technology. The latter is described by a short-run variable cost function which is specified as:

(2.0) vct =

$$[(yts**a_{11})*a_{12}*(wr**a_{13})*(pz**a_{14})*(kt**a_{15})]*(1+a_{16}*ir)$$

where vct, yts, wr, pz, kt and ir denote, respectively, short-run costs, supply of tradables, real wage rate, domestic relative price of imported inputs, fixed capital stock in real value in the tradables sector and real interest rate.[10] The term $(1+a_{16}*ir)$ included in equation (2.0) represents a portion (measured by the parameter $a_{16}\epsilon[0,1)$) of working capital that is financed by borrowing and is subject to the real interest rate which can be viewed as a weighted average of free and regulated interest rates in some periods. The borrowing cost of working capital is incorporated in the cost function in order to account for the state of development of the capital market and financial intermediation in Argentina and their consequences for financing production.

In equation (2.0), the parameter a_{11} measures returns to scale. For values of $a_{11} > 1$, $0 \leq a_{11} < 1$, and $a_{11} = 1$, the technology exhibits decreasing returns to scale, increasing returns to scale, and constant returns to scale respectively. The parameter a_{12} can be viewed as a shift parameter and should be positive. In general, this variable cost function is consistent with theory if and only if $a_{11} \geq 0$, $a_{13} \geq 0$, $a_{14} \geq 0$, $a_{13} + a_{14} = 1$, and $a_{15} \leq 0$. These conditions guarantee that the variable cost function is non-decreasing in prices of variable factors, non-increasing in fixed capital stock, non-decreasing in output and homogeneous of degree one in variable factor

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[10] Mathematical derivation of this cost function is given in Appendix 1.

prices.[11] In short-run analysis, decreasing returns to scale are more realistic and, hence, a_{11} should be greater than unity. Detailed discussions regarding variable cost functions can be found in Lau (1976), McFadden (1978), Brown and Christensen (1981), and Hazilla and Kopp (1986).

Given this variable cost function, the supply function of tradables, which can be directly derived from profit maximization, is given below:

(2.1) yts =

$$\left[\frac{pt}{a_{11}a_{12}*(wr**a_{13})*(pz**a_{14})*(kt**a_{15})*(1+a_{16}*ir)}\right]**[1/(a_{11}-1)]$$

where pt stands for the domestic relative price of tradables.

Clearly, the variable cost equation (2.0) and the supply equation (2.1) contain the same parameters, so these

[11] A variable cost function can be written as $VC = VC(P_i, Q_j, Y)$ where P_i are variable factor prices, Q_j are the fixed factor stocks, and Y is output. For the properties of the variable cost function: non-deceasing in P_i, non-increasing in Q_j, non-deceasing in Y, homogeneous of degree one in P_i, variable factor symmetry, fixed factor symmetry, concave in P_i, and convex in Q_j, it is required that

$\partial VC/\partial P_i \geq 0$, $\partial VC/\partial Q_j \leq 0$, $\partial VC/\partial Y \geq 0$, $\Sigma_i(\partial VC/\partial P_i)P_i = VC$, $\partial^2 VC/\partial P_i \partial P_j = \partial^2 VC/\partial P_j \partial P_i$,

$\partial^2 VC/\partial Q_j \partial Q_i = \partial^2 VC/\partial Q_i \partial Q_j$, the matrix of second order partial derivatives of

VC w.r.t. P's be negative semi-definite and the matrix of second order partial derivatives of VC w.r.t. Q's be positive semi-definite. These properties are satisfied in our variable cost function if $a_{11} \geq 0$, $a_{13} \geq 0$, $a_{14} \geq 0$, $a_{15} \leq 0$, and $a_{13} + a_{14} = 1$.

parameters can be estimated through either the cost equation or the supply equation depending on the availability of data.

In addition, the demand function for imported inputs in the tradables sector can be derived from the variable cost function (2.0) by using Shephard's lemma.

$$(2.2)\quad ztd = \frac{(1+a_{16}*ir)*a_{14}*a_{12}*(wr**a_{13})*(kt**a_{15})*(yts**a_{11})}{pz**(1-a_{14})}$$

where ztd denotes demand for imported inputs by the tradables sector in real terms and is also a portion of total imports.

Producers in the nontradables sector are assumed to operate in a fix-price market where external competition is absent and oligopolistic elements are present. Hence the supply of non-tradables, which is assumed to adjust to changes in excess demand, is specified as:

$$(2.3)\quad yns = yns_{t-1}*[(ynd_{t-1}/yns_{t-1})**a_{21}]$$

where yns, ynd_{t-1} and yns_{t-1} are supply of nontradables, demand for and supply of nontradables in the last period respectively.

Modelling yns in this manner conforms to a Leontief production technology and an average cost pricing rule, i.e., mark-up rule. The following average cost equation of nontradables serves as the base for the mark-up process.

(2.4) $VCN = (1+a_{31}*IR)*(WR*L/yns+PZ*znd/yns+KN/yns)$

where VCN, WR, L, PZ, znd, KN denote, respectively, the average nominal cost of nontradables, nominal wage rate, labour employment in the nontradables sector, nominal domestic price of imported inputs, demand for imported intermediate goods in real terms, and the capital stock in the nontradables sector.[12] The parameter a_{31} measures the proportion of average nominal costs which is financed by borrowing and is subject to the nominal interest rate. The value of this parameter belongs to the interval [0, 1).

Since there is no factor substitution in Leontief technology, the demand for imported inputs in the nontradables sector is assumed to be proportional to output, that is,

(2.5) $znd = a_{41}*yns$

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[12] In this cost equation, fixed capital stocks are also assumed to be subject to the real interest rate, i.e., a part of capital stocks are assumed to be financed by borrowing.

Clearly, with the supply of tradables and the supply of nontradables, aggregate supply in the economy is given by the following accounting identity:

(2.6) yys = pt*yts+pn*yns

where yys and pn stand for aggregate supply and domestic relative price of nontradables respectively.

2.3 Expenditures

The modelling of demand behaviour in Argentina consists of the following steps. We first explain how total private expenditure is determined and then add government expenditure to obtain aggregate expenditure. In the second step we explain how aggregate expenditure is allocated between tradables and nontradables.

The level of total real private expenditure is a function of disposable income, real money balances held by the residents and real domestic interest rate. The inclusion of the real interest rate is consistent with standard consumption and investment theories and also reflects its importance in the intertemporal allocation of expenditures. Accordingly the total private expenditure function is specified as:

(2.7) $ypd = (yd{**}b_{31})*(md{**}b_{32})*exp(b_{33}*ir)$

where ypd, yd, and md denote, respectively, the levels of real private expenditure, real disposable income, real money balances held by residents.

The real government expenditure on goods and services, denoted by ged, is exogenous in the model. Adding ged to ypd, we obtain aggregate expenditure, yyd:

(2.8) $yyd = ypd + ged$

The definition of disposable income follows the practice standard in the macroeconomic literature with, perhaps, the exception of the inclusion of the term (ri/(1+ri))*(Ms/P) representing the inflation tax in real terms,[13] where ri stands for the inflation rate while Ms and P are the nominal

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13 In general, ri*(Ms/P) can be considered as an approximate inflation tax on money creation - see Turnovsky (1977). This approximation, however, may not be appropriate in the case of Argentina with hyperinflation in the late 1980s because it implies that the real inflation tax will exceed the real money stock if the inflation rate is over 100%. Accordingly, (ri/(1+ri))*(Ms/P) is used to account for the inflation tax.

money supply and the general price level respectively. Equation (2.9) below defines the disposable income,

$$(2.9) \quad yd = yys-(ta+ty+tz+tx)+ir*bs_{t-1}+(1-trf)*(ER*IR^{*}*FD/P) +trs-(ri/(1+ri))*(Ms/P)$$

where ta, ty, tz, tx, bs_{t-1}, trf, ER, IR^{*}, FD, trs denote, respectively, real autonomous tax revenue, real output-dependent tax revenue, real import tax revenue, real export tax revenue, real government bonds held by the residents in the previous period, tax rate on income earned from foreign assets held by residents, nominal exchange rate, foreign nominal interest rate, foreign financial assets in foreign currency held by residents, and real government transfer payments to the private sector.

Given aggregate expenditure, yyd, a system of aggregate demand equations is required to model the corresponding allocation mechanism. We have adopted here a system of two demand-share equations on lines suggested by Christensen, Jorgenson and Lau (1975) and particularly by Jorgenson and Lau (1979), Conrad and Jorgenson (1979), and Lau (1986).

The demand functions of Christensen, Jorgenson and Lau, *Indirect Translog System* (1975), satisfy all the theoretical properties of the integrable demand functions of the theory of individual consumer behaviour. However, as is documented in the literature - see, e.g., Sonnenschein (1973a, 1973b), Debreu (1974), Mas-Colell (1977), and Shafer and Sonnenschein (1982) - there are no reasons why market demand functions such as those used in this study should satisfy the properties of individual demand functions other than *homogeneity* and *summability*. Hence, the motivation for choosing a well-known "demand system" as a description of the allocation of aggregate expenditure within our model should be understood here in the spirit of Conrad and Jorgenson's (1979) suggestions regarding the possible *methodological* advantages of "applying micro-theory to derive restrictions on the system of aggregate demand functions", rather than as an "attempt to approximate the demand of a 'representative consumer', which exists only under the very restrictive assumptions that are necessary for the integrability of aggregate demand functions" - see Theil (1980), p.178. Of course, the reader is free to assume the existence of such a 'representative consumer' or of some 'community utility functions'.

The system of demand functions, given below, describes the allocation mechanism for total expenditures.

$$(2.10)\quad ytd = \frac{(pt/yyd)^{-1} * [b_1 + b_{11} * \log(pt/yyd) + b_{12} * \log(pn/yyd)]}{-1 + (b_{11} + b_{21}) * \log(pt/yyd) + (b_{12} + b_{22}) * \log(pn/yyd)}$$

$$(2.11)\quad ynd = \frac{(pn/yyd)^{-1} * [b_2 + b_{21} * \log(pt/yyd) + b_{22} * \log(pn/yyd)]}{-1 + (b_{11} + b_{21}) * \log(pt/yyd) + (b_{12} + b_{22}) * \log(pn/yyd)}$$

where ytd, ynd, and yyd denote total (private plus government) demand for tradables, total demand for nontradables and aggregate expenditure respectively, and pn is domestic relative price of nontradables.

Demand functions in this system satisfy the properties of summability, symmetry and homogeneity if

1) $b_1 + b_2 = -1$

2) $b_{12} = b_{21}$

3) $b_{11} + b_{12} + b_{21} + b_{22} = 0$

However, for reasons given above, only the properties of homogeneity and summability will be imposed as restrictions in estimating the system.

Finally, the aggregate expenditure on tradables and nontradables in this economy can also be defined by the accounting identity: yyd = pt*ytd + pn*ynd.

The above five equations, (2.7) through (2.11), together constitute the expenditure sector of the model.

2.4 External Sector

The external sector consists of nine equations. Following standard macroeconomic theory, the balance of payments account contains two components: current account and capital account. We begin with the current account.

In the current account, net exports (or balance of trade) in real terms are defined as the difference between supply of tradables, yts, and demand for tradables, ytd. This is because tradable goods are composed of both exportables and importables, and the difference between supply of and demand for exportables can be viewed as approximately equal to exports while the difference between demand for and supply of importables can be treated as approximately equal to imports. Hence, we have

(2.12) $xt = yts - ytd + zt$

where xt and zt represent real total exports and imports respectively. Total real imports are the sum of imported inputs demanded by the production sectors and other imported goods.

(2.13) $zt = ztd + znd + zrd$

where zrd is other imported goods which are assumed to be exogenous in this model. Using xt and zt, the real current account, ca, is given by

(2.14) $ca = xt - zt - (ER*DE*IR^{*})/P$

where DE denotes the nominal foreign debt in foreign currency, and IR^{*} denotes the nominal foreign interest rate. The term $(ER*DE*IR^{*})/P$ in equation (2.14) represents real interest payments on the foreign debt in domestic currency.

The capital account records capital flows. In Argentina, however, the movements of capital were subject to different government policies in the 1970s and 1980s. In some periods, capital movements were almost totally liberalized, while in other periods severe restrictions were imposed. In this particular case, the capital account recorded only those capital flows which were observed and reported by the government. There were no records for those induced but unreported capital flows. Under the circumstance, the capital account in this study is modelled in a slightly different way from its treatment in standard macroeconomics.

We first consider the reported capital flows. In an unstable and highly inflationary economy, both the risk premium and the expected devaluation rate play important roles in determining capital flows. Thus, the reported capital flows were determined by the interest rate differential which was adjusted by taking into account the risk premium and the expected devaluation rate, i.e., (2.15) $kar = ER*KAR/P = c_{11}+c_{12}*(IR-IR^{*}-rp-\pi^{e})$

where KAR denotes the reported nominal capital inflows in terms of foreign currency and kar is the real KAR in terms of domestic currency. IR, IR^{*}, rp and π^{e} represent, respectively, domestic nominal interest rate, foreign nominal interest rate, risk premium, and expected devaluation rate. The parameter c_{11} in equation (2.16) can be viewed as autonomous capital flows in the sense that this part of the capital flows is independent of the interest rate differential, although the actual autonomous capital flows are not necessarily constant over time.

Next, for the unreported capital flows, we make the following assumptions. First, it is assumed that the unreported capital flow moves in the same direction as the reported capital flow does. Second, all unreported capital flows are induced by the adjusted interest rate differential. Accordingly, we specify

(2.16) $kau = ER*KAU/P = c_{21}*(IR-IR^{*}-rp-\pi^{e})$

where KAU stands for unreported capital flow in foreign currency and kau is the real KAU in domestic currency. Without data on kau, equation (2.16) cannot be estimated. However, we can simulate the effects of kau by assigning some plausible values for it.

Following the standard procedure, the capital account and the balance of payments account are defined as:

(2.17) ka = kar+kau

where ka denotes the real capital account, and

(2.18) bp = ca+ka

where bp is the real balance of payments account which is equal to the change in real official foreign exchange reserves.

As an approximation, the risk premium, denoted by rp, is assumed to be proportional to the size of foreign debt relative to the aggregate supply of output in the economy. The rationale is as follows: foreign investors will take the size of Argentine nominal foreign debt into account when they make decisions to invest in Argentina. The larger is the size of foreign debt relative to aggregate supply (or GDP), the weaker is the ability of the Argentine economy to repay the debt plus interest, and hence the higher will be the risk in investing in Argentina. This translates into the following equation for the risk premium:

(2.19) $rp = c_{31}*(ER*DE)/(P*yys)$

The exchange rate is defined as units of domestic currency per unit of foreign currency. So a rise in the exchange rate represents a devaluation of domestic currency. A large number of articles and books were published regarding the exchange rate determination and its dynamics. See, for instance, Bhandari (1982), Branson (1984), Bruno (1976, 1978), Calvo and Rodríguez (1977), Dornbusch (1976a, 1976b, 1988), Edwards (1989), Frankel (1976), Frankel and Mussa (1980, 1985), Frankel and Rodríguez (1982), Helpman and Razin (1982), Krueger (1983), Krugman (1989), Lizondo (1987a, 1987b), Liviatan (1981), Lucas (1982), Mussa (1982, 1984), Obstfeld (1980, 1981, 1982), Obstfeld and Rogoff (1984), Obstfeld and Stockman (1985), Rodríguez (1980), Stockman (1980, 1983), Stulz (1987) and many others. However, in Argentina, wherein high inflation was experienced for more than half a century, the relationship between the exchange rate and prices is of paramount importance in exchange rate determination. There is still a serious difficulty in modelling the institutional set-up of this relationship for the Argentine economy during 1975-1991 because Argentina experimented with all imaginable exchange rate regimes during this period - single, double, fixed, floating, etc., rates. The chosen solution has been to approximate the exchange rate to the price mechanism with the empirical relation embodied in equation (2.20) given below. This equation describes that the actual link between the relevant variables during the period is, on average, statistically very strong, and is consistent with the "naive" but a realistic assumption, that in a highly inflationary environment the exchange rate and the inflation rate cannot diverge fundamentally even in the short run. Hence the equation for exchange rate determination is specified as:

$$(2.20) \quad (ER_t/ER_{t-1}) = (P_t/P_{t-1})**c_{41}$$

where ER and P denote the nominal exchange rate and the domestic price level respectively.

Equation (2.20) describes the path of exchange rate movement. Clearly the parameter c_{41} plays an important role in the inflationary process. If $0 < c_{41} < 1$, assuming other things being equal, then an increase in price will lead to a relatively small increase in the exchange rate, i.e., the proportional change in the exchange rate is smaller than the proportional change in price, so a small devaluation of domestic currency occurs. This implies that the forward effect from domestic price to exchange rate is relatively weak. Assuming that this effect will not be expanded or reduced in the feedback channels from exchange rate to price, then inflationary pressure will dampen eventually. On the other hand, if $c_{41} > 1$, then, an initial rise in price caused by any exogenous shocks will lead to a larger increase in exchange rate, which, through the feedback channels, will be translated back into price, so both price and exchange rate will be quickly pushed up and this upward tendency will continue if there are no other adjustment mechanisms in the economy or no policy interventions to stop it.[14]

It should be noted, however, that the dynamics (acceleration or deceleration) of the inflation rate cannot be explained by c_{41} only. Given $c_{41} > 1$, all we may conclude is that both price and the exchange rate will increase and the proportional change in the exchange rate is greater than the proportional change in price. Without knowing the accurate feedback effects from exchange rate to price, we cannot draw any further conclusions regarding the dynamics of the inflation rate. The inflation rate can be accelerating, decelerating or constant under the condition of $c_{41} > 1$, all depending on whether the effect of the proportional change in exchange rate is expanded or reduced in the feedback

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[14] Two types of inflation propagation mechanisms are distinguished in this study, namely, the *non-accelerating mechanism* which transmits exogenous shocks into inflation, and the *accelerating mechanism* which sustains and magnifies (or reduces) inflation. This study focuses on the accelerating mechanisms, e.g., the price-exchange rate spiral.

mechanisms. However, if the feedback effect is strong enough and meanwhile c_{41} is greater than unity, we can conclude that the inflation pressure is magnified and the inflation rate will accelerate continuously. This interesting and very important question will be answered in the next chapter, partially based on empirical results and partially based on theoretical analysis.

2.5 Fiscal Sector

In addition to autonomous taxes, ta, the model also includes four other endogenously determined taxes, namely output-dependent taxes, import taxes, export taxes, and taxes on income from holding foreign assets. The tax equations are specified below.

(2.21) ty = try*yys

(2.22) tz = trz*zt

(2.23) tx = trx*xt

(2.24) tf = trf*(ER*IR**FD)/P

where ty, tz, tx, and tf denote, respectively, output-dependent taxes, import taxes, export taxes, taxes on income from holding foreign assets, and try, trz, trx and trf denote the corresponding tax rates, i.e., output-dependent tax rate, import tax rate, export tax rate and tax rate on the income from holding foreign assets. All these four tax rates, together with government spending, ged, serve as fiscal policy instruments in this model.

The real government deficit, df, is defined as the difference between government real expenditure plus real servicing of both domestic and foreign debt and real tax revenues with an additional component, d_{11}*ri, which linearly approximates the Olivera-Tanzi effect. Since an increase in the inflation rate erodes real tax receipts and creates a high real deficit, d_{11} is positive.

$$(2.25) \quad df = ged + (ir_{t-1} * bs_{t-1}) + (IR^{*}_{t-1} * DE_{t-1} * ER/P) - (ta+ty+tz+tx+tf) + d_{11} * ri$$

This budget deficit is financed by seigniorage, (i.e., printing money by the central bank) and/or by borrowing from residents (i.e., issuing government bonds). It should be noted that borrowing from foreign countries to finance the deficit is not considered in the model specification because in the theoretical analysis we are more interested in the effect of financing deficits through domestic sources and in reality the external credit disappeared at the beginning of 1980s.

2.6 Financial Sector

Three interrelated asset markets make up the financial sector. They are the money market, the bond market and the foreign financial asset market.

The nominal money supply is equal to the stock of money in the last period plus its change, ΔMs, in the current period. That is, $Ms_t = Ms_{t-1} + \Delta Ms_t$. The change in money supply, ΔMs, depends on the size of the money multiplier α and the change in the monetary base ΔMB. Formally, we have $\Delta Ms = \alpha \Delta MB$. Further, ΔMB is determined partially by the need for financing the budget deficit and partially by the change in the foreign reserves (i.e., the balance of payments). Thus, we have $\Delta MB = BP + \beta_1 M + \beta_2 (df * P)$, where BP is the nominal balance of payments in domestic currency, M is a monetary aggregate representing an "active" monetary policy component, and $df*P$ is the nominal deficit. Clearly, both β_1 and β_2 are positive while β_2 measures the proportion of the budget deficit that is financed by money creation.

Now we can write $\Delta Ms=Ms_t-Ms_{t-1}=\alpha\Delta MB=\alpha(BP+\beta_1 M+\beta_2(df*P))$ or $Ms_t=Ms_{t-1}+\alpha BP+\alpha\beta_1 M++\alpha\beta_2(df*P)$. Since data on M are not available, we assume that $\alpha\beta_1 M+Ms_{t-1}$ is approximately equal to $e_{11}*Ms_{t-1}$ whereas $\alpha\beta_2(df*P)=e_{13}*(df*P)$. On this basis, we specify the nominal money supply equation as:

$$(2.26)\quad Ms = e_{11}*Ms_{t-1}+e_{12}*BP+e_{13}*(df*P)$$

where the coefficient e_{12} (i.e., α) is the money multiplier.

Demand for money in real terms is assumed to depend upon real wealth, real income, the nominal interest rate, and the net foreign interest rate (IR^*-trf), i.e.,

$$(2.27)\quad md = (ww_{t-1}**e_{21})*(yys**e_{22})*\exp[e_{23}*IR+e_{24}*(IR^*-trf)]$$

where md and ww denote demand for real money balances and total real wealth respectively. In equation (2.27), the variables, ww and yys, account for the transaction demand for money whereas other variables explain the opportunity cost of holding money and account for the possibility of currency (or other financial assets) substitution. The equilibrium condition in the money market is defined as

$$(2.28)\quad Ms/P = ms \equiv md$$

and this condition is assumed to hold in every period.

In the bond market, nominal supply of government bonds, Bs, is equal to supply of bonds in the last period plus net change in the current period, i.e., $Bs_t = Bs_{t-1} + \Delta Bs_t$. The net change in Bs is determined partially by the need for financing the deficit and partially by the need for open market operations. Assuming that the quantity of bonds used in the open market operations is proportional to Bs_{t-1}, we can specify the equation of the supply of government bonds as:

$$(2.29) \quad Bs = e_{31}*Bs_{t-1}+e_{32}*(df*P)$$

where the parameter e_{32} is related to e_{13} in equation (2.26). Since the budget deficit is financed by money creation and bonds, we have $e_{32}=1-e_{13}/\alpha$, where $\alpha=e_{12}$ is the money multiplier.

The demand for government bonds in real terms, bd, is a function of the same variables as those in equation (2.27), i.e.,

$$(2.30) \quad bd = (ww_{t-1}**e_{41})*(yys**e_{42})*\exp[e_{43}*IR+e_{44}*(IR^{*}-trf)]$$

Equation (2.31) below describes the equilibrium condition in the bond market, which is also assumed to hold in every period.

$$(2.31) \quad Bs/P = bs \equiv bd$$

The third market is the foreign asset market. Real foreign financial assets (including both foreign currency and other financial assets) held by residents are defined as the foreign assets in nominal terms multiplied by the nominal exchange rate and deflated by the general domestic price level, i.e., fd=FD*ER/P, where fd is real foreign financial assets held by residents. The demand for foreign assets in real terms is explained by the following equation which is similar to equations (2.27) and (2.30). This implies interdependence among all financial markets.

$$(2.32) \quad fd = (ww_{t-1}**e_{51})*(yys**e_{52})*\exp[e_{53}*IR+e_{54}*(IR^{*}-trf)]$$

It should be noted that residents purchasing and holding foreign assets (including foreign currency) in Argentina were subject to different government regulations during the 1970s and 1980s. Hence for such periods in which purchasing and holding foreign assets were severely restricted, equation (2.32) is not applicable and equations (2.27) and (2.30) must also be modified since in these periods only money and government bonds were available for residents to form their financial asset portfolios.[15]

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[15] In these periods, equations (2.27) and (2.30) are:

$$(2.27.1) \quad md=(ww_{t-1}**e_{21})*(yys**e_{22})*\exp(e_{23}*IR)$$
$$(2.30.1) \quad bd=(ww_{t-1}**e_{41})*(yys**e_{42})*\exp(e_{43}*IR)$$

respectively. Note that in this study, the capital stock, which forms a part of total wealth, is not represented by tradable shares.

These three financial assets, together with the capital stock which is constant in this short-run model, form the total wealth which is defined by the following identity:

$$(2.33) \quad ww = WW/P = ((Ms+Es+ER*FD)/P)+kk$$

where WW stands for total nominal wealth held by residents while ww denotes real wealth, and kk is the constant total capital stock.

The next two equations describe the real domestic interest rate (ir) and the adjustment process of the domestic nominal interest rate (IR). Following Klein, Ortiz and Rao (1991), the relation between the real interest rate, the nominal interest rate and the inflation rate is self-explanatory. In the Argentine case, the usual approximation $ir = IR - ri$, where ri is the inflation rate, may not be useful because of the frequency of high inflation coupled with a high nominal interest rate. Accordingly, the real domestic interest rate is defined as

$$(2.34) \quad ir = (IR-ri)/(1+ri)$$

and the adjustment process of the nominal domestic interest rate is specified as:

(2.35) $IR - IR_{t-1} = e_{61} * (IR^{*} + \pi^{e} + rp - IR_{t-1}) + e_{62} * (\log Ms - \log Ms_{t-1})$

That is, the adjustment of the nominal interest rate depends on the gap between the expected foreign nominal rate of return and the one-period lagged domestic nominal interest rate, and the change in nominal money supply. The former is consistent with the doctrine of interest rate parity and the latter explains short-run deviations of the nominal interest rate from its equilibrium value. Clearly, the coefficient e_{61} should be positive while the coefficient e_{62} should be negative.

2.7 Prices, Wages and Expectations

Since there are only two types of commodities in this economy, the general price level is explained by the following Divisia index:

(2.36) $P = (PT^{**}f_{11}) * (PN^{**}(1-f_{11}))$

where PT and PN are the price levels of tradables and nontradables respectively.

The law of one price is assumed to prevail in the case of tradables, where Argentina is a price taker. So the domestic tradables price is assumed to adjust instantaneously in relation to the foreign tradables price, the foreign price of imported inputs and the difference between import and export tax rates.

$$(2.37) \quad PT = (f_{21}*PT^{*}+(1-f_{21})*PZ^{*})*ER*(1+trz-trx)$$

where PT^{*} and PZ^{*} are the foreign price of tradables and the foreign price of imported inputs. Since tradables contain both exportables and importables, both trx and trz are involved in equation (2.37). The domestic relative price of tradables, pt, is defined as

$$(2.38) \quad pt = PT/P$$

In view of the assumption of the presence of oligopolistic power in the nontradables market, the price of nontradables is determined by the mark-up rule based on the average cost - see equation (2.4) above. Accordingly, the price of nontradables, PN, is given by the product of the mark-up factor and the average cost of the nontradables sector, VCN,

$$(2.39) \quad PN = qf*VCN$$

where qf is the mark-up factor for the nontradables sector.

Given the price of nontradables, the relative price of nontradables, pn, is defined as

(2.40) $pn = PN/P$

Similar to the determination of the tradables price, the law of one price is also assumed to prevail in the case of imported goods. Thus, we have

(2.41) $PZ = PZ^{*} * ER * (1+trz)$

where PZ and PZ^{*} are domestic and foreign prices of imported goods. Since tradables are composed of both exportables and importables, PT in equation (2.37) is subject to both import and export tax rates while PZ is subject to the import tax rate only. It is clear that the domestic relative price of imported goods is

(2.42) $pz = PZ/P$

The mark-up factor for nontradables is assumed to be a function of price expectations and aggregate excess demand,

(2.43) $qf = (P^{e} ** f_{31}) * \exp[f_{32} * (yyd-yys)/yys]$

where P^{e} denotes expected price.

As discussed in Chapter 1, the Argentine economy was quite unstable in the last two decades during which several different stabilization policies were implemented by government. For purposes of strengthening the policy effects, all policies were highly transparent to the public. Given this situation, it is reasonable to assume that the economic agents have perfect foresight of the economy, i.e., the rational expectations hypothesis is assumed to hold. The next three equations explain the expected price, the expected inflation rate and the expected devaluation rate.

(2.44) $P^e = P_{t-1} * (1+ri^e)$

(2.45) $ri^e = f_{41} * \pi^e$

(2.46) $\pi^e = f_{51} * (\log Ms - \log Ms_{t-1}) + f_{52} * (ri_{t-1} - ri^e_{t-1})$

where ri^e is expected inflation rate. Equation (2.44) states that residents form their price expectations in the current period according to the actual price that prevailed in the last period and their expectations regarding the inflation rate. Equation (2.45) shows that the current expected inflation rate is determined by the expected devaluation rate. It equals the expected devaluation rate if $f_{41}=1$ or is proportional to the expected devaluation rate if f_{41} is positive and not equal to one. This relationship is clearly consistent with interactions between the exchange rate and prices. Equation (2.46) explains the formation of expectations in regard to the rate of devaluation.[16] Here, the money supply is introduced in the formation of expectations because residents are assumed to have perfect knowledge about the effects of changes in the money supply on the economy. Moreover, if the actual inflation rate is higher than the expected rate in the last period due to random factors, residents will immediately take this difference into account when they form their expectations on the current devaluation rate. Hence f_{51} and f_{52} are expected to be positive.

Given the price equation (2.36), the actual inflation rate can be derived,

(2.47) $ri = (P-P_{t-1})/P_{t-1}$

where ri is the actual inflation rate.

Finally, we construct wage equations in order to complete the model. Following a rather standard viewpoint, the nominal wage rate is specified as a function of the expected price and

[16] The classical quantity equation points out that an increase in money supply leads to a proportional increase in price. An interesting question is what mechanism in the economy plays the role to bridge these two. In this model, the expected devaluation rate and total private demand for goods and services serve as the main mechanisms.

the excess aggregate demand,[17] while the real wage is given by the definition.

(2.48) $WR = (P^e**f_{61})*\exp[f_{62}*((yyd-yys)/yys)]$

(2.49) $wr = WR/P$

The above 49 equations, (2.1) through (2.49), complete a short-run equilibrium model of Argentina. In Appendix 2, the equations of the model are pooled together. This is followed by the list of all endogenous and exogenous variables.

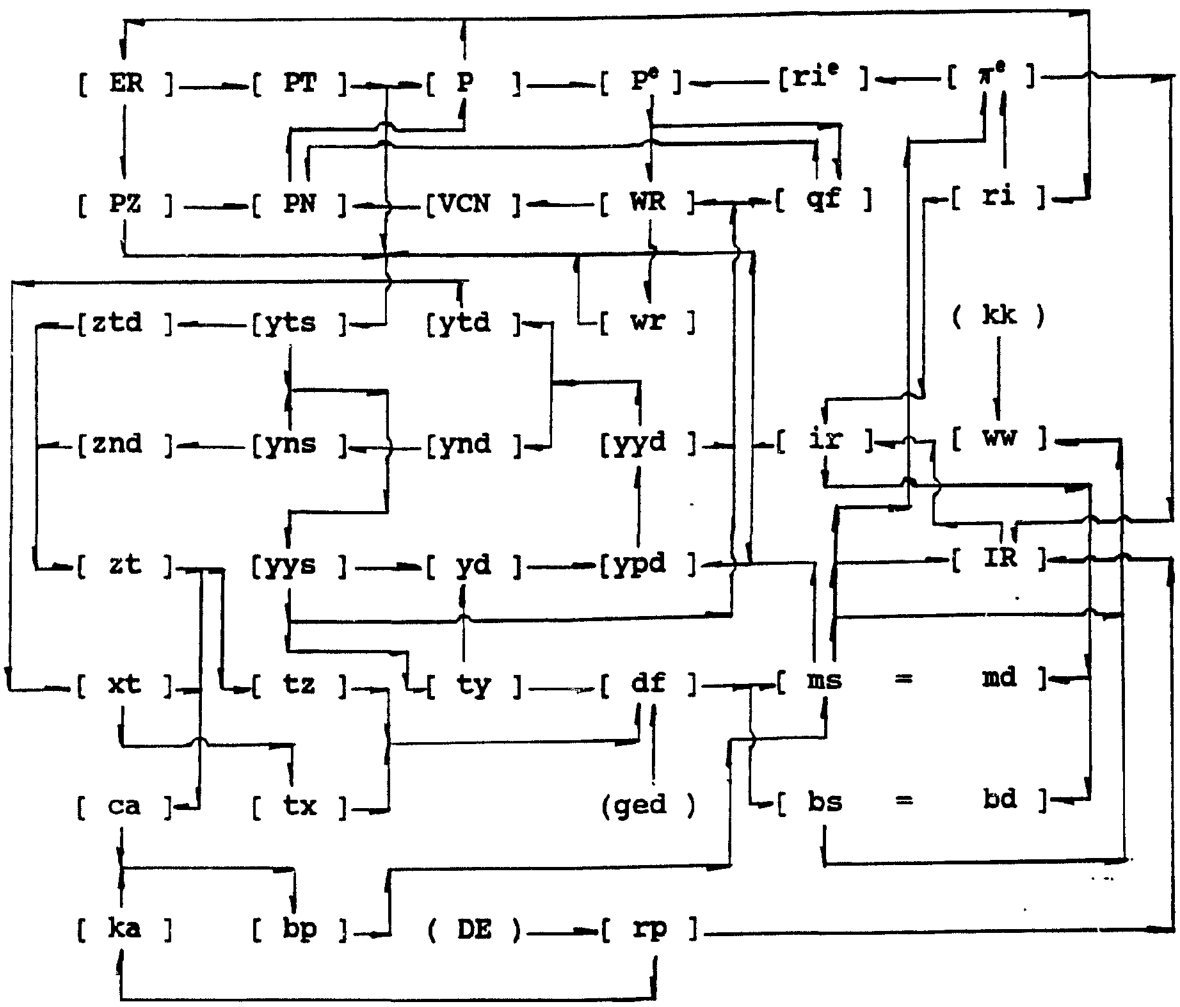
2.8 Inflation Mechanisms

This model has explicitly described the relationships among the key economic variables - see figure A - and the mechanisms through which various shocks are translated into inflation. More importantly, the model has also described the mechanisms represented by the interaction between prices and the exchange rate and the interaction between prices and wages, through which the initial inflationary pressure is

[17] Equation (2.48), together with equations (2.4), (2.36), (2.39), and (2.44), describes the price-wage spiral which generates inertial inflation. For more discussions on the price-wage spiral, see, e.g., Canavese and Heymann (1992).

Figure A

THE CGE MODEL



Note that only major relationships among the variables are shown in this figure and that, in the figure, [ ] identifies an endogenous variable whereas ( ) identifies an exogenous variable.

sustained and even magnified. We call the former mechanisms, which transmit exogenous shocks into inflation, as *non-accelerating mechanisms*, while the latter mechanisms, which sustain and magnify (or dampen) inflation pressure, are termed *accelerating mechanisms*. Some salient features of the model regarding these mechanisms are discussed below.

Firstly, the monetary shock is directly transmitted into inflation through expectations and wage determination. From equations (2.4), (2.36), (2.39), (2.44), (2.45), (2.46) and (2.48), we observe that:

$$Ms \rightarrow \pi^e \rightarrow ri^e \rightarrow P^e \rightarrow WR \rightarrow VCN \rightarrow PN \rightarrow P$$

In this way, the monetary shock, initially a demand-pull factor, also induces the cost-push effects through expectations. The pure demand-pull effects resulting from monetary shocks are implicitly modelled through the general equilibrium conditions, i.e. Ms → ypd → yyd (together with yys) → P.

Secondly, the fiscal shocks are directly transmitted into the inflationary process through different mechanisms. For the budget deficit shock, the generated inflationary pressure passes through money creation (financing the deficit) to expectations and wage mechanisms. This transmission is similar to the effects of the monetary shock described above. For the tax rate shocks, the generated inflationary pressure passes through the prices of tradables and imported inputs, i.e., trx and trz → PZ and PT → P.

Thirdly, external shocks, say, changes in foreign prices, are directly transmitted into the inflationary process through the mechanisms of the exchange rate and tax rates on imports and exports. An important fact is that the effects of external shocks are not only directly translated into the price of tradables, but also the price of nontradables, although the mechanisms are different, i.e.,

$$PT^* \text{ and } PZ^* \text{ (through ER \& trz, trx)} \rightarrow PT \text{ and } PZ \rightarrow P$$

$$PZ^* \text{ (through ER \& trz)} \rightarrow PZ \rightarrow VCN \rightarrow PN \rightarrow P$$

In view of the above discussion, it is clear that the price of nontradables cannot be completely isolated from the outside economy and from the interaction between the exchange rate and the general price level. In fact, the price of nontradables plays a very important role in the inflationary process. This problem will be discussed in detail in Chapter 3.

Fourthly, the interest rate plays an important role in the model. Not only does the interest rate affect the external sector by determining capital flows, but more importantly it influences both production and consumption. Interest rates (either nominal or real) enter cost equations of vct and VCN on the supply side through equations (2.0) and (2.4), and also enter the equation of ypd on the demand side via equation

(2.7). Even though the investment behaviour is not considered explicitly in this short-run model, the role of interest rates in the inflationary process is still clear:

$$ri_{t-1} \rightarrow \pi^e \rightarrow IR \rightarrow ir \rightarrow yys \; \& \; yyd \rightarrow P \rightarrow ri$$

through equations (2.1), (2.4), (2.7), (2.34), (2.35) and (2.46).

Finally, we consider the price-exchange rate spiral and the price-wage spiral. These two spirals produce inertial effects on inflation within the established economic structure:

$$ER \rightarrow PT \; \& \; PN \rightarrow P \rightarrow ER \quad \text{and} \quad P \rightarrow P^e \rightarrow WR \rightarrow VCN \rightarrow PN \rightarrow P$$

When the exchange rate is fixed and there, presumably, is no foreign price shock, inflationary pressure may still exist. The pressure comes from nominal wage and expectation adjustments. The first spiral, price-exchange rate spiral, is in the centre of this study and is further discussed in detail in Chapter 3.

The above discussion highlights how inflation is generated, transmitted, and magnified through these mechanisms. Inflation, in turn, produces various effects on other variables which further fuel the inflationary process. These features of the model will serve as foundations when the policy simulation experiments are designed.

Chapter 3

EMPIRICAL RESULTS

3.1 Introduction

The theoretical model presented in Chapter 2 consists of 49 simultaneous equations in 49 endogenous variables and 28 predetermined variables (including 16 exogenous and 12 lagged endogenous variables). Some equations are nonlinear. In general, before any attempt is made to estimate the unknown parameters in a *linear model*, we have to make sure that the parameters of the equations are identified. Unfortunately, the theory regarding identification of parameters in a *nonlinear model*, which contains simultaneous difference and/or differential equations, is still in its infancy. Hence no attempt is made in this study to identify the equations and it is assumed that the parameters of interest are identifiable.

In order to simulate the impacts of various stabilization policies, we require a numerical structure within the specified model. This is achieved by using the ordinary least squares (OLS) method when the equation is either linear or can be linearized by applying appropriate transformations, the most commonly applied being the logarithmic transformation. When the equation to be estimated is nonlinear, the nonlinear least squares method (NLS) is used. Occasionally, the parameters cannot be estimated for want of relevant data; in such cases, we conjecture the size of the parameters based on available information.

It should be noted that some equations, such as (2.16), (2.17), (2.24), and (2.32) - see Appendix 2, in the basic mathematical model of Chapter 2 were excluded from the final econometric model of Chapter 3. The corresponding endogenous variables in these equations were real unreported capital flows (kau), real total capital account (ka), real taxes on income from holding foreign assets (tf), and real foreign assets held by residents (fd). The fundamental reason for the decision to eliminate them was the unavailability of data on relevant variables, coupled with the conviction that these equations would only play a minor role, if at all, in the determination of the overall behaviour of the model. Recall the identity ka=kar+kau, where kar denotes real reported capital flows. It is clear that ka=kar after kau was excluded. In addition, with the exclusion of fd, only money and bonds form residents' financial portfolios, therefore, the relevant trf, tax rate for fd, and tf, tax revenue from fd, are not needed. Hence, trf and tf in equations (2.9), (2.25), (2.27), and (2.30) were also excluded. Further explanations regarding these exclusions and on their consequences can be found in Appendix 3.

In this chapter, we first explain the procedures which were followed in data construction. Then we report the estimated structure of the model and discuss the significance of the results. In addition, we discuss again the relationship between price and exchange rate albeit this time the discussion focuses not only on the theoretical aspects but also on the empirical results.

3.2 Data

The main sources of data in this study consist of DATAFIEL, a data bank of the Fundacion de Investigaciones Economicas Latinoamericanas in Buenos Aries and its statistical monthly journal "INDICADORES DE COYUNTURA", the study "ANALISIS Y PROYECCIONES DEL DESARROLLO ECONOMICO, Vol.V, EL DESARROLLO ECONOMICO DE LA ARGENTINA, Parte 1, CEPAL 1959", various issues of "INTERNATIONAL FINANCIAL STATISTICS", IMF, and various issues of the "FEDERAL RESERVE BULLETIN" of the USA. The data series cover the period from 1978 to 1989.

In selecting time series data, several alternatives, such as yearly, quarterly or monthly data, may be considered. It was felt that if annual data were used, the series would get smoothened and would conceal the very fluctuations which the model structure is intended to capture. On the other hand, if monthly data were used, too much detail would crowd in the short-run fluctuations which we wish to explain with the model. Hence, a compromise was struck by selecting quarterly data.

During the period from 1978 to 1989, different currencies were used in Argentina. Among the initially collected raw data, some series were measured in old pesos which were in circulation before the Austral Plan of 1985. Some later series were measured in australes and still some more recent series were measured in new pesos which began to circulate in January 1992. In this study, all series have been converted into new pesos to ensure consistency. In addition, the year 1988 has been chosen as the base year for all indexes.

Money supply is an important variables in the model. After examining the Argentine case, the relatively broad definition of money supply M2 was preferred to the narrower definition M1 in this study because in the last two decades the Argentine government several times imposed the policy of hundred percent reserve requirement for banks' deposits with a view to reducing the inflation rate. With this policy, the money multiplier of M1 was equal to or even less than unity in those periods.[18] In the case of Argentina, which exhibited frequent episodes of high inflation, M2 provides a better measure of money supply.

Since the model is for a small open economy, some foreign variables are included in the model, such as foreign prices and foreign interest rate. In this study, the relevant US economic variables are selected as representatives of foreign variables. This is because most domestic variables in the external sector are related to the US currency. In addition, the "dollar standard" plays a key role in the convertibility policy adopted in March 1991.

The model contains a number of endogenous and exogenous variables. Data on some of the variables in the model can be directly taken from DATAFIEL or from the already mentioned published materials while others have to be constructed from the available primary data, or have to be conjectured on the basis of what are deemed to be reasonable assumptions. The procedures followed in constructing the data are described in

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[18] Statistics show that, in the period from 1978 to 1989, on average, $\Delta M1 = 0.78723 * \Delta MB$, where MB is the monetary base and 0.78723 is the money multiplier of change of M1. On the other hand, the multiplier of M2 is 1.1557, on average, for the same period.

detail in Appendix 3. The quarterly data used in estimating the model's structure are presented in Appendix 4.[19]

3.3 Estimations

In the model, twenty-two equations contain unknown parameters which have to be either estimated or conjectured based on plausible assumptions. Foe convenience, these equations are reproduced below with same notations used in Chapter 2.

(3.1) yts =

$$\left[\frac{pt}{a_{11}*a_{12}*(wr**a_{13})*(pz**a_{14})*(kt**a_{15})*(1+a_{16}*ir)}\right]**[1/(a_{11}-1)]$$

(3.2) $yns = yns_{t-1}*[(ynd_{t-1}/yns_{t-1})**a_{21}]$

(3.3) $VCN = (1+a_{31}*IR)*(WR*L/yns+PZ*znd/yns+KN/yns)$

(3.4) $znd = a_{41}*yns$

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[19] It should be noted that the Argentine National Accounts figures have been revised and replaced by the new estimates in 1992. However, in this research, only data preceding the revision were used because no published quarterly data on GDP and its components were available to us as late as July 1993. Estimation of the model with the revised data is planned for the future research.

(3.5) $ypd = (yd^{**}b_{31})*(md^{**}b_{32})*exp(b_{33}*ir)$

(3.6) $$ytd = \frac{(pt/yyd)^{-1}*[b_1+b_{11}*log(pt/yyd)+b_{12}*log(pn/yyd)]}{-1+(b_{11}+b_{21})*log(pt/yyd)+(b_{12}+b_{22})*log(pn/yyd)}$$

(3.7) $$ynd = \frac{(pn/yyd)^{-1}*[b_2+b_{21}*log(pt/yyd)+b_{22}*log(pn/yyd)]}{-1+(b_{11}+b_{21})*log(pt/yyd)+(b_{12}+b_{22})*log(pn/yyd)}$$

(3.8) $kar = c_{11}+c_{12}*(IR-IR^*-rp-\pi^e)$

(3.9) $rp = c_{31}*(ER*DE)/(P*yys)$

(3.10) $(ER_t/ER_{t-1}) = (P_t/P_{t-1})^{**}c_{41}$

(3.11) $df = ged+(ir_{t-1}*bs_{t-1})+(IR^*_{t-1}*DE_{t-1}*ER/P)$
$-(ta+ty+tz+tx+tf)+d_{11}*ri$

(3.12) $Ms = e_{11}*Ms_{t-1}+e_{12}*BP+e_{13}*(df*P)$

(3.13) $md = (ww_{t-1}{}^{**}e_{21})*(yys^{**}e_{22})*exp(e_{23}*IR)$

(3.14) $Bs = e_{31}*Bs_{t-1}+e_{32}*(df*P)$

(3.15) $bd = (ww_{t-1}{}^{**}e_{41})*(yys^{**}e_{42})*exp[e_{43}*(IR-ri^e)]$

(3.16) $IR-IR_{t-1} = e_{51}*(IR^*+\pi^e+rp-IR_{t-1})+e_{52}*(logMs-logMs_{t-1})$

(3.17) $P = (PT^{**}f_{11})*(PN^{**}(1-f_{11}))$

(3.18) $PT = (f_{21}*PT^*+(1-f_{21})*PZ^*)*ER*(1+(trz-trx))$

(3.19) $qf = (P^{e**}f_{31})*exp[f_{32}*(yyd-yys)/yys]$

(3.20) $ri^e = f_{41}*\pi^e$

(3.21) $\pi^e = f_{51}*(\log Ms - \log Ms_{t-1}) + f_{52}*(ri_{t-1} - ri^e_{t-1})$

(3.22) $WR = (P^e**f_{61})*\exp[f_{62}*((yyd-yys)/yys)]$

Among these equations, (3.1), (3.6) and (3.7) are non-linear equations so that the ordinary least squares (OLS) method cannot be directly applied. Equations (3.3), (3.4) and (3.9) include unknown parameters but these parameters cannot be estimated either because data on the dependent variables are not available (VCN and znd) or cannot be observed (rp). So the values of parameters in these equations have to be conjectured. In addition, the parameter d_{11} in equation (3.11), which measures the Olivera-Tanzi effect in its linear approximation, is allowed to take some plausible non-negative values for the purpose of simulation[20] while the coefficient f_{11} in (3.17) is equal to 0.42, which was obtained from procedures followed in constructing the data (see Appendix 3). The remaining equations are either linear or loglinear so that their parameters can be directly estimated by OLS.

Estimation Methods

The supply equation (3.1) of tradables can be estimated in two ways: by using Taylor expansion to linearize the

[20] The Olivera-Tanzi effect works in different ways in different periods. In the period when the inflation rate drops from high to low, this effect improves real tax collections. In the period when the inflation rate accelerates, the effect erodes real tax receipts.

equation and then applying OLS, or by using the nonlinear least squares (NLS) estimator.[21] In practice, linearization and OLS were first applied but not all estimated parameters satisfied the theoretical properties. However, these preliminary estimates shed some light on the possible values of some unknown parameters in equation (3.1) and allow us to apply NLS to estimate the parameters of this equation. Several different sets of initial values for the unknown parameters, hinted from OLS estimation, were alternatively experimented with. From all estimations, the parameter a_{16}, which measures the proportion of working capital that is financed by borrowing, fluctuated from -0.08 (unreasonable) to 0.21, but appeared very often in the range of 0.07 to 0.15, while the estimates of other parameters were not satisfactory. To improve the estimates, a_{16} was set equal to 0.1,[22] and the equation was re-estimated with the best set of initial values. The results, after 100 iterations, were reasonable and consistent with the restrictions that the parameters are expected, in theory, to satisfy.[23]

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[21] Some basic details regarding nonlinear estimation can be found in Maddala (1977). A more rigorous treatment of nonlinear estimation can be found in Davidson and MacKinnon (1993).

[22] We also experimented with other values, but this plausible value yielded the best estimates.

[23] In order to improve estimation results, we also experimented other functional form for the supply of tradables, such as CES, and tried to introduce dummy variables and/or other econometric devices, but none could provide better results than what we obtained through NLS estimation. However, there is still a problem with this nonlinear estimation because

The translog system of demand equations was first linearized and estimated by OLS. Here too, the preliminary OLS estimates were used as the basis for specifying several different sets of initial values were selected for the NLS estimation. The linear restrictions on parameters were imposed to ensure that the theoretical properties of homogeneity and summability of aggregate demand functions hold good. Although, as stated, several sets of different starting values were experimented with, the procedure converged soon after 19 iterations and a unique set of estimated values was obtained. Therefore, it could be concluded that at least a local minimum of the sum of squared residuals was guaranteed to have been reached in estimating this demand system.[24]

The OLS estimates of the coefficients c_{11} and c_{12} in equation (3.8), reported capital flows, were poor. Part of the reason was possibly that kar was measured in levels while the explanatory variables, IR, IR^*, rp and π^e were given in percentage terms. Thus, a vary large OLS estimate of the intercept was obtained, which smoothened to a large extent the

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the estimated parameters did not converge even after 1000 iterations so that neither the global nor the local optimum could be guaranteed. Since the set of estimated parameters after 100 iterations performed reasonably well in simulations, it was finally chosen and presented in this chapter.

[24] This is also a local maximum if the maximum likelihood method is applied.

actual fluctuations of kar. In this situation, the predicted kar was moving along a horizontal line over time and was inconsistent with the observed trend of kar. Several methods can be adopted to improve estimation without violating the theoretical specification of the behaviour of capital flows. A frequently used method is to introduce lagged explanatory variables. The theoretical justification for introducing the lagged variables is this: although capital movements occur in the current period, the decisions about some of these movements were probably made in the previous period. So the overall current capital flows are determined not only by the current interest rate differential but also by the past interest rate differential. With these considerations in mind, we introduced one-period lagged explanatory variables with their powers (up to and including the third power) into the equation to capture the fluctuations in capital movements. A dummy variable was also introduced identifying those periods when a liberalized policy regarding capital movements was implemented. The actual estimated equation is

$$(3.8.1) \qquad kar_t = c_{11} + c_{12}X_t + c_{13}X_{t-1} + c_{14}X^2_t + c_{15}X^2_{t-1} + c_{16}X^3_t + c_{17}X^3_{t-1} + c_{18}dum$$

where $X_t = (IR-IR^*-rp-\pi^e)_t$ and dum denotes the dummy variable. This equation, (3.8.1), was consistent with the theoretical specification of capital flows made in Chapter 2 and performed better in estimation than the unmodified one - equation (3.8). Although the difference between the predicted and observed values of kar_t remained large, the basic trend of capital movements was captured.

A modification was also made in equation (3.16) explaining the nominal interest rate adjustment. During the period of 1978 to 1989, nominal interest rates in Argentina followed closely the inflation rates. But in some periods regulated interest rates and free market interest rates co-existed, as, for instance, during the Austral Plan period. This situation deserves special consideration when estimating this equation. Another interesting problem relates to the quarterly nature of data to the extent that three months may be too long a period for the adjustment of nominal interest rates in a "small open economy", such as Argentina. Recognizing this, the lagged nominal interest rate in the equation was assigned the average value of the current interest rate and the interest rate in the previous quarter, i.e., $(IR+IR_{t-1})/2$. Thus, the equation (3.16) is modified to read:

$$(3.16.1) \qquad Y_t = e_{51}X_{1,t} + e_{52}X_{2,t} + e_{53}X_{3,t}$$

where $Y_t=IR_t-(IR_t+IR_{t-1})/2$, $X_{1,t}=(IR^*_t+rp_t+\pi^e_t-(IR_t+IR_{t-1})/2)$, $X_{2,t}=\log(Ms_t)-\log(Ms_{t-1})$, and $X_{3,t}$ is the dummy variable. The inclusion of a dummy variable in equation (3.16.1) is to account for government regulations on nominal interest rates in some periods.

Equation (3.19), the mark-up factor, was also modified. In order to improve estimation results, a constant term was added to the logarithmic form of this equation. The inclusion of this term, clearly, did not conflict with theoretical underpinnings. The actual regression equation in logarithmic form is given by:

$$(3.19.1) \qquad Y_t = f_{31} + f_{32}X_{1,t} + f_{33}X_{2,t}$$

where $Y_t = \log(qf_t)$, $X_{1,t} = \log(P^e_t)$, and $X_{2,t} = ((yyd - yys)/yys)_t$.

It should be noted that, in this CGE model, demand for and supply of real money balances are assumed to be equal in every period. Such an equilibrium condition is also postulated in regard to the demand for and supply of real bonds. After these two equilibrium conditions are imposed, to avoid over-determination of the model, only one equation in each demand-supply pair can be used in computing the equilibrium solution. Since supply of money and supply of bonds are observable, we choose the supply equations for the purpose of modal validation. For the sake of completeness, we present below the estimated demand equations for money and for bonds. Although none of these demand equations were used in model validation, they did replace the supply equations in policy simulation experiments during periods for which a fully balanced budget was assumed. The zero deficit condition was then completed with the assumption that the Central Bank followed a sterilization policy which would fully neutralize any effect of the balance of payments. Under such circumstances, the quantity of money and the quantity of bonds were determined by the demand side. In other words, during such periods the monetary authority was assumed to supply money and bonds in exact quantities demanded by the private sector. The parameters in the demand equations for money and for bonds were re-estimated for simulation experiments by using data relevant only for those periods.

Estimation Results

The estimation results are presented and commented upon below. The sample size is of 48 observations, starting with the first quarter of 1978 and ending with the last quarter of 1989. The disturbances u_{ti} for equation i in period t are not shown explicitly. They are present and are assumed to be additive and nid $(0,\sigma^2_i)$.[25] A hat is placed to denote an

[25] It may be pointed out that the nonlinear least squares method is a distribution-free method of estimation though for inferential purposes normality is required. Under the assumption of normally distributed disturbances, the NLS estimator yields the same estimates as the maximum likelihood estimates.

estimated coefficient. The figures given in parentheses are t-ratios. The signs of *, **, and *** following t-ratios indicate significance of estimates at the levels of 0.01, 0.05, and 0.10 respectively.

Supply of tradables (equation 3.1)

$$yts = \left[\frac{pt}{a_{11} * a_{12} * (wr ** a_{13}) * (pz ** a_{14}) * (kt ** a_{15}) * (1 + a_{16} * ir)}\right] ** [1/(a_{11}-1)]$$

This equation was estimated by NLS method. The homogeneity property of variable costs, $a_{13}+a_{14}=1$, was imposed and a_{16} was replaced by a value of 0.1. Initial values of 1.0001, 0.5, 0.6, -0.8 were given to the parameters a_{11}, a_{12}, a_{13}, and a_{15}. The estimates after 100 iterations were:

$\hat{a}_{11} = 2.7697$ (63.951)* $\quad\quad$ $\hat{a}_{12} = 0.74127*10^{-5}$ (5.3899)*

$\hat{a}_{13} = 0.46601$ (9.3397)* $\quad\quad$ $\hat{a}_{14} = 1 - \hat{a}_{13} = 0.53399$

$\hat{a}_{15} = -1.0727$ (-32.843)* $\quad\quad$ $\hat{a}_{16} = 0.1$ (assumed)

The estimates satisfy all theoretical properties stated in Chapter 2. The short-run case of decreasing returns to scale is verified by $\hat{a}_{11} > 1$ while the output elasticities with respect to productive factors and the elasticity of substitution between variable factors can be derived from estimates of $\hat{a}_{13}$, $\hat{a}_{14}$ and $\hat{a}_{15}$ (see Appendix 1).

Supply of nontradables (equation 3.2)

$$yns = yns_{t-1}*[(ynd_{t-1}/yns_{t-1})**a_{21}]$$

$\hat{a}_{21} = 0.99511 \quad (6.8698)* \qquad R^2$ (adjusted) $= 0.5862$

Nominal variable cost of the nontradables sector

(equation 3.3)

$$VCN = (1+a_{31}*IR)*(WR*L/yns+PZ*znd/yns+KN/yns)$$

$\hat{a}_{31} = 0.1$ (assumed)

Demand for imported inputs by the nontradables sector

(equation 3.4)

$$znd = a_{41}*yns$$

$\hat{a}_{41} = 0.026$ According to the input-out ratio.

(See Appendix 3)

Private expenditures (equation 3.5)

$$ypd = (yd**b_{31})*(md**b_{32})*exp(b_{33}*ir)$$

$\hat{b}_{31} = 0.84787 \quad (30.508)* \qquad \hat{b}_{32} = 0.16688 \quad (5.4913)*$

$\hat{b}_{33} = -0.1730*10^{-2} \quad (-1.3125) \qquad R^2$ (adjusted) $=0.8121$

The signs of all estimates are consistent with theory but $\hat{b}_{33}$ is significant only at the 0.20 level.

Demand for tradables and nontradables (equations 3.6 and 3.7)

$$ytd = \frac{(pt/yyd)^{-1} * [b_1 + b_{11} * \log(pt/yyd) + b_{12} * \log(pn/yyd)]}{-1 + (b_{11}+b_{21}) * \log(pt/yyd) + (b_{12}+b_{22}) * \log(pn/yyd)}$$

$$ynd = \frac{(pn/yyd)^{-1} * [b_2 + b_{21} * \log(pt/yyd) + b_{22} * \log(pn/yyd)]}{-1 + (b_{11}+b_{21}) * \log(pt/yyd) + (b_{12}+b_{22}) * \log(pn/yyd)}$$

These equations were estimated by NLS method. The selected initial values for b_1, b_{11}, b_{12}, b_{21} were 0.5, -0.8, 0.6, and 0.6 respectively. Linear restrictions of $b_1+b_2=-1$ and $b_{11}+b_{12}+b_{21}+b_{22}=0$ were imposed whereas the property of symmetry, $b_{12}=b_{21}$, was not imposed in the estimation on account of the aggregate nature (market demand functions) of these relations - see Chapter 2 for explanations. The estimates, after 19 iterations, converged to the following set of estimates:

$\hat{b}_1 = 2.9540$ (4.0944)* $\hat{b}_2 = -1 - \hat{b}_1 = -3.9540$

$\hat{b}_{11} = -0.33623$ (-5.2713)* $\hat{b}_{12} = 0.52124$ (7.0740)*

$\hat{b}_{21} = -0.08771$ (-1.7097)***

$\hat{b}_{22} = -\hat{b}_{11} - \hat{b}_{12} - \hat{b}_{21} = -0.0973$

The estimates are consistent with demand theory.

Reported Capital flows (equation 3.8.1)

$$kar_t = c_{11} + c_{12}X_t + c_{13}X_{t-1} + c_{14}X^2_t + c_{15}X^2_{t-1} + c_{16}X^3_t + c_{17}X^3_{t-1} + c_{18}dum$$

where $X_t = (IR-IR^*-rp-\pi^e)_t$ and dum denotes the dummy variable. Estimates of c_{14} and c_{16} were insignificant and the sign of $\hat{c}_{12}$ was incorrect in the first estimation. After dropping the insignificant arguments, we obtained the following results from re-estimation,

$\hat{c}_{11} = 0.54562*10^6$ (5.0247)* $\hat{c}_{12} = 0.36561*10^6$ (4.8710)*

$\hat{c}_{13} = -0.91640*10^6$ (-2.3279)** $\hat{c}_{15} = -0.14761*10^7$ (-6.9005)*

$\hat{c}_{17} = -0.25326*10^6$ (-8.5334)* $\hat{c}_{18} = 8509.6$ (6.3108)*

R^2 (adjusted) = 0.8322

Risk premium (equation 3.9)

$$rp = c_{31}*(ER*DE)/(P*yys)$$

$\hat{c}_{31} = 1.0$ (assumed)

Nominal exchange rate (equation 3.10)

$$(ER_t/ER_{t-1}) = (P_t/P_{t-1})**c_{41}$$

$\hat{c}_{41} = 1.040$ (20.690)* R^2 (adjusted) = 0.8223

Nominal money supply (equation 3.12)

$$Ms = e_{11}*Ms_{t-1}+e_{12}*BP+e_{13}*(df*P)$$

$\hat{e}_{11} = 1.3957$ (13.584)* $\hat{e}_{12} = 1.1557$ (7.8454)*

$\hat{e}_{13} = 0.90889$ (1.3184) R^2 (adjusted) = 0.7876

The estimate $\hat{e}_{13}$ is significant at the 0.20 level.

Demand for real money balances (equation 3.13)

$$md = (ww_{t-1}**e_{21})*(yys**e_{22})*exp(e_{23}*IR)$$

$\hat{e}_{21}$ = 0.024589 (3.5108)* $\hat{e}_{22}$ = 0.88290 (106.80)*

$\hat{e}_{23}$ = -0.014405 (-0.67542) R^2 (adjusted) = 0.3058

Supply of nominal bonds (equation 3.14)

$$Bs = e_{31}*Bs_{t-1}+e_{32}*(df*P)$$

$\hat{e}_{31}$ = 1.0217 (80.886)* R^2 (adjusted) = 0.9648

$\hat{e}_{32} = 1-(\hat{e}_{13}/\alpha) = 1-(0.90889/1.1557) = 0.21356$

where α (i.e., $\hat{e}_{12}$) is the money multiplier of M2, which was equal to 1.1557, on average, during this period - see also the specification of nominal money supply and nominal bonds supply equations in Chapter 2.

Demand for real bonds (equation 3.15)

$$bd = (ww_{t-1}**e_{41})*(yys**e_{42})*exp(e_{43}*IR)$$

$\hat{e}_{41}$ = 0.42292 (3.0560)* $\hat{e}_{42}$ = 0.60977 (3.7505)*

$\hat{e}_{43}$ = 1.1425 (1.9116)*** R^2 (adjusted) = 0.1987

Nominal interest rate (equation 3.16.1)

$$Y_t = e_{51}X_{1,t} + e_{52}X_{2,t} + e_{53}X_{3,t}$$

where $Y_t = IR_t - (IR_t + IR_{t-1})/2$, $X_{1,t} = (IR^*_t + rp_t + \pi^e_t - (IR_t + IR_{t-1})/2)$, $X_{2,t} = \log(Ms_t) - \log(Ms_{t-1})$, and $X_{3,t}$ denotes the dummy variable.

$\hat{e}_{51} = 0.40804$ (7.5219)* $\hat{e}_{52} = -2.4869$ (-7.2904)*

$\hat{e}_{53} = 0.43749$ (4.7461)* R^2 (adjusted) = 0.5611

General price level (equation 3.17)

$$P = (PT^{**}f_{11})*(PN^{**}(1-f_{11}))$$

$\hat{f}_{11} = 0.42$ (computed) see Appendix 3

Price of tradables (equation 3.18)

$$PT = (f_{21}*PT^* + (1-f_{21})*PZ^*)*ER*(1+(trz-trx))$$

$\hat{f}_{21} = 0.63005$ (9.4839)* R^2 (adjusted) = 0.2373

Mark-up factor (equation 3.19.1)

$$Y_t = f_{31} + f_{32}X_{1,t} + f_{33}X_{2,t}$$

where $Y_t = \log(qf_t)$, $X_{1,t} = \log(P^e t)$, $X_{2,t} = [(yyd-yys)/yys]_t$.

$\hat{f}_{31} = 0.43467$ (21.868)* $\hat{f}_{32} = 0.0043433$ (1.8853)***

$\hat{f}_{33} = 0.70945$ (3.8974)* R^2 (adjusted) = 0.2125

Expected inflation rate (equation 3.20)

$$ri^e = f_{41}*\pi e$$

$$\hat{f}_{41} = 0.97291 \quad (19.196)* \quad R^2 \text{ (adjusted)} = 0.8667$$

Expected devaluation rate (equation 3.21)

$$\pi^e = f_{51}*(\log Ms - \log Ms_{t-1}) + f_{52}*(ri_{t-1} - ri^e_{t-1})$$

$$\hat{f}_{51} = 2.4062 \quad (6.9497)*$$

$$\hat{f}_{52} = 0.04153 \quad (0.33076) \quad R^2 \text{ (adjusted)} = 0.4487$$

Nominal wage rate (equation 3.22)

$$WR = (P^e**f_{61})*\exp[f_{62}*((yyd-yys)/yys)]$$

$$\hat{f}_{61} = 0.99304 \quad (191.48)*$$

$$\hat{f}_{62} = 1.0026 \quad (0.92158) \quad R^2 \text{ (adjusted)} = 0.9970$$

Some Interpretations

A few important points which are implied by the estimated structure of the model are interpreted and summarized below.

1. It was revealed by $\hat{e}_{33}$ that the effect of real interest rate on private expenditure was weak in the period between 1978 and 1989 since $\hat{b}_{33}$ was significant only at the 20% level. This result is not surprising. It corroborates with frequent

arguments given by researchers that in a high inflationary and unstable economy, the interest rates play a minor role in the intertemporal allocation of expenditures.

2. The estimated structure predicted that, on average, about 78% of the budget deficit during this period was financed by money creation (seigniorage) as revealed by ($\hat{e}_{12}$ /1.1557)=0.78=78%, while 22% of the deficit was financed by government bonds as revealed by $\hat{e}_{32}$. It seems very high that 78% of the deficit was, on average, financed by seigniorage during the period between 1978 and 1989. However, it is very interesting to note that "In a few high inflation countries, the revenue from money creation is more important. As an extreme example, for Argentina over 1960-1975, money creation accounted for nearly half of government revenues ..." Barro, (1990), p.189. As discussed earlier in Chapter 1, a large budget deficit which was financed mainly by money creation was one of the important causes of high inflation.

3. The estimates of f_{51} and f_{52} in the equation for the expected devaluation rate showed that expectations concerning the devaluation rate were directly and significantly related to nominal money supply in this period, while the relation to $(ri-ri^e)_{t-1}$, though positive, was not significant. The balance of payments, the balance of trade, and interest rate differentials were also introduced into this equation and the

equation was re-estimated, but none of them was significant. However, we have still retained $(ri-ri^e)_{t-1}$ (not the others) in the equation because this lagged term assists in explaining the dynamics of expectations - see also equation (3.20). In addition, this term improves the simulation results. An important implication which emerges from the relationship between money supply and expected devaluation rate is this: when a large budget deficit exists and needs to be financed by money creation, the expectations of the economic agents can hardly be managed by the government. The transmission chain $Ms \rightarrow \pi^e \rightarrow ri^e \rightarrow P^e \rightarrow WR \rightarrow VCN \rightarrow PN \rightarrow P$ goes into operation and leads to inflation.

4. A full wage indexation with respect to expected inflation during this period was revealed by the estimate of f_{61} in equation (3.22) of 0.99304 which is not significantly different from 1.0. With full indexation, interaction between wages and prices through the chains $P \rightarrow P^e \rightarrow WR$ and $WR \rightarrow VCN \rightarrow PN \rightarrow P$ would produce an inertial effect on inflation. This estimate also implies that inflation and expectations only could explain the wage determination process since excess aggregate demand was not a significant variable in wage determination for this period.

5. The estimated value of c_{41} in equation (3.8) was, on average, 1.04 during this period. Given this value, as we

discussed in Chapter 2, the effect of any exogenous shocks to either price or exchange rate would be magnified through the price-exchange rate spiral and would lead to high inflation. This problem is discussed further in the next section.

3.4 Price-Exchange Rate Spiral

Two issues are addressed in this section, namely, the interaction between price and exchange rate in the inflationary process and the determination of the parameter c_{41} in equation (3.10). We reproduce the relevant equations of the model below to facilitate discussion of the issues involved.

(3.23) $ER/ER_{t-1} = (P/P_{t-1})**c_{41}$

(3.24) $P = (PT**f_{11})*(PN**(1-f_{11}))$

(3.25) $PT = (f_{21}*PT^{*}+(1-f_{21})*PZ^{*})*ER*(1+(trz-trx))$

(3.26) $PN = qf*VCN$

(3.27) $PZ = PZ^{*}*ER*(1+trz)$

(3.28) $VCN = (1+a_{31}*IR)*(WR*L/yns+PZ*znd/yns+KN/yns)$

First, we assume, for convenience, that foreign prices, PT^* and PZ^*, are both equal to one, and that no borrowed working capital is involved in the nominal variable cost equation of the nontradables sector so that the term a_{31}*IR can be eliminated from equation (3.28). Further, we set m=L/yns (labour-output ratio), n=znd/yns (input-output ratio for imported inputs) and k=KN/yns (capital-output ratio) in the nontradables sector, and obtain thereby the following simplified equations:

(3.29) PT = ER*(1+trz-trx)

(3.30) PN = qf*VCN = qf*(WR*m+PZ*n+k)

(3.31) PZ = ER*(1+trz)

Substituting (3.31) into (3.30), we obtain

(3.32) PN = ER*qf*[n*(1+trz)]+qf*(WR*m+k)

Consider equation (3.29) first. It is obvious from this equation that an absolute change (for example, an increase) in the exchange rate, ΔER, leads to a change in the price of tradables, ΔPT, and that $\Delta PT > \Delta ER$ if trz > trx, i.e., if the import tax rate is higher than the export tax rate. However, given equation (3.29), a percentage change in ER leads to the same percentage change in PT regardless of the values of trz and trx. Therefore, if there is a percentage shock to ER, then PT will reflect the same percentage change.

Special attention should be given to equation (3.32). We find, from equation (3.32), that a change in ER also affects the price of nontradables, PN, through imported inputs. More specifically, $\Delta PN=[qf*n*(1+trz)]*\Delta ER$, i.e., the effect of changes in ER on PN depends on the mark-up factor qf, the input-output ratio for imported inputs n, and the import tax rate trz. Since all these variables are positive, it should be concluded that an increase in ER leads to an increase in PN, and, quantitatively, $\Delta PN > \Delta ER$ if $[qf*n*(1+trz)] > 1$. Given this positive relationship between PN and ER, we can meaningfully discuss the relationship of percentage changes between these two variables assuming that the effect of other factors on PN is constant in the short run. First, since PN and ER are positively related, percentage changes in these two variables are also positively related. Second, unlike the relationship of percentage changes between PT and ER discussed above, percentage changes in PN and ER need not be equal or even proportional because PN is determined differently from PT. With these considerations in mind, we postulate a standard linear relationship (which satisfies the above two conditions) between percentage changes in PN and ER and write

(3.33) $\Delta PN_t/PN_{t-1} = h_0+h_1*(\Delta ER_t/ER_{t-1})$ $h_1 > 0$

where $\Delta PN_t=PN_t-PN_{t-1}$, $\Delta ER_t=ER_t-ER_{t-1}$ and $h_0=0$ if $\Delta ER_t=0$.[26] If the percentage changes in PN and ER are equal, then $h_0=0$, $h_1=1$; if they are proportional, then $h_0=0$, $h_1>0$.

Set $\Delta PN_t/PN_{t-1} = \Delta ER_t/ER_{t-1} = cv$, and call cv the "critical value" of inflationary process, we obtain $cv=h_0/(1-h_1)$. The interpretation of this critical value is clear: given h_0 and h_1, a percentage change in ER will lead to the same percentage change in PN if and only if the percentage change in ER is exactly equal to $cv=h_0/(1-h_1)$. If the percentage change in ER is smaller (greater) than cv, then the associated percentage change in PN will be greater (smaller) than the initial percentage change in ER. This result can be seen more clearly if we use some numerical values. Given equation (3.33), the OLS estimates of parameters h_0 and h_1 based on the quarterly data covering the period 1978-1989 are:

$\hat{h}_0 = 0.23954$ (2.0321)**

$\hat{h}_1 = 0.49689$ (5.7032)* R^2 (adjusted) = 0.4067

With these estimates of h_0 and h_1, the critical value, cv, can be calculated as: cv = 0.23954/(1-0.49689) = 0.4761 = 47.61%.

[26] Equation (3.33) describes the relationship of percentage changes in PN and ER. Hence, if $\Delta ER=0$, this relationship does not exist, so h_0 is zero. This linear relationship can be mathematically approximated - see Appendix 5.

Suppose that the initial percentage change in ER is 50%, then the associated percentage change in PN will be: 0.23954+0.49689*50%=48.79% < 50%. On the other hand, if the initial percentage change in ER is 40%, then the associated percentage change in PN is 0.23954+0.49689*40%=43.83% > 40%.[27]

It is important to note that in the theoretical analysis, the values or the ranges of h_0 and h_1 are not the most important issues since numerical values of these two parameters vary as functions of the factors that determine them. More important issues in the analysis are, instead, the linear relationship between the percentage changes in ER and PN, which is characterized by h_0 and h_1, and the role played by the critical value, cv, in the inflationary process. No matter what the numerical value of cv is, a percentage change in PN will be greater than a percentage change in ER as long as the latter is smaller than cv. In other words, PN, unlike PT, will not absorb the effect of the given percentage change in ER; it may magnify this effect under certain conditions and, together with PT, lead to an acceleration of the general price level through equation (3.24).

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[27] It should be noted that we use these estimates here only for the purpose of showing a numerical example. Values of these estimates should not be viewed very important since equation (3.33) was estimated under a strong assumption that the effects of other factors on PN were constant in the short run.

In summary, a given initial percentage increase in ER generates the same percentage increase in PT and, perhaps, a larger percentage increase in PN if the critical value is larger than the percentage increase in ER. The percentage increases in PN and PT will together result in a larger percentage increase in general prices than the percentage increase in ER. If, at the same time, the parameter c_{41} in equation (3.23) is greater than unity, (other things being unchanged), an expansionary process is initiated and the inflation rate will accelerate continuously through both the forward effect, P → ER, and the feedback effect, ER → P, until the percentage change in ER hits the critical value.

This price-exchange rate spiral also explains oscillations of domestic relative prices. If the percentage increase in ER is greater than the critical value, then PT will increase faster than PN; if the percentage increase in ER is smaller than the critical value, PN will increase faster than PT. It is clear that since the percentage change in ER actually varies over time and so does the critical value, hence, relative prices also oscillate accordingly.[28] The oscillation of relative prices may produce another shock to the economy and fuel the inflationary process.

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[28] The author hopes to be able to address these issues in a separate research project.

We now address the second issue, namely, the determination of the parameter c_{41}. The OLS estimate of this parameter is 1.04 for the period between 1978 and 1989 in Argentina. Since the estimate of c_{41} is greater than unity, it produces an expansionary effect from percentage change in P to percentage change in ER. In other words, a given inflation rate will result in a larger devaluation rate (i.e., a larger percentage increase in ER).

From a statistical point of view, c_{41} is a parameter which can be estimated using the time series data on P and ER. However, as an exercise, we may calculate this parameter for each quarter, instead of estimating it for the entire period, to examine how it varies over time. If it varies largely from time to time and its variation is consistent with the movement of some key economic variables, then we should not simply view it as a fixed parameter in the general sense; instead, it may be better to consider the parameter c_{41} as a function of some other economic variables. Figure 1 shows the variations of c_{41} in comparison with the actual inflation rate and the actual devaluation rate from 1978 to 1989. All three are computed from the data sources described earlier.[29]

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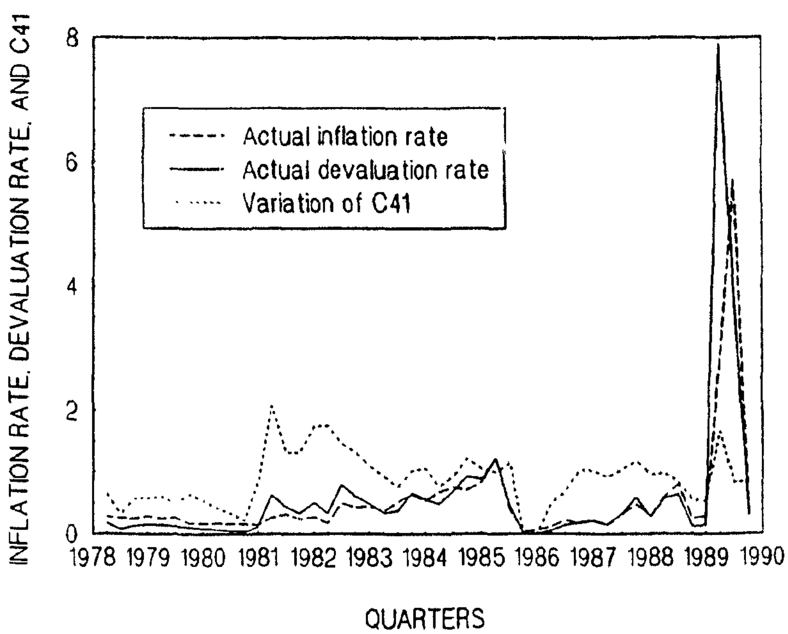
[29] The parameter c_{41} for any time period t was computed in the following way,

$$c_{41} = [\log(ER)/\log(ER_{t-1})]/[\log(P)/\log(P_{t-1})]$$

while the inflation rate and the devaluation rate were computed according to general definitions respectively.

Figure 1 INFLATION RATE, DEVALUATION RATE, AND C41



The parameter c_{41} was greater than one for more than half of the total quarterly observations between 1978 and 1989 and fluctuated in the range from zero to 2.06. Comparing the variations of c_{41} with actual inflation rates, we may conclude that c_{41} was leading the inflation rate between 1978 and 1988. In other words, c_{41} increased first, then the inflation rate followed. This is because both the upward and downward movements of the inflation rate were on the right side, for most periods, of similar movements of c_{41}. Thus, a first tentative conclusion suggests itself, namely, that control of inflation requires monitoring as well as reducing the size of the parameter c_{41}. It can be also seen from Figure 1 that the variation of c_{41} was basically consistent with the movement of the devaluation rate for most quarters except for the four quarters of 1989.

It is natural to raise the question as to the identity of the factors which determine the value of c_{41}. However, there is no easy answer. In an attempt to answering this question, we regressed the time series of c_{41} on the expected devaluation rate, the growth rate of the nominal money supply, the percentage change in the balance of payments (or the percentage change in the balance of trade, as an alternative), nominal interest rates, and other variables. The result showed that the expected devaluation rate and the growth rate of nominal money supply were significant.

Therefore, it is safe to say that, to a certain extent, expectations and the money supply are able to explain the variability in this parameter.

Chapter 4

POLICY SIMULATIONS

4.1 Introduction

This chapter reports and discusses the results of model validation and policy simulation experiments. Simulation consists in solving a set of differential or difference equations which compose a model. The model, which is specified in Chapter 2, contains lagged endogenous variables which imply the presence of difference equations and describe the dynamic structure of the Argentine economy.

Simulation with a model can be either static or dynamic. In static simulation, the actual lagged values are assigned to the corresponding lagged endogenous variables in the model whereas in dynamic simulation the simulated values in the last period are assigned to the corresponding lagged endogenous variables in computing the current values of the endogenous variables. In other words, for a lagged variable $Y_{i,t-1}$ in the model, $Y_{i,t-1}=Y^a_{i,t-1}$ is used in the static simulation whereas $Y_{i,t-1}=Y^s_{i,t-1}$ is used in the dynamic simulation, where $Y^a_{i,t-1}$ is the actual Y_i in the period t-1 and $Y^s_{i,t-1}$ is the simulated Y_i in the period t-1. Therefore, the dynamic simulation requires only the initial values of all endogenous variables while static simulation requires the entire time series data on these endogenous variables. Clearly both static and dynamic simulations require a structure of the model, estimated or conjectured, as well as the time series data on all exogenous variables.

Policy analysis and economic forecasting form the major tasks of model simulations. The general method of policy simulations includes changing values of parameters or assigning some desired values to exogenous policy variables - see, for example, Auerbach and Kotlikoff (1987). By doing so, we are able to examine what might have been the effects of adopting assumed alternative polices. In addition, we can forecast the future economic path in the dynamic simulation if plausible values are assigned to the exogenous variables in the post-sample periods. Based on the results generated from policy simulations and forecasting, we can address economic issues in a coherent manner and prescribe appropriate counter measures to overcome the economic maladies.

In this study, however, policy simulations are conducted in a different way. The actual effects of different stabilization policies, which were implemented in different situations in the past, were already absorbed into the observed time series data, so it is unnecessary to simulate the effects of these policies. However, as discussed in Chapter 1, these stabilization polices did not produce the expected medium-term effects on the economy. These policies failed soon after they were implemented and reasons for their failure were widely debated among economists and policy analysts. This situation has raised an interesting question: what would the Argentine economic performance have been during these periods if the conditions responsible for the failure of stabilization policies had been completely removed? For example, the existence of a large budget deficit was considered as a direct cause of the failure of expectations management policies. Could policies of expectations management have been successful in the long term if there had not been fiscal deficits at the time? In order to answer this question, we may introduce this policy into the model together with the assumption that all deficits were eliminated, and then simulate the policy effects. For this purpose, we are required not only to modify values of some parameters but also to change a part of our model-structure, i.e., change the specification of some equations. By following this procedure, we can assess the effects of different policies in different situations as well as the theoretical arguments made to explain the failure of economic stabilization policies in Argentina. To simulate impacts of the convertibility policy which was introduced in 1991 and is still in place now, we may imagine that the government imposed this policy at some other point of time in history, for instance at the beginning of the third quarter of 1985 when the Austral Plan went into effect. Then we use the simulation results as references to assess this stabilization program. According to the methodology adopted in this study, the policy simulations should be viewed as *counterfactual* experiments.

The objectives of policy simulations in this study are: to evaluate some common arguments and explanations made in regard to the inflationary process and the failures of stabilization programs in Argentina in the past; to answer the question whether there existed some ways to improve economic performance under different stabilization policies during the period between 1978 and 1989; and, finally, to assess the stabilization program which is now in place.

This chapter is divided into five parts. The theoretical model is first validated, and assessed by the usual econometric criteria. Results from this simulation will be reported in Section 4.2. Sections 4.3, 4.4 and 4.5 are devoted to reporting results of policy simulations. In each of these sections, a specific policy simulation package is designed and experimented with. It is important to note that these policy simulations should also be referred as the "prototype simulation" since each package is able to involve a long list of possible experimental variations. Finally, some important implications derived from simulation experiments will be summarized in the last section of this chapter.

4.2 Validation of The Model

In comparison with a single-equation model, the multi-equation model is more complicated to validate and assess. In the case of the single-equation model, there are statistical measures and tests, such as R^2, F test, t test, DW statistic, etc., that can be used to judge the significance of the model as well as the estimates of parameters. However, in a multi-equation model, it is quite possible that each individual equation has a very good statistical fit, but the model as a whole does a poor job in tracking the historical trends in the observed data. It is also possible that some equations have a poor statistical fit but perform well in simulation while some have a good fit but perform poorly. All these problems are generated from the dynamic structure of the model as a whole, which is richer than that of any one of its individual equations.

Various statistical criteria can be used to assess the significance and forecasting ability of multi-equation models. The frequently used criteria in model validation are the MAPE (mean absolute percentage error) and the RMSPE (root-mean-square percentage error). See Klein (1974, p.242) and Pindyck and Rubinfeld (1991, p.338) for more details. These two statistics are defined below:

$$(4.1) \qquad MAPE = 1/T*\sum_{t=1}^{T} (|Y^s_t - Y^a_t|/Y^a_t)$$

and

$$(4.2) \qquad RMSPE = \left(1/T*\sum_{t=1}^{T} [(Y^s_t - Y^a_t)/Y^a_t]^2 \right)^{1/2}$$

where Y^s and Y^a denote the simulated and the actual Y values respectively, and T is the number of simulation periods. MAPE is used to circumvent the problem of positive and negative errors cancelling each other, so that it yields a measure of systematic bias. The greater is the magnitude of MAPE, the larger is the systematic bias. On the other hand, RMSPE is used even more often in practice since it measures the deviation of a simulated variable from its actual time path with respect to the average size of that variable. Clearly, the smaller is the RMSPE, the better is the over-all performance of the model in simulation.

The model validation for the whole period was performed through static simulation. This choice was made after it was established that the values in dynamic simulations exploded sharply due to the value of the estimated parameter c_{41} in the exchange rate equation, which was 1.04, on average, for all 48 quarters (i.e., over the sample period), and the effect of the nontradables price on inflation which was discussed in Chapter 3. The values of MAPE and RMSPE for each variable are presented in Table 1.

In reporting the simulation results, two expressions are used, namely, performance of the model and performance of the variables in simulation, according to the context. These two expressions are used somewhat synonymously in this study. Whenever we use the expression of "performance of variables in simulation", we mean that the performance of the model in simulating these variables within the model structure.

The model did not perform well in simulating the historical time paths of real current account (ca), real capital account (ka), real balance of payments account (bp), and real interest rate (ir). In addition, the performance of the model in regard to the expected devaluation rate (π^e) and the expected inflation rate (ri^e) was less than satisfactory. It can be clearly seen from Table 1 that both MAPE and RMSPE are very high for these variables. Poor performance of these variables was, as mentioned above, rooted in the dynamic structure of the model. Errors, which may be small in each

TABLE 1: MAPE and RMSPE

Variable	MAPE	RMSPE	Variable	MAPE	RMSPE
yts	12.5413	14.8975	Ms	8.4214	11.4831
yns	3.2447	4.2966	bs	17.0642	20.5950
yys	4.7483	5.8533	Bs	8.1553	13.0947
ztd	12.5113	14.8975	ww	1.6456	2.2179
znd	3.2447	4.2966	IR	30.1627	41.7697
VCN	12.6931	17.0266	ir	54.0173	97.0399
ypd	6.3529	7.7032	qf	5.9391	7.2737
yd	4.3813	5.8160	PN	8.0195	10.3280
yyd	6.2767	7.6123	PT	26.0078	33.1480
ytd	14.0920	17.0204	P	12.7811	15.8480
ynd	4.6451	5.6923	PZ	27.6346	31.8442
ca	173.6792	502.5624	ri	54.2937	72.7870
kar	331.7739	973.3319	P^e	13.7858	18.4563
bp	133.2655	180.9359	ri^e	62.8285	127.0430
rp	12.0672	16.5757	π^e	78.9474	119.2333
ER	13.9921	19.6662	pn	10.9819	13.3407
ty	10.6054	13.2541	pt	14.7467	18.3596
tx	26.5261	38.9010	pz	18.0610	21.1323
tz	4.7489	5.8530	WR	13.7436	16.9132
df	7.0796	11.1975	wr	14.2786	17.8748
ms	12.2921	14.5975	xt	26.5255	38.9013
zt	10.6053	13.2541			

Note: In model validation, kau, unreported capital flows, was assumed to be zero, so that ka=kar. Therefore, there are no separate MAPE and RMSPE for kau and ka.

individual equation, might have accumulated in the process of solving for the system. In comparison with these variables, other variables, especially those in the supply, demand, and fiscal sectors, performed better. Figures 2 through 9 show the performance of some important variables, namely, real aggregate supply, inflation rate, real government budget deficit, real balance of payments account, nominal interest rate, real wage rate, and relative prices of tradables and nontradables.

Figure 2 shows the performance of the model in simulating real aggregate supply, yys. The generated time series of real aggregate supply captures the movements of actual data over time and the deviation in relative terms between simulated and actual yys is not large for the whole period. However, the simulated yys, on average, is slightly smaller than the actual yys. As reported in Chapter 3, non-linear least squares did not yield good estimates of the parameters in the yys equation. However, in model validation, this set of estimates generated good simulation results within the model structure.

The simulated inflation rate is shown in Figure 3. In comparison with the actual inflation rate, the simulated inflation rate was much lower in the two hyperinflationary periods, i.e., the second quarter of 1985 and the third

Figure 2 MODEL VALIDATION yys

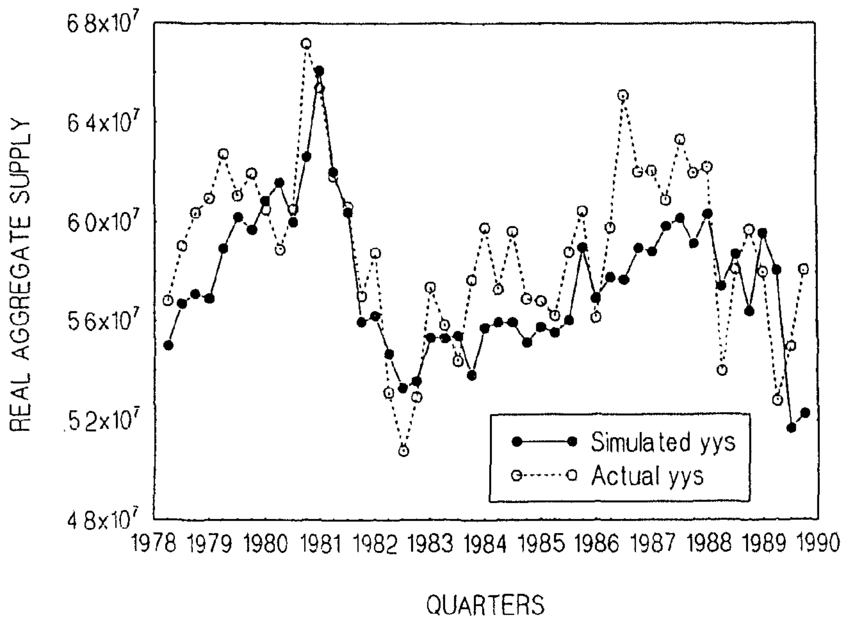


Figure 3 MODEL VALIDATION ri

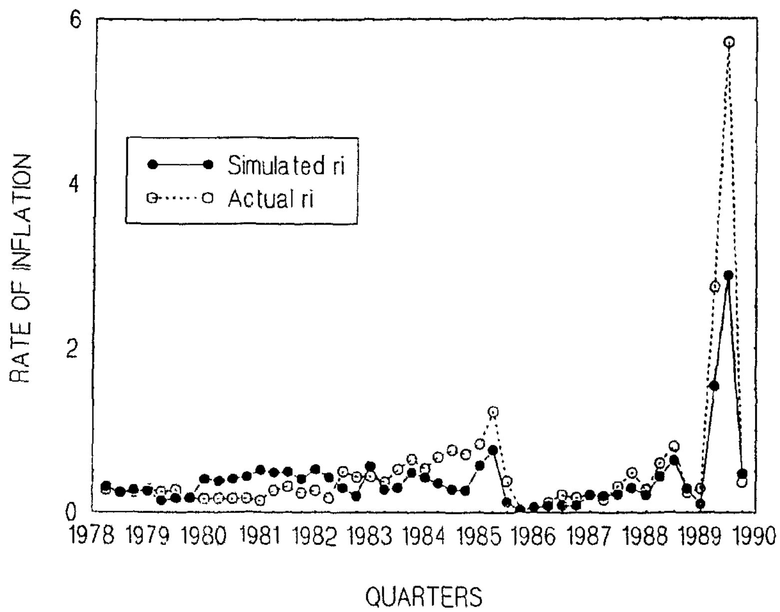


Figure 4 MODEL VALIDATION df

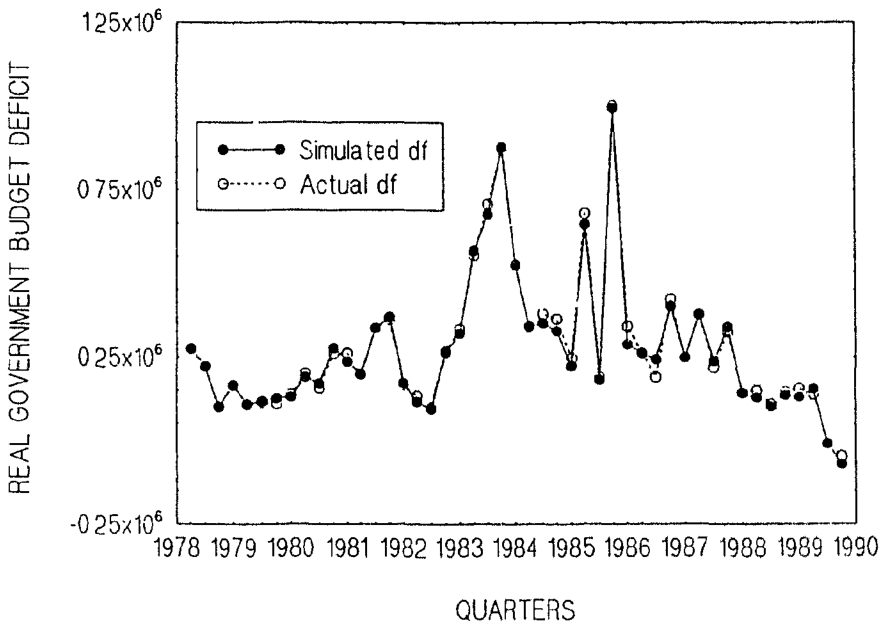


Figure 5 MODEL VALIDATION bp

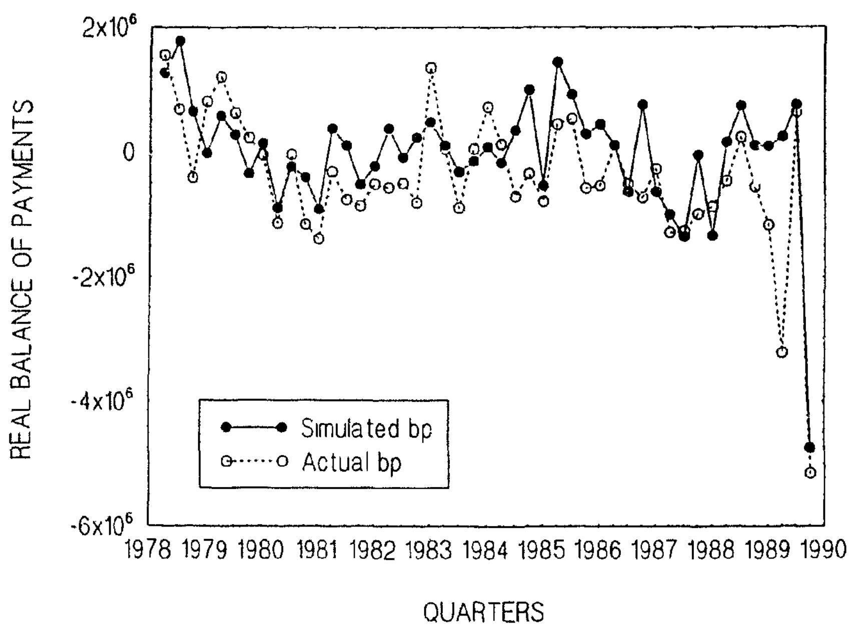


Figure 6 MODEL VALIDATION IR

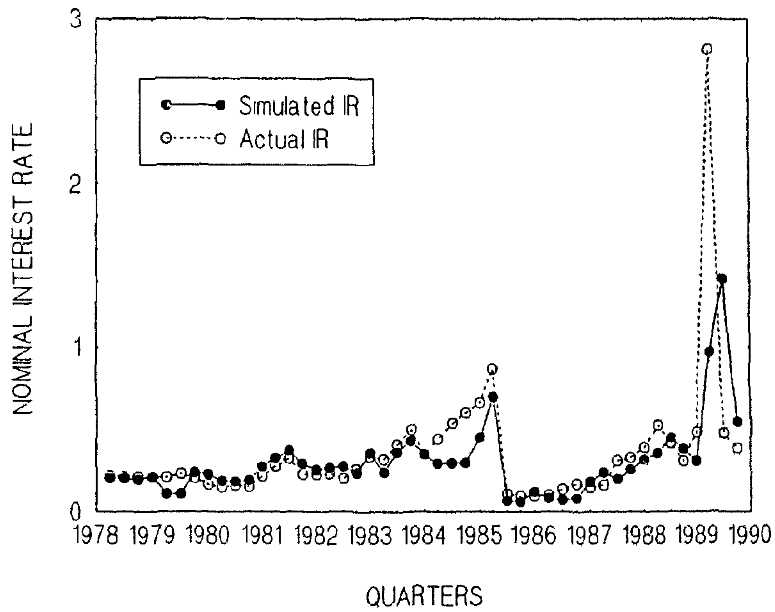


Figure 7. MODEL VALIDATION wr

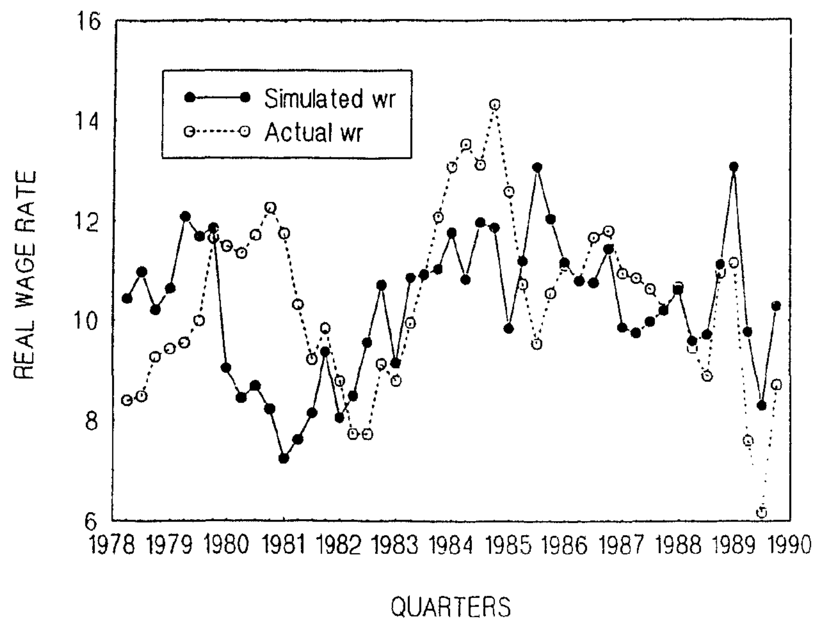


Figure 8 MODEL VALIDATION pn

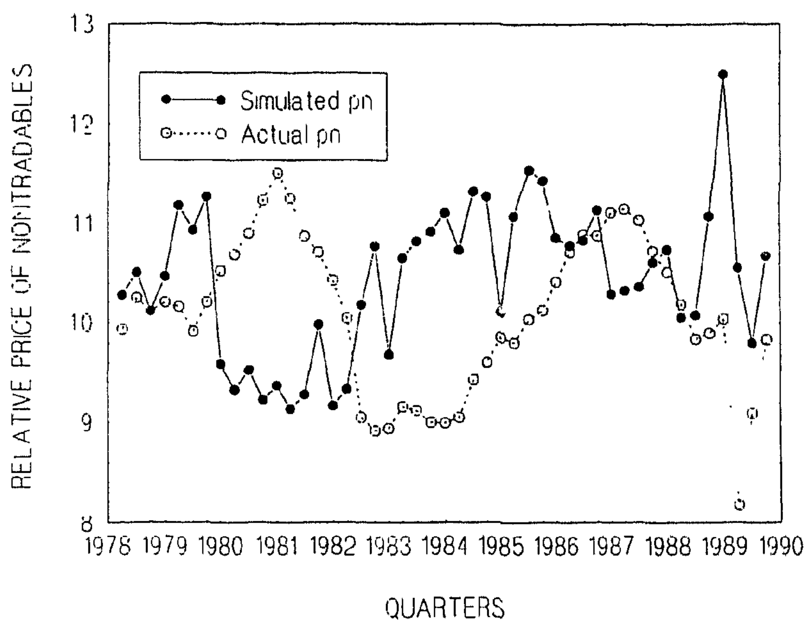
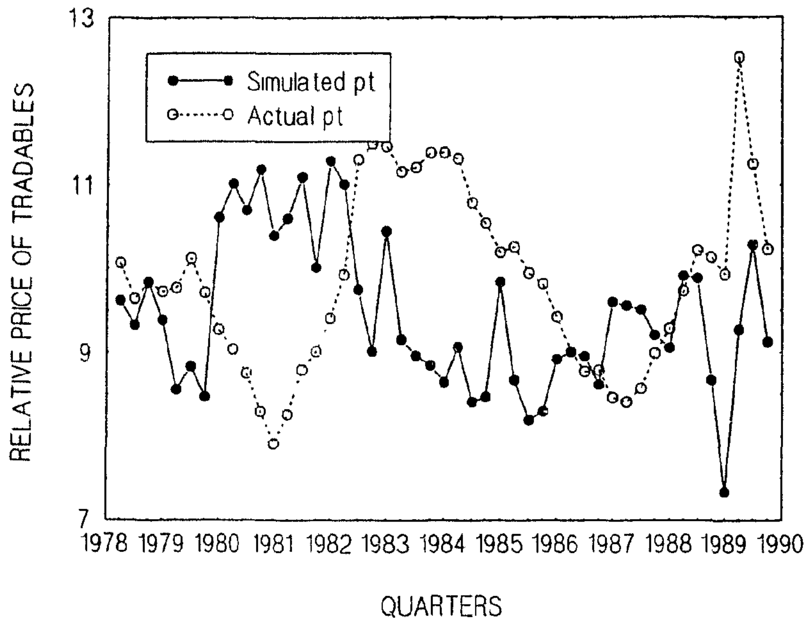


Figure 9 MODEL VALIDATION pt



quarter of 1989. This indicates that there were some sudden and large structural changes in these hyperinflationary periods and the model, to a degree, was unable to capture all these changes, although the basic trend in actual data was still well-tracked.

Figure 4 shows the performance of the real government deficit, df, one of the variables that performed best. The deviation between simulated and actual values of df is very small for the whole period. This fact is reflected by values of 7.0796 for MAPE and 11.1975 for RMSPE. The simulated df and the actual df reach their respective peaks in the third quarter of 1985 and turn negative, i.e., a budget surplus, in the last two quarters of 1989.

Figure 5 exhibits the behaviour of simulated and actual values of real balance of payments, bp. Since both current account and capital account perform badly in model validation, errors from these two accounts are jointly reflected in the balance of payments account, though they partly cancel each other out. Statistics of MAPE and RMSPE are 133.2655 and 180.9359, respectively, for this variable. In most quarters, simulated and actual bp move in the same direction, but in a few quarters, they move in opposite directions.

The performance of the nominal interest rate, IR, is shown in Figure 6. In most periods, simulated and actual nominal interest rates move consistently together, except in two quarters of 1979, the four quarters of 1984 and two quarters in 1989 during which large gaps exist between simulated and actual interest rates. The explanation for this situation is the same as the one given in relation to the inflation rate. The model is relatively limited in its ability to capture sudden and large structural changes.

Figure 7 shows the performance of the real wage rate, wr. The values of MAPE and RMSPE are not large; they are 14.2786 and 17.8748 respectively. Simulated and actual wr move consistently together in most periods, but some exceptions can be noticed from the figure. The average level of the real wage rate during the whole period is well reproduced by the model with the simulated wr fluctuating within a smaller range.

Finally, the performance of relative prices is shown in Figure 8 for nontradables and in Figure 9 for tradables respectively. The values of MAPE and RMSPE are 10.9819 and 13.3407, respectively, for the relative price of nontradables and 14.7467 and 18.3596, respectively, for the relative price of tradables; they are all smaller than 20%. It can be observed that simulated relative prices oscillated more frequently and with relatively larger amplitudes than the actual relative prices during the whole period.

According to the values of MAPE and RMSPE in Table 1, it can be concluded that the model has, in general, tracked the historical paths of key endogenous variables and captured the essential traits of the Argentine economy in this period. We use it now to simulate impacts of various stabilization policies.

4.3 Policy Simulation Experiment 1: An Expectations Management Approach with Budgetary Consistency

The first policy simulation is designed for the period between 1978 and 1982 during which the policies of expectations management were implemented, but these policies, as discussed in Chapter 1, failed to stabilize the economy. The purpose of this experiment is to examine what might have taken place if the polices had been implemented under some assumed circumstances which some economists strongly believed to be necessary for success of the stabilization policy.

Many analysts and policy makers argued that the failure of expectations management was, to a great extent, due to the existence of a sustained large budget deficit which was mainly financed by money creation. For example, see Fernández (1985). When the government had to finance the deficit internally because no external credit was available and also make interest payments on the large foreign debt, it was forced to give up the exchange rate policy which was embodied in the "tablita". On the other hand, the economic agents lost confidence in the stabilization program because of generalized disbelief in the government's ability to maintain the preannounced exchange rate under the circumstances. The situation was followed by a substantial devaluation and then the inflation rate sharply increased. According to this argument, if the budget deficit had been successfully and completely removed at the same time as stabilization policies were put into effect, the economic consequences would have been different and policy success would have been achieved to a large extent.

Based on the above argument, the policy simulation experiment was designed as follows. We assumed that the government successfully and completely removed all of the deficit in the beginning of 1978 and maintained a zero deficit afterwards, so that the government's credibility would be strong enough to ensure that public's expectations would follow the exact pattern desired by the government. Given this assumption, the expected devaluation rate would be the same as the actual devaluation rate preannounced in the "tablita". To implement these changes, the following equations of the model must be modified: 1. Aggregate demand equation (2.8); 2. Exchange rate equation (2.20); 3. Real deficit equation (2.25); Nominal and real money supply equations (2.26 and 2.28); Nominal and real bonds supply equations (2.29 and 2.31); Expected price equation (2.44); Expected inflation rate equation (2.45); and Expected devaluation rate equation (2.46). (See Appendix 2)

Since, by assumption, the government budget was balanced, government expenditure, ged, was equal to tax revenue, so that aggregate demand, yyd, would equal the sum of total private expenditure, ypd, plus government tax revenue, i.e.,

$$(4.1) \qquad yyd = ypd + (ta + ty + tx + tz)$$

Given the preannounced "tablita", the exchange rate became an exogenous variable and was given by

$$(4.2) \qquad ER = ER_{t-1} * (1+\pi^e)$$

where π^e denotes the expected devaluation rate[30] which was equal to the actual preannounced devaluation rate. Since all

[30] The actual devaluation rate was 22% in the first quarter of 1978 according to our statistics. For the purpose of policy simulation, a set of values was assigned to the devaluation rate for the following quarters up to the end of 1982, i.e., 20%, 18%, 16%, 14%, 12%, 10%, 9%, 8%, 7%, 6%, 5%, 4%, 3%, 2.7%, 2.4%, 2%, 1.7%, 1.4%, 1%. These values were assumed to be the preannounced quarterly devaluation rates for this period.

deficits were removed, the deficit equation would disappear from the model. Moreover, without a deficit, both money and bonds supply equations were replaced by demand equations, i.e., the amount of money and the amount of bonds that the government produced were exactly equal to what were demanded by the private sector. The modified equations are given below:

$$(4.3) \quad ms = md = (ww_{t-1}**e_{21})*(yys**e_{22})*\exp(e_{23}*IR)$$

$$(4.4) \quad Ms = md*P$$

$$(4.5) \quad bs = bd = (ww_{t-1}**e_{41})*(yys**e_{42})*\exp(e_{43}*IR)$$

$$(4.6) \quad Bs = bd*P$$

In addition, the expected price level, P^e, was related, in this situation, to the preannounced devaluation rate which was pre-established in the "tablita". So we have

$$(4.7) \quad P^e = P_{t-1}*(1+\pi^e)$$

$$(4.8) \quad ri^e = (P^e - P^e_{t-1})/P^e_{t-1}$$

Finally, the risk premium, rp, was assumed to be reduced by 50% to reflect an increase in confidence among foreign investors since the Argentine government possessed a stronger power to stabilize the economy and manage foreign debt in this postulated situation. The reduction in risk premium was taken into account by decreasing the coefficient c_{31} from 1 to 0.5 in equation (2.19) - see Appendix 2.

Given these postulated structural changes, the policy simulation was performed by the dynamic simulation method. The results generated from this experiment were not satisfactory from an economic policy point of view. The inflation rate was indeed reduced, but the average quarterly rate still remained at a level higher than 10%. The balance of payments situation improved due to a large increase in net exports, although there was no substantial positive change in the capital account. However, the increase in net exports was generated from a substantial reduction in domestic demand for tradables, ytd. It is useful here to recall the specification of demand equations in Chapter 2. First, private expenditure, ypd, is determined by real income, real money balances and real interest rate. Second, aggregate expenditure, yyd, is obtained by adding government expenditure to ypd. Third, yyd is allocated between tradables, ytd, and nontradables, ynd. Therefore, when ged was cut down to eliminate df, i.e., yyd=ypd+ged was replaced by yyd=ypd+(ta+ty+tx+tz), yyd decreased in each period and so did ytd. Moreover, since, in this general equilibrium model, the quantity of net exports is the difference between supply of and demand for tradables, large net exports were generated when demand for tradables decreased substantially. The nominal interest rate fell dramatically and the average quarterly rate settled around the 10% level during the period, which still resulted, on average, in a negative real interest rate. The most serious policy problem in this simulation was that aggregate supply, yys, fell dramatically during the period except for 1982. This implies that a deep recession would occur from 1978 to 1981 under the postulated structural changes and expectations management policies.

Figures 10 to 13 show, respectively, the performances of aggregate supply, balance of payments account, inflation rate, and nominal interest rate in this policy simulation experiment. In each figure, three time series data of the variable are given for purposes of comparison. For yys, for example, the observed yys is referred to as ACTUAL yys, the generated yys from model validation as VALIDATED yys, and finally the generated yys from the policy simulation as POLICY SIMULATED yys. The same distinction is also used when the results from other policy simulations are presented.

It was already discussed in Chapter 1 that, on the whole, government was unable to manage the economic agents' expectations in the presence of a large deficit which needed

Figure 10. POLICY SIMULATION 1 yys

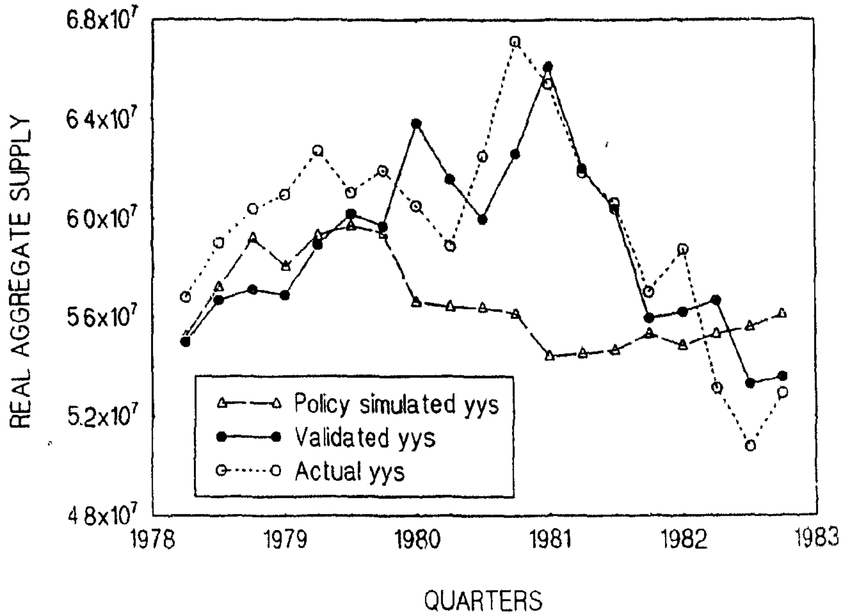


Figure 11 POLICY SIMULATION 1 bp

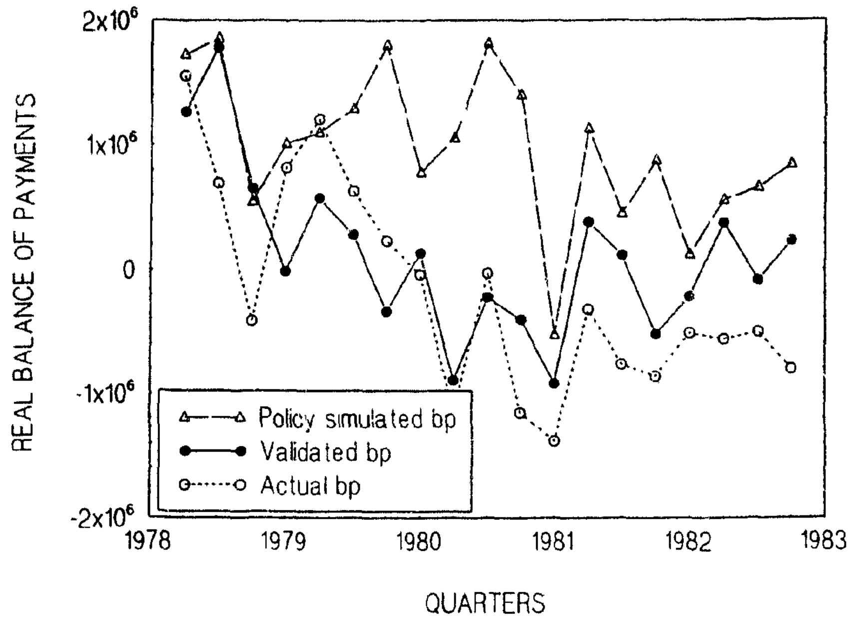


Figure 12. POLICY SIMULATION 1 ri

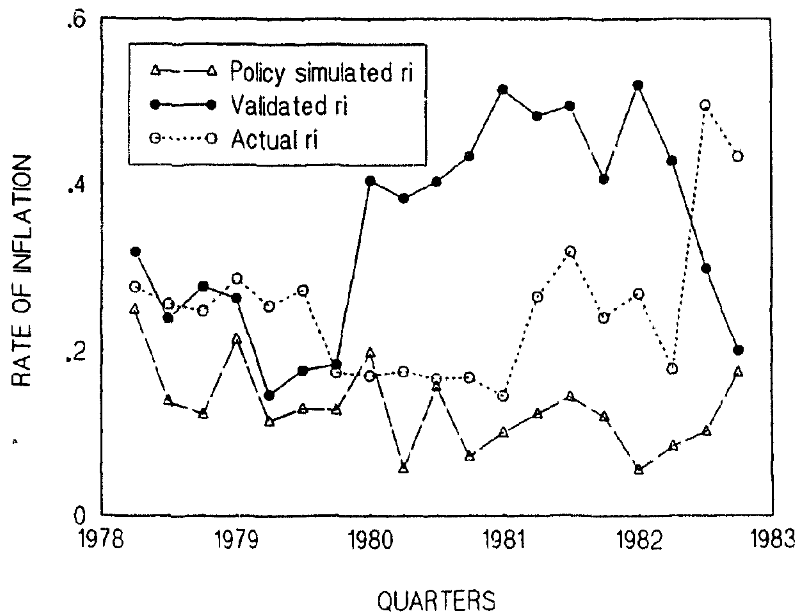
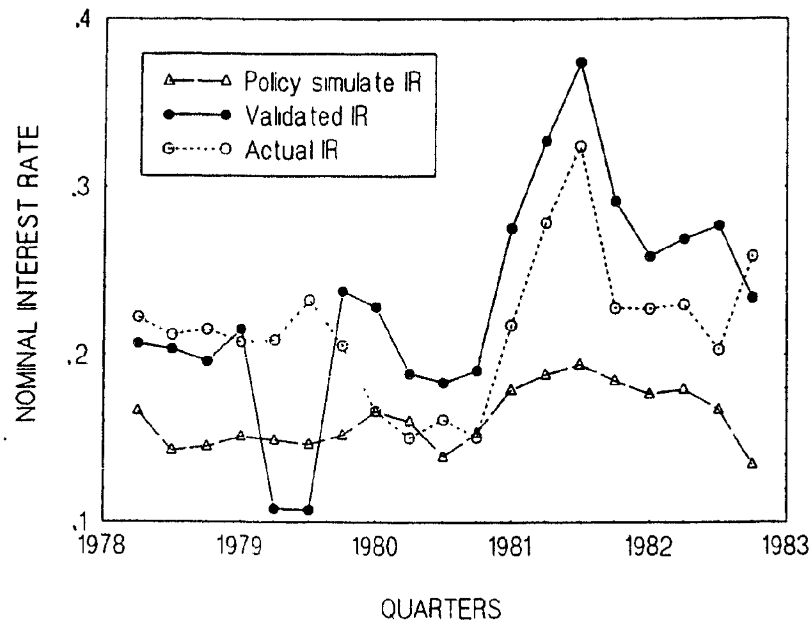


Figure 13 POLICY SIMULATION 1 IR



to be financed by money creation. With reference to the simulated results in this experiment, we may further argue that even if there had been no deficit and expectations had been completely managed by the government, the policies initiated in this period were still unable to stabilize the economy. Removing all deficits by cutting government expenditures was equivalent to adopting a contractionary fiscal policy which indeed reduced the inflation rate but also created a recession. In addition, although the devaluation rate was continuously decreasing (see the footnote on page 114 of this Chapter), the inflation rate still fluctuated and remained, on average, at more than 10%. This result may be taken as evidence for, what was discussed in chapter 3, the effect that decreasing devaluation rate may or may not reduce the inflation rate; the result depends on the relationship between the percentage increase in the exchange rate and the critical value, cv, which is determined by economic conditions prevailing in the nontradables sector.

4.4 Policy Simulation Experiment 2: A Modified Austral Plan with Fiscal Discipline

The second policy simulation is designed for the period between 1985 and 1989 during which the Austral Plan and other stabilization programs were implemented. Economic responses to stabilization programs in this period were mixed. Although many research publications have been devoted to analyzing the successes and failures of these programs, it is not easy to point out a specific factor or factors as being fully responsible for the final failure of the programs. Given this situation, the policy simulation experiment is designed to capture some very general arguments embodied in some of the proposed explanations. To this end, we did maintain the assumption that fiscal deficits were completely removed in this period with the consequences that equations (4.1), (4.3), (4.4), (4.5), and (4.6) were used to replace the corresponding equations in the original model.

In addition to these structural changes, three more policy changes were introduced into the simulation experiment. The first change relates to the exchange rate. The exchange rate was frozen for nine months immediately after the Austral Plan was launched and it was later allowed to float in response to various and diverse pressures, such as demand for higher nominal wages, the needs in relation to fiscal deficit financing, as well as the requirement to improve the balance of trade. In the policy simulation, we assumed that the exchange rate was fixed at a constant level for the entire period from the third quarter of 1985 to 1989. The possibility of freezing the exchange rate was founded upon the assumptions that the budget deficits had been completely removed, the price and wage freeze had been abandoned, and the nominal interest rate had been regulated during the whole period (see explanations below). Once the exchange rate is fixed for the entire period, the expected devaluation rate equation is no longer needed in the model because the expected devaluation rate is zero in this case. Moveover, since the exchange rate is fixed and the expected devaluation rate is zero, the formation of the expected inflation rate needs to be modified. In this situation, the expected inflation rate is assumed to follow an adaptive pattern, i.e.,

(4.9) $ri^e = ri^e_{t-1}+k_1*(ri_{t-1}-ri^e_{t-1})$

where k_1 is the correction parameter which can be estimated by OLS. On the other hand, the expected price level retains the form of $P^e=P_{t-1}(1+ri^e)$, the same as in the original model.

The second modification concerns price and wage. Historically, prices and wages were also frozen during the first nine months of the Austral Plan implementation and the freeze was ended afterwards under the same pressures mentioned in the above paragraph. In the policy simulation, we give up the price and wage freeze for the period. With flexible prices and a frozen exchange rate, the balance of trade would totally depend on the competitiveness of the domestic tradables sector within a world economy. The tradables sector has to compete directly with foreign producers while the nontradables sector has to compete with the tradables sector to the extent that substitution between the two composite goods is allowed within the model. In addition, since prices and wages were flexible, there is no need to be concerned with the problem of higher nominal wage being demanded. Given the assumption of flexible price and wage, it is not necessary to modify the specifications of the price and wage equations in the model.

The third modification relates to the nominal interest rate. In the period 1985-1989, the nominal interest rate was sometimes regulated by the government and sometimes determined in the financial market. In addition, regulated and free nominal interest rates coexisted, for example, in late 1985 and early 1986. In the policy simulation experiment, it was assumed that the nominal interest rate was regulated at the quarterly rate of 10% for the whole period.[31] Exogenizing the nominal interest rate can also be viewed as a condition for freezing the exchange rate.

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[31] The regulated monthly nominal interest rate was around 4.5% for the first nine months after the Austral Plan was initiated - see the Appendix in Canavese and Di Tella (1988), pp.186-187. Given the 4.5% monthly rate, the associated quarterly rate is about 14%. In this simulation experiment, we assumed a 10% quarterly rate which is lower than the actual regulated nominal interest rate.

In addition to these changes, we assumed a decrease in the risk premium by 50% for the period to reflect an increase in foreign investors' confidence.

For the policy simulation, we again used the dynamic simulation method. From the viewpoint of examining economic policies, the results of this simulation experiment are quite good. Figures 14 - 17 show the performance of four important variables during this period. Simulated aggregate supply, yys, moved along an upward trend from 1985 to the second quarter of 1988, and it then fell slightly afterwards although it remained at a higher level than the actual yys and yys generated in the model validation for the rest of 1988 and early 1989. The balance of payments improved due to an improvement in the balance of trade. However, this time the improvement in the balance of trade resulted not only from a reduction in demand - with the assumption of a zero deficit, simulated aggregate demand and demand for tradables were still less than the actual values - but also from an increase in the supply of tradables. Inflation declined substantially at the beginning of the period and then fluctuated in the range between 1.1% to 4.6%, 3.1% on average, for the rest of the period. Real money balances increased quickly in the first two quarters and remained at a steady level afterwards.

Figure 14 POLICY SIMULATION 2 yys

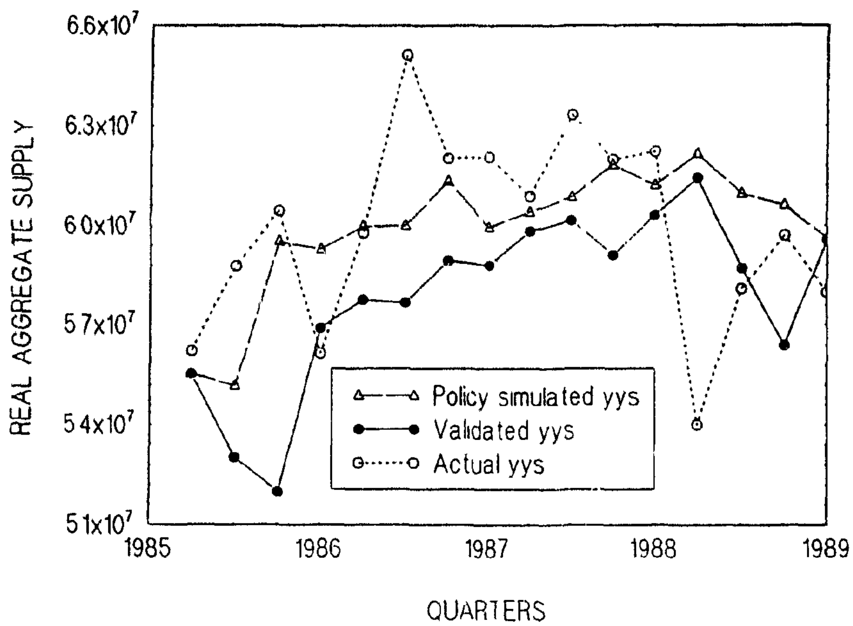


Figure 15. POLICY SIMULATION 2 . bp

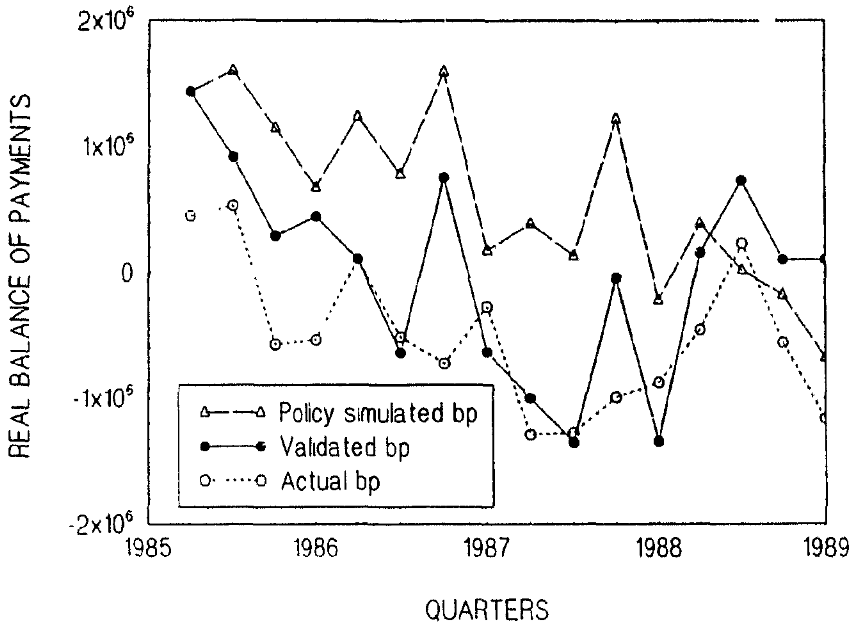


Figure 16. POLICY SIMULATION 2 ri

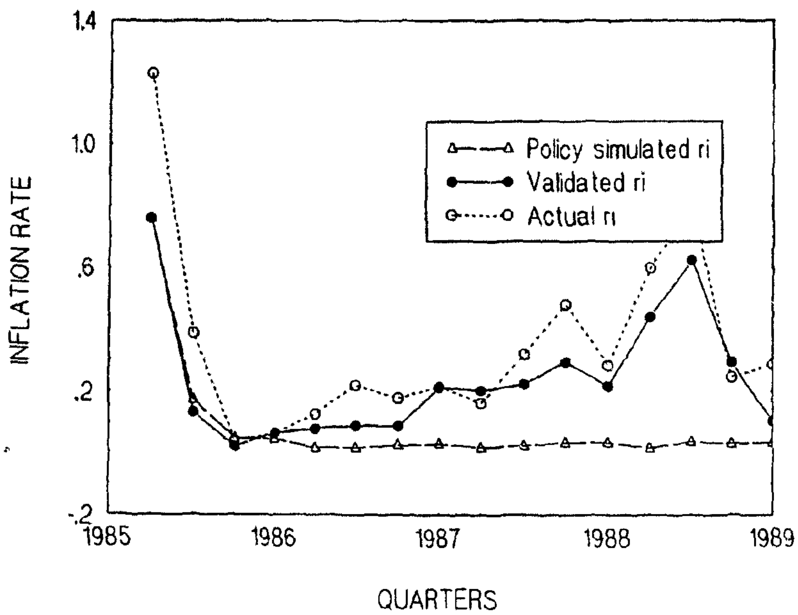
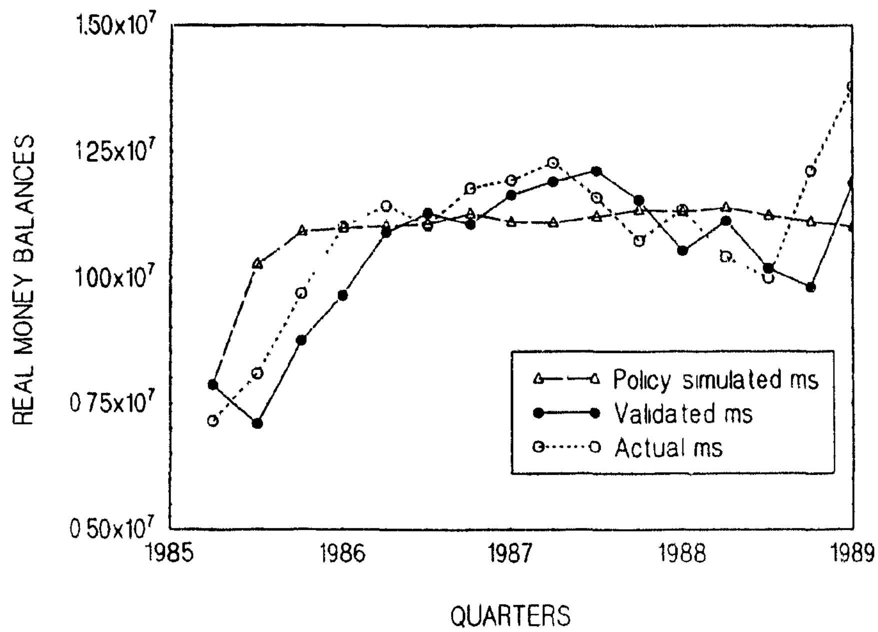


Figure 17 POLICY SIMULATION 2 ms



According to the simulation results, the Argentine economy could have performed better in this period under the condition that all postulated structural changes had really occurred and that a set of different policies had been really implemented. It is very clear, in comparison with other experiments which are not reported here for want of space, that the fixed exchange rate played the most important role in stabilizing the economy. This can be explained as follows: Given a fixed exchange rate, the price-exchange rate spiral is completely removed and the mechanism which involves the nontradables price in generating an accelerating effect on inflation also disappears.

However, one question regarding the policy of fixing the exchange rate in this period needs to be asked. With a fixed exchange rate, was there a real appreciation problem? The answer is yes. The simulated quarterly inflation rate was, on average, around 3.1% which was still much higher than the US inflation rate for the same period. The higher domestic inflation rate led to a real appreciation of the local currency when the nominal exchange rate was fixed and this would eventually cause the balance of trade to deteriorate. In fact, Figure 15 shows a decrease in bp in 1988, caused by the balance of trade deterioration. Aggregate supply also decreased in the same period - see Figure 14.

The above discussion of the simulation suggests that Argentine economic performance could have been improved in the short run, provided that the postulated structural changes had been introduced and that alternative policies had been implemented. However, in the longer run, a real appreciation of the local currency occurs so that the economy comes under great pressure to devalue and the authorities are eventually forced to abandon the fixed exchange rate regime unless the Argentine inflation rate follows *pari passu* the US inflation rate.

4.5 Policy Simulation Experiment 3: An Antedated Convertibility Based Stabilization Program

The third policy simulation is designed to experiment with the current stabilization program based upon the Convertibility Law of 1991 but in a totally different historical context. The available data on economic variables are not adequate for a contemporary analysis since this program was put in place as recently as March 1991. As an alternative, we have chosen to simulate the effects of this program not in terms of actual economic conditions, but we assume, instead, that the program was initiated at the end of the second quarter of 1985 - i.e., we suppose that the

Argentine government implemented the convertibility program, not the Austral plan, after June 1985. The simulated results are expected to shed some light on the properties and perhaps the prospects of this stabilization program.

According to the Convertibility Law, the monetary base must be fully backed by foreign reserves at a fixed exchange rate. The modelling of this requirement and of other policies which were implemented together with the Convertibility Law makes some modifications to the basic model indispensable. We comment upon these next.

First, both the supply of money and the supply of bonds equations are modified. Under the Convertibility Law, money supply is directly related to changes in foreign reserves and bonds supply is directly related to the budget deficit. Since the change in foreign reserves is equivalent to the balance of payments, we have

(4.10) $ms = ms_{t-1} + \alpha * \Delta mb = ms_{t-1} + \alpha * bp$

(4.11) $bs = bs_{t-1} + df$

where Δmb denotes change in the real monetary base which must be fully backed by changes in foreign reserves; the parameter α is the money multiplier. Nominal supply of money, Ms, and supply of bonds, Bs, are obtained by multiplying ms and bs by the general price level respectively.

Secondly, since the exchange rate is fixed by law, the expected devaluation rate equation is not required. However, in so far inflation is not completely stopped the expected inflation rate equation is still valid and is specified as in the second policy simulation experiment - i.e., as equation (4.9). In other words, the adaptive expectations hypothesis is assumed to hold.

The third modification hinges upon taxes. Export taxes are removed (this should not be viewed as an assumption because export taxes were actually eliminated when the Convertibility Law based program was in effect). Autonomous taxes are assumed to have doubled and the output-dependent tax rate is assumed to increase by 50% - meaning that the tax rate was increased from 1%, for example, to 1.5%.[32] Changes in taxes and in the tax rate together reflect the policies of opening markets and improving tax collection.

Figures 18-23 show the performance of some selected major variables in this policy simulation. From a policy evaluation

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[32] The constructed output-dependent tax rate, based on the data given in DATAFIEL, is very low (see Appendix 4), so this assumption on the output-dependent tax is not unreasonable.

Figure 18. POLICY SIMULATION 3 yys

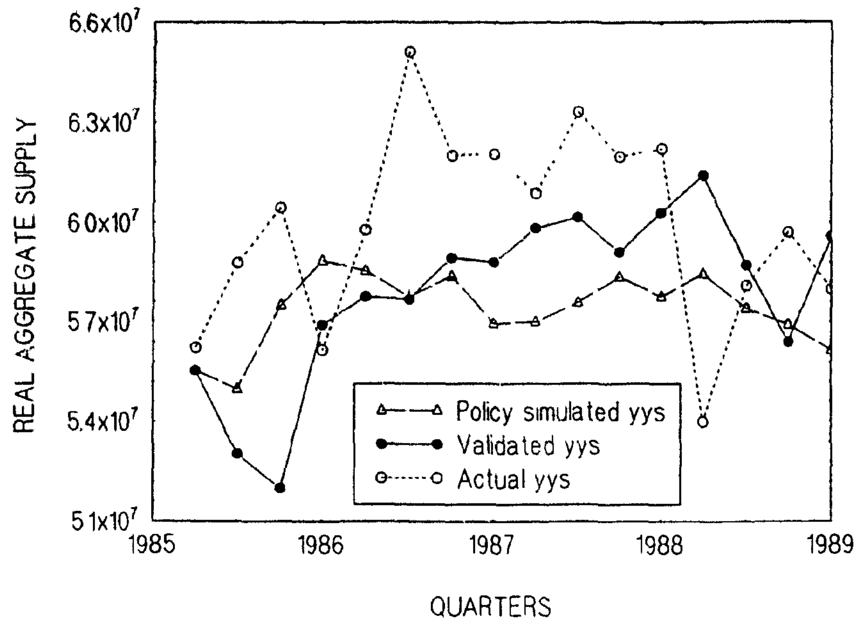


Figure 19. POLICY SIMULATION 3 bp

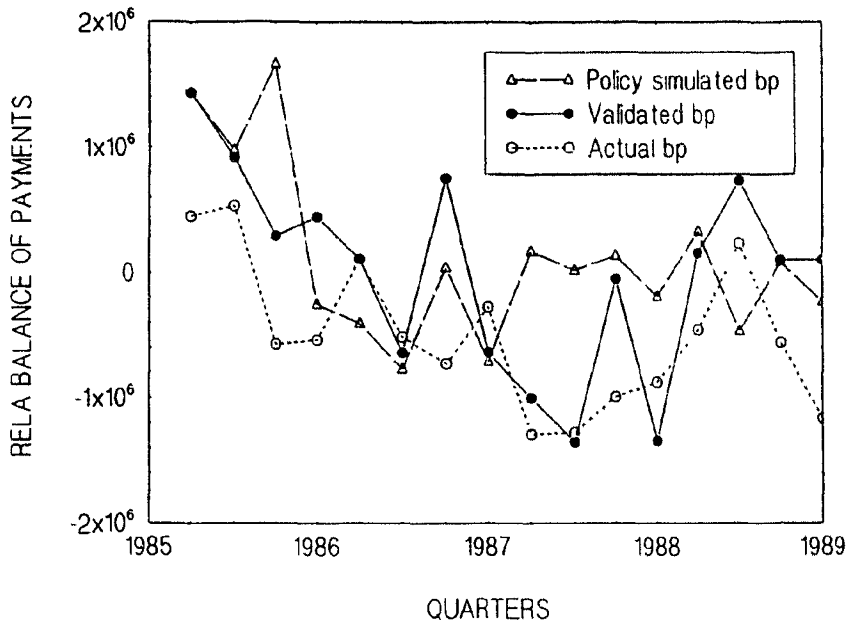


Figure 20 POLICY SIMULATION 3 df

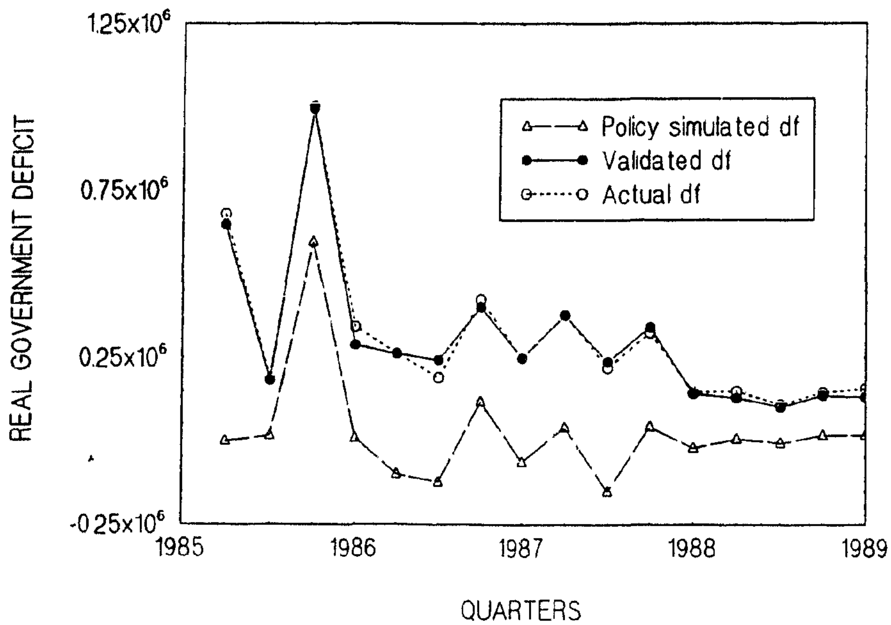


Figure 21 POLICY SIMULATION 3 ri

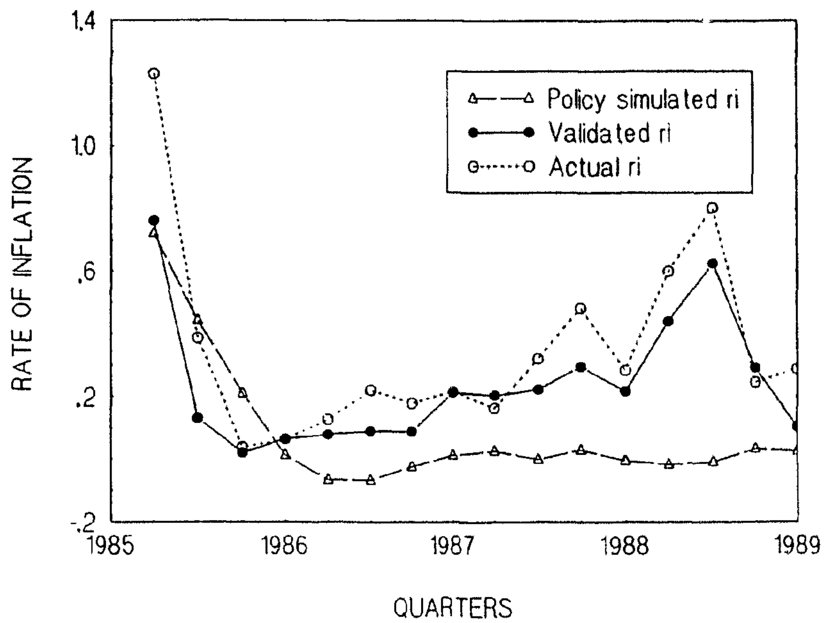


Figure 22 POLICY SIMULATION 3 ir

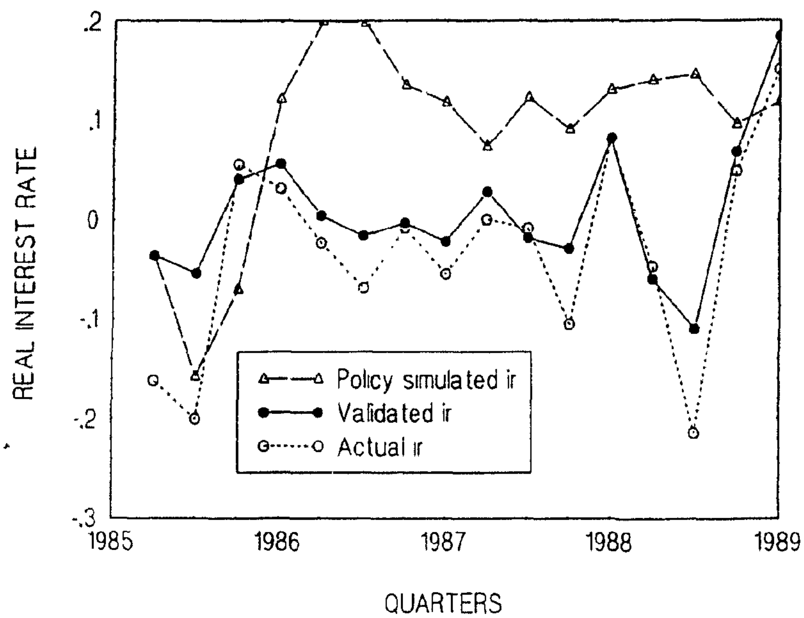
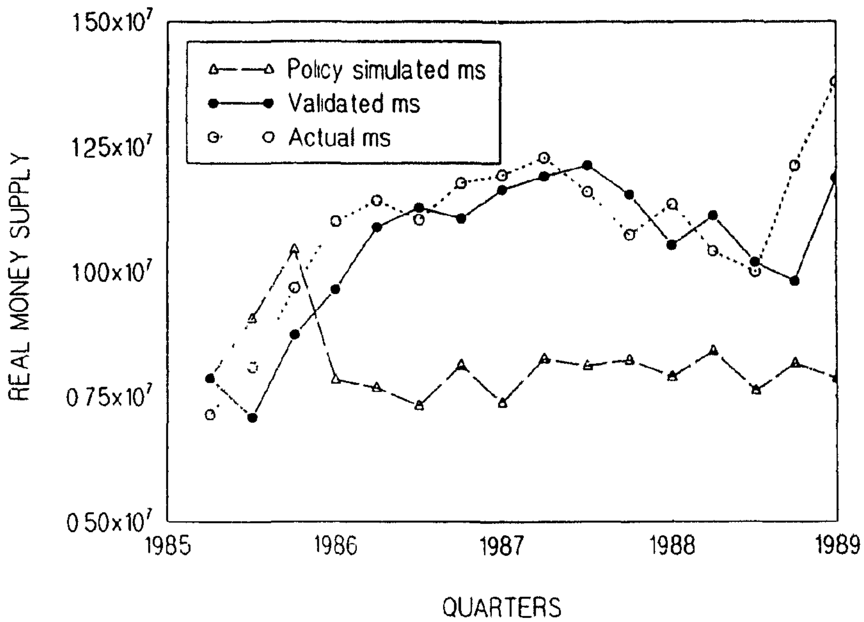


Figure 23. POLICY SIMULATION 3 ms



perspective, the simulated results (based on the data in the period 1985-1989) for some of these variables were consistent with the actual economic responses to the convertibility program during 1991-1993 while others were not as satisfactory. In particular, the aggregate supply, yys, and the real balance of payments account, bp, did not perform well.

The simulated aggregate supply, yys, increased at the beginning of the simulation period and then slightly fluctuated, but tended to decrease during the rest of the period (see Figure 18). The actual situation in 1991 to 1993 in Argentina, on the other hand, was that real GDP was continuously increasing. The stagnation of yys in the policy simulation can be explained by two reasons. First, and very important, the model is a short-run model and, as such, does not incorporate technological progress, capital accumulation, and resource reallocation. Consequently, if growth of real GDP in 1991 to 1993 was caused mainly by a more efficient allocation of resources and technological progress after opening Argentine markets to the rest of the world, then the model would not appropriately simulate such a sustained growth of real GDP. Second, the decreasing tendency of yys in the policy simulation is due to the high real interest rate. Given a very low inflation rate, the simulated real interest rate is considerably high. It can be seen from Figure 22 that the simulated quarterly real interest rate is around 12%, on average, for the entire simulation period. The real interest rate is a part of production costs and enters the supply equation of tradables (see equation (2.1) in Appendix 2), and hence the higher the real interest rate, the smaller is the supply of tradable goods, which, in turn, makes aggregate supply smaller.

The simulated real balance of payments, bp, improves in comparison with bp generated from the model validation for the simulation period. This improvement is consistent with actual performance of bp in the period between 1991 and 1993. However, there is an important difference. The actual situation during 1991-1993 was that a large trade deficit was created by a substantial increase in imports which were brought about by rapid economic growth. This trade deficit was compensated by very large capital inflows with the result that the overall balance of payments still signalled an improvement during the period. In the policy simulation, a surplus does appear in real capital account, though not very large, while a deficit is also recorded in real current account. However, this trade deficit is not generated by an increase in imports, but it is caused, instead, by a decrease in the supply of tradables, which leads to a decrease in exports - see equation (2.12) in Appendix 2.

In contrast to the simulated yys and bp, the simulated budget deficit, df, and the inflation rate, ri, for the simulation period are very close to the actual df and ri for the period 1991-1993. Given the improvement in tax collection, the real budget deficit is almost completely removed and a budget surplus is generated for some periods. The simulated quarterly inflation rate is dramatically and quickly reduced during the first four quarters and then fluctuates between -0.6% to 2.7%, 1.9% on average, for the rest of the period. This simulated inflation rate is, on average, only slightly higher than the US inflation rate for the same period. Consequently, the problem of real appreciation of the domestic currency is not severe in the fixed exchange rate regime. Figures 20 and 21 depict the performances of these two variables.

Real money balances, ms, grew in the policy simulation at the beginning of the period but quickly returned to their initial level and then remained in a constant range with a few fluctuations during the rest of the period - see Figure 23. In comparison with the validated ms for the simulation period, the simulated values are smaller. Since the expansion of the monetary base is directly related to the balance of payments and since the size of the money multiplier α is constant - whenever the required reserve ratio remains unchanged - the money supply is very likely to fall short of what the private sector requires. Such a shortage would lead to a high interest rate which would affect production, investment, and consumption negatively and would, perhaps, cause some liquidity problems as discussed in Chapter 1.

The serious problems regarding the convertibility program, which emerged in the context of the policy simulation experiment, are the issues related to money, the interest rate and the balance of trade. These problems are interrelated.

Since monetary expansion is quantitatively restricted by the size of the increase in foreign reserves, the shortage of money in the economy is a distinct possibility when high inflation is defeated and the demand for money (as financial assets) increases. This shortage of money will drive up the interest rate and the high interest rate will cause negative effects on production, investment and consumption. In the short run, the large trade deficit may be created by a decrease in exports because high interest rates hurt production of tradables (notice that in the model, no technological progress and reallocation of resources take place in the short run). Although high interest rates induce capital inflows, the trade deficit may not be totally offset by increases in capital inflows. This result is apparent in the policy simulation experiment. In the long run, though the model is unable to simulate, it may be the case that the negative effect of high interest rates on production is offset by technological progress and reallocation of resources. But as the economy grows, a substantial increase in imports occurs, which also leads to a trade deficit if the increase in exports cannot catch up with the increase in imports. The large trade deficit may cancel out net capital inflows and cause an overall deficit in the balance of payments. The deficit in the balance of payments, in turn, limits monetary expansion and leads to another cycle to begin all over again.[33] Something of this actually happened in Argentina between 1991 and 1993. Of course, since the long-run economic phenomenon is more complicated than that of the short run, any plausible conclusions can be made only if there is enough evidence to support them.

It is interesting to note that, actually, although the convertibility program has been very successful in arresting inflation and stabilizing the economy, it has also created some new problems. If these problems are persistent in the long run, the program may have to be revised to cope with them.

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[33] In Chapter 1, two issues regarding convertibility policy were discussed, namely the relative price problem and the monetary expansion problem. The latter one was verified in the policy simulation. But the former issue was not examined because we did not know what should be the equilibrium paths of relative prices. Therefore, the issue of relative price is left open for future research.

4.6 Policy implications

The theoretical analysis and the policy simulation experiments in this study, although obviously limited by the short-run nature of the model, shed some light on the future of the stabilization program in Argentina. We summarize a few of those implications in this section.

1. In fighting inflation, the policy of fixing the exchange rate is, in general, very effective. This has been proved by the second and the third policy simulation experiments in which the assumption of the fixed exchange rate was invoked. As discussed above, an increase in the exchange rate (meaning a devaluation in domestic currency) is likely to generate spiralling inflation through both tradables and nontradables prices. When the exchange rate is fixed at a constant level during a certain period, this inflation mechanism stops operating automatically. The important problem generated by the policy of fixing the exchange rate, however, is that it may lead to a real appreciation of domestic currency if domestic inflation is still higher than its major trade partners. A policy dilemma appears in this context: the fixed exchange rate arrests inflation but may also produce real appreciation; devaluation solves the real appreciation problem but may lead to an accelerating inflation. In other

words, there is a trade-off between inflation and real appreciation of the domestic currency. This policy dilemma implies that the policy of fixing the exchange rate at some chosen level cannot last in the long run unless inflation is fully brought under control. If there is no internal inflationary pressure, then fixing the exchange rate is an attractive policy option to stabilize the economy.

2. Wage indexation is one of the most important mechanisms to generate inertial inflation. In the high inflation period, the freezing of wages is as important as the freezing of prices to stop inertial inflation. To this end, policies to stop and prohibit indexation should be incorporated into the stabilization program. However, the simulation experiments in this study have shown that the price-wage spiral was not as strong as the price-exchange rate spiral in the Argentine economy during the study period. In all three policy simulation experiments, the fixed wage (and prices) hypothesis was not imposed, but the experimental results showed that once the inflation rate was successfully brought under control by removing the price-exchange rate spiral, the mechanism of prices and wages did not yield the accelerating effects on inflation. This implies that an incomes policy of freezing wages and prices should be, if necessary, implemented only if the inflation rate is very high.

3. The 100% backing requirement in the convertibility policy is useful to constrain government spending as it eventually helps to reduce or remove fiscal deficits. In addition, the requirement is successful for restoring public confidence in the domestic currency, and hence, to stabilize the economy. However, this requirement has also created some problems. As revealed in the policy simulation experiments, directly linking the money supply and the balance of payments constrains monetary expansions. In the short run, once high inflation is successfully defeated, demand for domestic currency (as financial assets) increases. Given the 100% backing requirement, the increase in demand for money will drive up the nominal interest rate which leads to an increase in capital inflows on the one hand, and a decrease in production of tradables and consequently a decrease in exports on the other. This short-run equilibrium, simulated by the model, is not fully desirable because production is negatively affected. The problem of the shortage of money supply, to a certain extent, can be solved in the short run by changing the reserve requirements, i.e., increasing the size of the money multiplier; or even by expanding open market operations. Similar problems, i.e., shortage of money, high nominal interest rates and trade deficits, may also exist in the long run, but issues regarding the long run prospects are beyond the scope of this study.

4. Special attention should also be given to fiscal instruments. It has been widely accepted that a large deficit financed by money creation is one of the direct causes responsible for inflation. However, acceptance of this argument does not imply that a zero budget deficit is an ideal target worth achieving. In our policy simulation experiments, the zero deficit hypothesis was imposed in the first and the second policy simulation experiments while in the third experiment an improvement in tax collection was imposed and government was allowed to overspend as long as this overspending (deficit) could be financed by borrowing. The lowest inflation rate was not generated in either the first or the second experiment. The average quarterly inflation rates were around 10% and 3.1% for the first and second experiments respectively. The lowest average quarterly inflation rate of 2% was generated in the third experiment. These policy simulation results imply that deficits alone do not cause high inflation. They cause high inflation only if they are financed directly by money creation. To this end, government expenditure, as a fiscal instrument, should not be completely neglected in stabilization policies.

5. According to the simulation experiments, policies of expectations management are not recommended. The government generally cannot manage economic agents' expectations, but even if government could, the preannouncement of the future

exchange rate is a highly risky policy because, on the one hand, the accelerating mechanism of the price-exchange rate spiral still operates so that high inflation cannot be defeated, and, on the other hand, maintaining the preannounced rate for a long period may conflict with other economic goals and may delay quick corrections of other policy mistakes.

Chapter 5

CONCLUSIONS

5.1 Summary and Conclusions

In this study, we have specified a short-run CGE model for the Argentine economy. The model has been used to describe the functioning of the economy, with the focus on the inflationary process, between the late 1970s and the early 1990s. In addition, the estimated structure of the model has been used to simulate the impacts of alternative stabilization policies either under some postulated structural changes or under a totally different historical context. Some of these "policy games" may be thought of as counterfactual experiments whose methodological role is to contribute to our knowledge of the properties of the studied structure.

Two types of inflation mechanisms in the Argentine economy, namely the non-accelerating and accelerating mechanisms, have been characterized in the specification of the model. Operations of these two mechanisms lead to a sustained high inflation rate in the economy. For instance, a one-time exogenous shock - say, an increase in the foreign price of imports - is immediately transmitted to the economy through the exchange rate channel and import tariffs and causes an increase in domestic prices. However, the resulting increase in domestic prices is not a one-time movement. On the contrary, it will be sustained and even magnified by the accelerating mechanisms and result in an accelerating inflationary process. The model has mainly described two accelerating mechanisms, namely the price-wage spiral and the price-exchange rate spiral.

Clearly, if an increase in prices pushes up wages which, in turn, push up prices, then given a one-time shock to either prices or wages, both variables will interact and generate a spiralling result. If, especially, wages are fully indexed to prices, the inflation pressure will be fully sustained through the mechanism $P \rightarrow P^e \rightarrow WR \rightarrow VCN \rightarrow PN \rightarrow P$. The hypothesis of full wage indexation in Argentina for the last two decades has been verified by the empirical study - see Chapter 3.

In comparison with the price-wage mechanism, it has been suggested by the empirical study that the price-exchange rate mechanism played a more important role in the inflationary process of the last two decades in Argentina. Consequently, considerable attention has been given to this mechanism. Analytically, it has been shown how prices and the exchange rate interact positively and the extent to which the quantitative relationship between these two variables is determined by the parameter c_{41} in the exchange rate equation (2.20) and the critical value, which is derived from the parameters in equation (3.33). Actually, c_{41} determines the forward effect from price to the exchange rate and the critical value determines the feedback effect from the exchange rate to prices. An important analytical conclusion is that as long as the devaluation rate is less than the critical value, the inflation rate of nontradables prices will be greater than the devaluation rate. Since the inflation rate of tradables prices is always equal to the devaluation rate as shown in equation (3.29), the inflation rate of the general price level will be higher than the devaluation rate. If, in this situation, the parameter c_{41} is larger than unity, an expansionary process is initiated and results in accelerated inflation which continues until some other mechanisms or policy interventions arrest it.

The empirical results of this study have supported the above claim. According to the data of the last 20 years, both forward and feedback effects were quite strong in Argentina. Given these strong effects, it is concluded that unless there are some adjustment mechanisms in the economy to reduce the effects of this spiral, high inflation is most likely to be generated and sustained.

In this study, three policy simulation packages have been designed and experimented with the aim of (1) evaluating some common arguments and explanations given in regard to the inflationary process and the failure of past stabilization programs in Argentina; (2) answering the question whether economic performances could have improved under some postulated structural changes; and (3) commenting on aspects of the stabilization program currently in place. As stated before, the scope of the experiments and their significance are restricted by the short-run nature of the model. However, it seems plausible to draw the following three conclusions from the results of simulation experiments. First, a zero fiscal deficit was not a precondition for success of the expectations management policy followed between 1978 and 1981; instead, the simulations suggest that the economy could not have been stabilized by using the preannounced devaluation rate. Secondly, economic performance could have improved in 1985-1989 during the Austral Plan if the fiscal deficit had been completely removed and if the exchange rate and the nominal interest rate had been fixed at some constant levels. This notwithstanding, an important problem remains, namely, the fact that with the modified structure, the real appreciation is still severe. Thirdly, the Convertibility Law based program is very successful in arresting inflation and eliminating the budget deficit, but it is by no means free of side effects, such as inducing shortages of the money supply in the economy followed by high interest rates.

The results of the simulation experiments also suggest that to fight high inflation and stabilize the economy: (1) a fixed exchange rate policy may be indispensable; (2) an incomes policy consisting of freezing prices and wages is necessary only at a time when the price-wage spiral generates a very strong inertial effect of inflation (otherwise, such a policy is not warranted); (3) the full backing requirement of a convertibility based program easily generates a shortage of money and high interest rates, and may, therefore, require a set of compensatory monetary measures, like changing reserve requirements, to adjust; (4) fiscal policy is still useful but must be applied with caution and a zero budget deficit should not always be viewed as an ideal target; (5) policies of expectations management were the least effective and should be firmly rejected as a means of defeating inflation.

It has been pointed out in Chapter 1 that the ultimate objective of this study is to say something relevant regarding the over-all performance of the Argentine economy between the late 1970s and the early 1990s. Therefore, a methodological note of caution regarding the meaning of this objective would seem to be appropriate at this place.

For the purpose of our investigation we constructed a model that, within acceptable limits of statistical tolerance, mirrors selected features of the Argentine economy during this period. However, independently of the degree of success achieved in this formal depictions, it must be clear that this model is only a first step - still distant from the target - in a process of successively approximating the "actual system".

The consequence from this methodological standpoint is very significant because it implies that, in a very strict sense, the "positive conclusions" as well as the "prescriptive statements", while displaying the power of truth in relation to the immediate referent (i.e., the model), cannot show much more than interpretative-suggestive soundness with respect to the mediate referent (i.e., the actual economy).

5.2 A Brief Discussion of the Short-run Aspects of the "Dollar-Standard" Exchange Rate Regime

A few general policy implications which emerged from the results of the simulation experiments have been summarized in the preceding section. Here we extend the discussion to touch specifically on issues related to the "dollar-standard", fixed exchange rate regime which is a cornerstone of the current Convertibility Law based stabilization program.

Actually, it is clear that anchoring the nominal exchange rate has been proven to be a very powerful tool in defeating high inflation. In addition, the simulation experiments strongly recommend a fixed exchange rate policy to stabilize inflation. Moreover, this is consistent with the analytical conclusion that a fixed exchange rate regime will put out of operation the price-exchange rate spiral which, given certain conditions, accelerates the inflation rate. What may be the shortcomings of a "dollar-standard" regime? It would seem that, with a fixed exchange rate regime in place, the domestic economy will be unable to avoid external shocks; for instance, a foreign price shock will be fully transmitted to the domestic economy. Admittedly, this problem may not be very serious for the Argentine economy as long as its important economic goal is to contain inflation on par with that of its major trade partners.

More important questions concerning a fixed exchange rate regime arise when such a regime is expected to remain in place in a longer run. First, there is the issue of how to resist strong appreciation or depreciation pressures in order to maintain the backing requirement; and second, there is the issue of how the economy adjusts with the anchored exchange rate plus the backing requirement.

In general, by adopting a "dollar-standard" fixed exchange rate regime, authorities give up much of the control over the domestic money supply and hence monetary policy becomes a by-product of the fixed exchange rate requirement. Under this regime, appreciation or depreciation pressures on the fixed exchange rate should be eliminated by balance of payments induced changes in the money supply. In this case, the economy moves along the same equilibrium path but with some adjustments in prices, interest rates, etc. However, if the adjustment of the money supply is restricted by law to link directly with change in foreign reserves, then maintaining the fixed exchange rate by using monetary policy options, such as changing banks reserve requirements and open market operations, is possible only if the appreciation or depreciation pressure is consistent with the inflow or outflow of foreign reserves. It is not easy to assert that this consistency can always be maintained in the economy.

In principle, both a trade surplus and a net capital inflow will lead to an appreciation pressure on the peso. However, there is a difference between these two events. The trade surplus may result from a lower domestic price relative to foreign price; it brings about an inflow of foreign exchange and causes an expansion of the domestic money supply. This increase in money supply pushes up the domestic price level and the higher price level eliminates the trade surplus and the appreciation pressure on the peso. In this case, the domestic price adjusts to the international price level. On the other hand, a net positive capital inflow with fully balanced trade leads to an increase in foreign reserves, calls for currency appreciation, and also results in an increase in the money supply. This increase in money supply removes the appreciation pressure but pushes the domestic price above the foreign price level and consequently leads to a trade deficit. This argument raises an interesting issue regarding the actual Argentine economic performance during 1991-1993 when large trade deficits and large capital inflows occurred. Many policy analysts have argued that since large trade deficits were compensated by large net capital inflows during 1991-1993, the overall state of the balance of payments was quite acceptable and the Convertibility Law based regime was not threatened. The analysis here suggests that the sustained trade deficit in the Argentine economy might have been caused by sustained large capital inflows in the context of the fixed exchange rate and the convertibility based program.

Perhaps the most fundamental question that arises here is in regard to the long-run sustainability of the "dollar-standard" regime or, if the answer is positive, of the conditions therefor. An answer to this cannot be provided in view of the short-run nature of the model.

5.3 Directions for Future Research

One important line of future research should focus on developing a long-run or, at least, a medium-run model. The short-run model has demonstrated its usefulness in explaining some fundamental inflationary mechanisms though it falls short of providing a satisfactory dynamic explanation of the stabilization processes beyond the initial impacts. This shortcoming becomes apparent, for instance, when one tries to assess the future of the convertibility-based program.

A second extension could consist in disaggregating the tradable sector as suggested by the Klein-Ortiz-Rao model (1991) into two sectors, namely exportables and importables. Whereas the present model has the advantage of a smaller number of equations while still mirroring some essential traits of the Argentine economy, it might conceal potential differences in the price determination processes between the exportables sector and the importables sector. Disaggregation may cast some light on these possible differences and thereby improve the description of the determination of the general price index.

In another part of this study we have justified the presence of the empirical relation equation (2.20) - the exchange rate equation - in our model and we have also shown its important dynamic role in the working of the whole system. An important extension - though, admittedly, difficult to implement - could consist in substituting of a set of distinct policy mechanisms mimicking the diverse policy discontinuities (structural breaks) in the empirical relation embodied in equation (2.20).

From the viewpoint of its aims, a new model would need to emphasize those aspects and relations which are relevant for the understanding of an economy under a "dollar standard" in the longer run - e.g., workings of the current and capital accounts, control of the money supply, flexibility of the price system - while refining its quantitative accuracy.

Last but not least, improvement in knowledge can only be the result of systematic and even tedious experimentation with the models. In Chapter 4 we did refer to our experiments as "prototype simulations". The idea was to make clear that we did not consider our simulation work as exhaustive but, much to the contrary, as a sketchy description of what really amounts to three "simulation classes", each class involving itself a long list of possible experimental variations. In a way, this study merely exemplifies how such intensive work may be done.

Appendix 1

THE VARIABLE COST FUNCTION OF THE TRADABLES SECTOR

The derivation of the variable cost function for the tradables sector is presented below.[34]

The short-run Cobb-Douglas production function for the tradables sector is:

1. $Y = A*L^{a}*M^{b}*K^{c}$

where A is a shift parameter; L, M, K denote labour, imported inputs, and fixed capital stock respectively; and as usual, the coefficients a, b and c measure output elasticities with respect to the production factors, respectively.

Given this short-run production function in which the capital stock is fixed, the corresponding variable cost

[34] The result in this appendix was conveyed to me by Dr. Erwin Klein in private communication.

function will be:

$$2.\quad C(\mathbf{P}, Y) = \min_{L,M} \quad P_L*L + P_M*M$$

$$\text{s.t.} \quad A*L^a*M^b*K^c = Y$$

where **P** is a vector of prices of variable factors; P_L is the price of labour; P_M is the price of imported inputs. From (1), we have

$$3.\quad L = [(Y/A)*M^b*K^c]^{1/a}$$

$$4.\quad M = [(Y/A)*L^a*K^c]^{1/b}$$

Using (2), (3), and (4), we derive the conditional factor demand functions for variable factors:

$$5.\quad L = (a*P_M/b*P_L)^{b/(a+b)}*Y^{1/(a+b)}*A^{-1/(a+b)}*K^{-c/(a+b)}$$

$$6.\quad M = (a*P_M/b*P_L)^{-a/(a+b)}*Y^{1/(a+b)}*A^{-1/(a+b)}*K^{-c/(a+b)}$$

Substituting (5) and (6) into the variable cost function, we have

$$7.\quad C(\mathbf{P}, Y) = P_L*L+P_M*M$$

$$= P_L*[(a*P_M/b*P_L)^{b/(a+b)}*Y^{1/(a+b)}*A^{-1/(a+b)}*K^{-c/(a+b)}]$$

$$+ P_M*[(a*P_M/b*P_L)^{-a/(a+b)}*Y^{1/(a+b)}*A^{-1/(a+b)}*K^{-c/(a+b)}]$$

$$= A^{-1/(a+b)} * [(a/b)^{a/(a+b)} + (a/b)^{-a/(a+b)}] * P_L^{a/(a+b)} * P_M^{b/(a+b)} * K^{-c/(a+b)} * Y^{1/(a+b)}$$

If we set $1/(a+b)=\alpha_1$, $A^{-1/(a+b)} * [(a/b)^{a/(a+b)} + (a/b)^{-a/(a+b)}] = \alpha_2$, $a/(a+b)=\alpha_3$, $b/(a+b)=\alpha_4$, $-c/(a+b)=\alpha_5$, equation (7) can be re- written as

8. $C = \alpha_2 * (P_L ** \alpha_3) * (P_M ** \alpha_4) * (K ** \alpha_5) * (Y ** \alpha_1)$

where $\alpha_3+\alpha_4=1$ and $\alpha_5 < 0$. Note that, for constant returns to scale, a+b=1. However, in the short run, decreasing returns to scale are assumed to prevail so that a+b < 1, i.e., $1/(a+b)=\alpha_1>1$.

Finally, if we define (8) as the variable *production cost* (vpc) and then extend it to include the *borrowing cost* of working capital (vbc), we obtain the short-run variable cost function for the tradables sector

9. $vct = vpc+vbc = (Y ** \alpha_1) * \alpha_2 * (P_L ** \alpha_3) * (P_M ** \alpha_4) * (K ** \alpha_5) * (1+\alpha_6 * r)$

where r denotes the real interest rate.

Appendix 2

EQUATIONS AND VARIABLES

The Equations of The Model

(2.1) $$yts = \left[\frac{pt}{a_{11}a_{12}*(wr**a_{13})*(pz**a_{14})*(kt**a_{15})*(1+a_{16}*ir)}\right]**[1/(a_{11}-1)]$$

(2.2) $$ztd = \frac{(1+a_{16}*ir)*a_{14}*a_{12}*(wr**a_{13})*(kt**a_{15})*(yts**a_{11})}{pz**(1-a_{14})}$$

(2.3) $$yns = yns_{t-1}*[(ynd_{t-1}/yns_{t-1})**a_{21}]$$

(2.4) $$VCN = (1+a_{31}*IR)*(WR*L/yns+PZ*znd/yns+KN/yns)$$

(2.5) $$znd = a_{41}*yns$$

(2.6) $$yys = pt*yts+pn*yns$$

(2.7) $$ypd = (yd**b_{31})*(md**b_{32})*exp(b_{33}*ir)$$

(2.8) $$yyd = ypd+ged \quad \text{or} \quad yyd = pt*ytd+pn*ynd$$

(2.9) $$yd = yys-(ta+ty+tz+tx)+ir*bs_{t-1}+(1-trf)*(ER*IR^{*}*FD/P) +trs-(ri/(1+ri))*(Ms/P)$$

(2.10) $$ytd = \frac{(pt/yyd)^{-1}*[b_1+b_{11}*log(pt/yyd)+b_{12}*log(pn/yyd)]}{-1+(b_{11}+b_{21})*log(pt/yyd)+(b_{12}+b_{22})*log(pn/yyd)}$$

(2.11) $$ynd = \frac{(pn/yyd)^{-1} * [b_2+b_{21}*\log(pt/yyd)+b_{22}*\log(pn/yyd)]}{-1+(b_{11}+b_{21})*\log(pt/yyd)+(b_{12}+b_{22})*\log(pn/yyd)}$$

(2.12) $xt = yts-ytd+zt$

(2.13) $zt = ztd+znd+zrd$

(2.14) $ca = xt-zt-(ER*DE*IR^*)/P$

(2.15) $kar = c_{11}+c_{12}*(IR-IR^*-rp-\pi^e)$

(2.16) $kau = c_{21}*(IR-IR^*-rp-\pi e)$

(2.17) $ka = kar+kau$

(2.18) $bp = ca+ka$

(2.19) $rp = c_{31}*(ER*DE)/(P*yys)$

(2.20) $(ER_t/ER_{t-1}) = (P_t/P_{t-1})**c_{41}$

(2.21) $ty = try*yys$

(2.22) $tz = trz*zt$

(2.23) $tx = trx*xt$

(2.24) $tf = trf*(ER*IR^**FD/P)$

(2.25) $df = ged+(ir_{t-1}*bs_{t-1})+(IR^*_{t-1}*DE_{t-1}*ER/P)$
$-(ta+ty+tz+tx+tf)+d_{11}*ri$

(2.26) $Ms = e_{11}*Ms_{t-1}+e_{12}*BP+e_{13}*(df*P)$

(2.27) $md = (ww_{t-1}**e_{21})*(yys**e_{22})*exp[e_{23}*IR+e_{24}*(IR^{*}-trf)]$

(2.28) $ms = Ms/P = md$

(2.29) $Bs = e_{31}*Bs_{t-1}+e_{32}*(df*P)$

(2.30) $bd = (ww_{t-1}**e_{41})*(yys**e_{42})*exp[e_{43}*IR+e_{44}*(IR^{*}-trf)]$

(2.31) $bs = Bs/P = bd$

(2.32) $fd = (ww_{t-1}**e_{41})*(yys**e_{42})*exp[e_{43}*IR+e_{44}*(IR^{*}-trf)]$

(2.33) $ww = WW/P = [(Ms+Bs+ER*FD)/P]+kk$

(2.34) $ir = (IR-ri)/(1+ri)$

(2.35) $IR-IR_{t-1} = e_{51}*(IR^{*}+\pi^{e}+rp-IR_{t-1})+e_{52}*(logMs-logMs_{t-1})$

(2.36) $P = (PT**f_{11})*(PN**(1-f_{11}))$

(2.37) $PT = (f_{21}*PT^{*}+(1-f_{21})*PZ^{*})*ER*(1+(trz-trx))$

(2.38) $pt = PT/P$

(2.39) $PN = qf*VCN$

(2.40) $pn = PN/P$

(2.41) $PZ = PZ^{*}*ER*(1+trz)$

(2.42) $pz = PZ/P$

(2.43) $qf = (P^{e}**f_{31})*exp[f_{32}*(yyd-yys)/yys]$

(2.44) $P^e = P_{t-1}*(1+ri^e)$

(2.45) $ri^e = f_{41}*\pi^e$

(2.46) $\pi^e = f_{51}*(\log Ms - \log Ms_{t-1}) + f_{52}*(ri_{t-1} - ri^e_{t-1})$

(2.47) $ri = (P - P_{t-1})/P_{t-1}$

(2.48) $WR = (P^e ** f_{61}) * \exp[f_{62}*((yyd - yys)/yys)]$

(2.49) $wr = WR/P$

List of variables

Endogenous Variables:

1. yts: real supply of tradables
2. yns: real supply of nontradables
3. yys: real aggregate supply
4. ztd: real demand for imported inputs by the tradables sector
5. znd: real demand for imported inputs by the nontradables sector
6. VCN: nominal variable cost in the nontradables sector
7. ytd: real demand for tradables
8. ynd: real demand for nontradables
9. yyd: real aggregate demand
10. ypd: real domestic private expenditure
11. yd: real disposable income

12. ca: real current account

13. zt: total real imports

14. xt: total real exports

15. ka: real capital account

16. kar: real net reported capital flow in domestic currency

17. kau: real net unreported capital flow in domestic currency

18. bp: real balance of payments account

19. rp: risk premium

20. ER: nominal exchange rate

21. ty: real output-dependent taxes

22. tz: real import taxes

23. tx: real export taxes

24. tf: real taxes on income from holding foreign assets

25. df: real government budget deficit (df=DF/P)

26. Ms: nominal money supply

27. ms: real money supply

28. md: real demand for money (md=ms=Ms/P)

29. Bs: nominal supply of government bonds

30. bs: real supply of government bonds

31. bd: real demand for government bonds (bd=bs=Bs/P)

32. fd: real foreign financial assets held by domestic residents (fd=FD/P)

33. ww: real wealth (ww=WW/P)

34. ir: real interest rate

35. IR: nominal interest rate

36. P: general price index

37. PT: price index of tradables

38. pt: relative price of tradables (pt=PT/P)

39. PN: price index of nontradables

40. pn: relative price of nontradables (pn=PN/P)

41. PZ: domestic price index of imports

42. pz: domestic relative price of imports (pz=PZ/P)

43. qf: mark-up factor in the nontradables sector

44. ri: inflation rate

45. ri^e: expected inflation rate

46. P^e: expected price

47. π^e: expected devaluation rate of domestic currency

48. WR: nominal wage rate

49. wr: real wage rate (wr=WR/P)

Exogenous Variables

1. kt: real capital stock in the tradables sector

2. L: employment in the nontradables sector

3. KN: nominal capital stock in the nontradables sector

4. ta: real autonomous taxes

5. try: average output-dependent tax rate

6. trz: average import tax rate

7. trx: average export tax rate

8. trf: tax rate on the income from holding foreign assets

9. DE: nominal external debt in foreign currency

10. IR^*: nominal foreign interest rate

11. zrd: other real imports
12. ged: real government expenditure
13. PT^*: foreign price index of tradables
14. PZ^*: foreign price index of imports
15. kk: total real capital stocks: $kk = kt + KN/P$
16. trs: real government transfer payments to the private sector

Appendix 3

DATA CONSTRUCTION

The basic model presented in Chapter 2 includes forty nine endogenous and sixteen exogenous variables (see Appendix 2). In a very few cases, time series on these variables - e.g., foreign financial assets held by residents, fd, and unreported capital flows, kau - either did not exist or could not be made available during our investigation. Such difficulties led to the elimination of the variables from the final econometric model when the variable in question was not deemed to be critically important to the study - e.g., the variable of fd - or, alternatively, to the substitution of a "conjectured" time series for the actual data when there were reasons to believe that a "conjectured approximation" was preferable, in terms of results, to the pure and simple exclusion of the variable - e.g., the case of kau. In the econometric model, the following variables occur:

Endogenous Variables

1. yts: real supply of tradables
2. yns: real supply of nontradables
3. yys: real aggregate supply

4. ztd: real demand for imported inputs by the tradables sector
5. znd: real demand for imported inputs by the nontradables sector
6. VCN: nominal average variable cost of the nontradables sector
7. ytd: real domestic demand for tradables
8. ynd: real demand for nontradables
9. yyd: real aggregate demand
10. ypd: real domestic private expenditure
11. yd: real disposable income
12. ca: real current account
13. zt: total real imports
14. xt: total real exports
15. ka: real capital account
16. kar: real net reported capital flows
17. kau: real net unreported capital flows
18. bp: real balance of payments account
19. rp: risk premium
20. ER: nominal exchange rate
21. ty: real output-dependent taxes
22. tz: real import taxes
23. tx: real export taxes
24. df: real government budget deficit (df=DF/P)
25. Ms: nominal money supply
26. ms: real money supply

27. Bs: nominal supply of government bonds
28. bs: real supply of government bonds
29. ww: real wealth (ww=WW/P)
30. ir: real domestic interest rate
31. IR: nominal domestic interest rate
32. P: general price index
33. PT: price index of tradables
34. pt: relative price of tradables (pt=PT/P)
35. PN: price index of nontradables
36. pn: relative price of nontradables (pn=PN/P)
37. PZ: domestic price index of imports
38. pz: domestic relative price of imports (pz=PZ/P)
39. qf: mark-up factor in the nontradables sector
40. ri: inflation rate
41. ri^e: expected inflation rate
42. P^e: expected price
43. π^e: expected devaluation rate of domestic currency
44. WR: nominal wage rate
45. wr: real wage rate (wr=WR/P)

Exogenous Variables

1. kt: real capital stock in the tradables sector
2. ta: real autonomous taxes
3. try: average output-dependent tax rate
4. trz: average import tax rate

5. trx: average export tax rate
6. DE: nominal external debt in foreign currency
7. IR^*: nominal foreign interest rate
8. zrd: other real imports
9. ged: real government expenditure
10. PT^*: foreign price index of tradables
11. PZ^*: foreign price index of imports
12. kk: total real capital stock
13. trs: real government transfer payments to the private sector

We devote the remainder of this appendix to describing the procedures followed in constructing the data used in this study. The sources of the empirical data have been given in the first section of Chapter 3.

1. Supply Sector

1.1 Real gross domestic product (GDP), denoted by gdp, is the sum of real GDP of tradables, gdpt, and real GDP of nontradables, gdpn. We included the following sectoral product in constructing data on real GDP of tradables:

Agriculture

Manufacturing - Food, Beverages and Tobacco

Manufacturing - Textiles, Clothing and Leather

Manufacturing - Wood and Furniture

Manufacturing - Paper, Printing, Publications

Manufacturing - Chemicals and Associated Products

Manufacturing - Metallic Industries

Mining and Quarries

Manufacturing - Non-Metallic Minerals and Products

Manufacturing - Machines and Equipment

Manufacturing - Others

The real GDP of nontradables includes:

Construction

Electricity, Water and Gas

Trade, Restaurants and Hotels

Transport, Storage and Communication

Financial, Real Estate and Insurance Institutions

Communal, Social and Personal Services

Given the degree of aggregation of our model, the only criterion that seemed relevant for the inclusion of a sectoral product as "tradable" or "nontradable" was its presence or absence from the balance of trade.

Note that gdpt and gdpn are measured in (new) pesos at 1970 prices as given in DATAFIEL. In order to convert them to the base 1988, we calculated two conversion factors:

(1) WPI(1988)/WPI(1970) = 54747696.5517

(2) CPI(1988)/CPI(1970) = 68054105.6557

where WPI and CPI are the wholesale price index and the consumer price index respectively. Multiplying GDP of tradables and GDP of nontradables by the respective conversion factors, we obtain gdpt and gdpn measured in (new) pesos at 1988 prices.

1.2 Given gdpt and gdpn, supply of tradables, yts, and supply of nontradables, yns, were computed using the following definitional equations:

--- yts = gdpt - cit

--- yns = gdpn - cin

where cit and cin are changes in inventories in the tradables and the nontradables sectors respectively. Data on cit are available in DATAFIEL while data on cin have to be computed. A careful examination of the available data reveals that, on average, cin is proportional to cit. This proportionality constant was computed using the following rule: $\sum gdpn / \sum gdpt$ for the period between 1978 and 1989. This yielded a value of 1.38. Hence data on cin were computed from the formula:

cin=1.38*cit

Data on aggregate supply, yys, were computed from the definitional equation:

--- yys = pt*yts + pn*yns

where pt and pn are relative prices of tradables and nontradables respectively.

1.3 Direct data on capital stocks were not available. Instead, information was available on the output-capital ratio for the exportables sector in 1955 - see "ANALYSIS Y PROYECCIONES DEL DESARROLLO ECONOMICO, Vol.V, EL DESARROLLO ECONOMICO DE LA ARGENTINA, Parte 1, CEPAL 1959". Since capital stocks do not play a crucial role in this short-run model, we made a strong assumption that the output-capital ratio of the tradables sector during the study period was the same as the corresponding ratio of the exportables sector in 1955. Based on this assumption,

--- kt = capital stock in the tradables sector

= gdpt/0.444

where 0.444 was computed as the ratio of GDP of exportables to capital stocks in the exportables sector in 1955. In addition,

kn = kt*1.38

where 1.38 is the average of the ratio, $\sum gdpn/\sum gdpt$, for the entire study period. Clearly,

--- kk = kt + kn or kk = 2.38*kt

1.4 Demand for imported inputs in the tradables sector, ztd, can be computed by means of equation (2.2) - see Appendix 2 - once the parameters in equation (2.1) have been estimated. However, data on this variable can also be constructed in the same manner as the demand for imported inputs in the nontradables sector, znd, which is assumed to be proportional to the output, yns. By reviewing statistical information in "ANALYSIS Y PROYECCIONES DEL DESARROLLO ECONOMICO, Vol.V, EL DESARROLLO ECONOMICO DE LA ARGENTINA, Parte 1, CEPAL 1959", we found a relevant input-output ratio for all production sectors in 1950. This ratio is also assumed to remain constant over time and is used to construct the data on ztd and on znd - see the sector "Prices and Wages" below, in this Appendix, where detailed statistics are presented.

--- ztd = 0. 26*yts

--- znd = 0.026*yns

where 0.026 is the input-output ratio.

2. Demand Sector

2.1 The basic definitional identities in the demand sector are:

--- ytd = yts - xt + zt

--- ynd = gdpn

--- yyd = pt*ytd + pn*ynd

where ytd, ynd, yyd, xt and zt denote domestic demand for tradables, demand for nontradables, aggregate demand, exports and imports respectively, all in real terms.

Private expenditure, ypd, was constructed by subtracting real government expenditure, ged, from yyd, i.e.,

--- ypd = yyd - ged

It should be noted that in the theoretical model, ypd is first determined by real disposable income, real money balances and real interest rate. Then yyd is calculated by adding ged to ypd, and finally yyd is allocated between ytd and ynd. Here ytd and ynd are first constructed and then yyd and ypd. It should also be noted that ypd includes not only private consumption expenditure but also private investment expenditure.

2.2 Data on real disposable income, yd, were constructed from the equation in the model, which is reproduced below.

--- $yd = yys - (ta+ty+tx+tz) + trs + ir*bs_{t-1} - it$

where ta, ty, tx, tz, trs, ir, bs, and it denote, respectively, autonomous tax, output-dependent tax, export tax, import tax, transfer payments, real interest rate, domestic bonds and inflation tax respectively, all in real terms. The real inflation tax, it, is defined here as

$$it = (ri/(1+ri))*(Ms/P)$$

where ri, Ms and P denote, respectively, the inflation rate, the nominal money supply, and the general price level. It should be noted that the above definition of yd is different from the standard definition of "personal disposable income" in national income accounting, thus, it is probably better to refer to it as "private disposable income" rather than "personal disposable income". Since statistics on capital depreciation or net investment were not available, it was actually impossible to construct data on yd which would satisfy the standard definition. However, since one of the main tasks in this study is to analyze total demand behaviour, which includes both personal consumption behaviour and investment demand behaviour, the variable yd as defined here was deemed adequate for our purposes.

3. External Sector

3.1 Data on exports and imports can be found in several sections in DATAFIEL - for example, in the section on balance of payments account and in the section on national accounts. Some of these data are monthly while others are quarterly. Moreover, some are measured in current US dollars while others are measured in constant domestic currency. In this study, the data on both exports and imports are selected from the national accounts and converted to the base 1988 as explained below.

--- xt = (exports in national account) * $(WPI_{1988})/(WPI_{1970})$

--- zt = (imports in national account) * $(WPI_{1988})/(WPI_{1970})$

Total imports, zt, are the sum of demand for imported inputs in the tradables sector, ztd, demand for imported inputs in the nontradables sector, znd, and demand for other imports, zrd, which mainly consists of consumption goods and is treated in this study as exogenous. Examination of Argentine data shows that imported inputs constituted almost 90% of total imports for most periods. Therefore, data on zrd were constructed using the following proportionality rule:

--- zrd = 0.1 * zt

3.2 The primary monthly data on public foreign debt and private foreign debt in current US dollars are found in the statistic bulletin "INDICADORES DE COYUNTURA" (FIEL). Summing these two series and calculating the quarterly average from monthly data, we obtained the total foreign debt in current US dollars, i.e.,

--- DE = total public foreign debt + total private foreign debt

3.3 The nominal current account is given by the following definitional equations:

CA = BM + SS + UT
= XT - ZT + RS + FS + UT
= BT + FS + UT

where CA = current account
BM = balance of merchandises

SS = balance of services (total)

UT = unilateral transfers

XT = exports FOB

ZT = imports CIF

RS = real services

FS = financial services

BT = balance of trade = XT - ZT + RS

Since data on CA in current US dollars are found directly in DATAFIEL, we constructed the real current account variable, ca, in the following way: first quarterly data were computed as averages of the three corresponding monthly figures and then these figures were expressed in real terms based on 1988 prices.

--- $ca = (CA * ER) / P$

where ER and P are the nominal official exchange rate and the general price index.

3.4 The variable KAR, reported capital flows in current US dollars, is the sum of CKG, NCKG and NCKF found in DATAFIEL, where CKG, NCKG and NCKF denote, respectively, compensatory capital movements of government, non-compensatory capital movements of government and non-compensatory capital movements of firms. Data on real reported capital flows, kar, were constructed by first calculating the monthly average to obtain quarterly data and then converting them into real terms.

--- $kar = (KAR * ER) / P$

Since no information on unreported capital flows is available, we are constrained to operate on the basis of conjectures. However, since data on real reported capital flows, kar, are available, we assumed following proportionality relation,

--- $kau = \omega * kar \qquad \text{where } \omega \geq 0$

--- $ka = kar + kau$

In model validation, we simply assumed that kau was equal to zero so that kar was equal to ka. Different values can then be assigned to the coefficient ω for other simulation purposes.

3.5 Given ca and ka (actually kar), we computed the data on the real balance of payments account, bp, using the following equation:

--- $bp = ca + ka = \Delta ff$

where Δff is the change in official foreign reserves in real terms.

3.6 Data on risk premium, rp, were constructed by means of the formula

--- $rp = \lambda * [(DE*ER) / P*yys]$

where first λ was assigned a value of unity. But in other simulations, λ could be given different values depending on the objectives at hand.

3.7 During the period between 1978 and 1989, Argentina experimented with different exchange rate regimes (such as fixed, floating, single, double, and even multiple rate regimes). In this situation, we decided to choose the official exchange rate as the only exchange rate in the economy.

The primary data on the official exchange rate (nominal) are first converted from monthly to quarterly and then converted to the base 1988.

--- ER_{index} = (Quarterly nominal exchange rate) / 0.0008774

where ER_{index} denotes the exchange rate index and 0.0008774 is obtained by computing the average of the four quarterly nominal exchange rates in 1988. Statistics on the ER_{index}, instead of the nominal official exchange rate itself, are given in Appendix 4.

4. Fiscal Sector

4.1 The fiscal sector includes different taxes, tax rates, budget deficit, government expenditures, transfer payments, and so on. Data on these variables were available to us only up to the end of 1989. Therefore, the overall period (1978-1989) in the empirical study was constrained by time series on variables in the fiscal sector.

4.2 Data on nominal fiscal expenditure variables were constructed according to the following accounting framework:

OUTLAYS: BO = CO + KO + MO

CO = OO + TRS + IP.FD + IP.DD + IP.OD

where BO = budget outlays

CO = current outlays

KO = capital outlays

MO = miscellaneous outlays

OO = operation outlays

TRS = transfer payments

IP.FD = government's interest payments on external debts

IP.DD = government's interest payments on domestic debts

IP.OD = government's interest payments on other debts

The primary data on monthly nominal CO, KO, OO, IP.FD, IP.DD, IP.OD are available from DATAFIEL, data on real transfer payments were computed by taking the quarterly average and then converting them into real terms based on 1988 prices.

--- trs = (CO - OO - IP.FD - IP.DD - IP.OD) / P

On the other hand, since the data on MO were not available, BO could not be computed directly. Instead, the primary data on BO were collected from various issues of the statistical journal "INDICADORES DE COYUNTURA" (FIEL). Once BO was available, MO was obtained from the equation MO=BO-CO-KO.

4.3 Data on revenues (in nominal terms) satisfy the following equations:

REVENUES: BR = TAXR + NONTAXR

TAXR = TY + TX + TZ + TA

TY = TI + TVA + TUD

where BR = budget revenue

TAXR = tax revenue

NONTAXR = nontax revenue

TY = output-dependent tax

TX = export tax

TZ = import tax

TA = autonomous tax

TI = income tax

TVA = value-added tax

TUD = unified domestic tax

It should be noted that sales tax was not included as part of TY because of the unavailability of data.

Primary nominal monthly data on these variables, except TA, are given in DATAFIEL so that data series on the variables in our model could be constructed by computing the quarterly average and converting them into real values,

--- ty = (TI + TVA + TUD) / P

--- tx = TX / P

--- tz = TZ / P

--- ta = (TAXR - TY - TX - TZ) / P

4.4 Given budget outlays and budget revenues, data series on the real budget deficit, df, were computed by subtracting BR from BO and then dividing the difference by the general price index, i.e.,

--- df = (BO - BR) / P

After df was constructed, real government expenditure, ged, was computed according to the formula

--- ged = df + ty + tx + tz + ta - (IP.FD+IP.DD+IP.OD)/P

4.5 Finally, since we had all relevant data, the three tax rates in our model were easily calculated as follows:

--- try = ty / yys

--- trx = tx / xt

--- trz = tz / zt

5. Financial Sector

5.1 It was mentioned in Chapter 3 that M2 was selected to represent money supply. Monthly data on nominal M2 are available from DATAFIEL Quarterly nominal and real money supplies, which are assumed to be equal to nominal and real demand for money in every period, were constructed as follows:

--- Ms = monthly average of M2 in every quarter

--- ms = Ms / P

5.2 The volume of total outstanding bond stock in the third quarter of 1988 was found as 103,824 million current Australes in "INDICADORES DE COYUNTURA" (FIEL). With this information, the nominal and real supply of bonds were constructed in the following way.

First, it was assumed that the government budget deficit was partially financed by a net increase in bonds and partially by money creation. In general, DF could also be partially financed by foreign debt. However, financing the budget deficit by foreign debt became almost irrelevant after 1982 when the government found it impossible to secure external credit. This notwithstanding, total foreign debt still increased during this period on account of accrued interest payments. Let

$$DF = \Delta Bs + \Delta Ms$$

where ΔBs is a net increase in nominal bonds. Since ΔMs can be computed, and data on DF were already available, we have

$$\Delta Bs = DF - \Delta Ms$$

and the real change in bonds is given by

$\Delta bs = df - \Delta ms$

Next, the outstanding volume of nominal domestic debt in the third quarter of 1988 (103,834 million Australes) was converted into real terms. Using this figure, together with the data series on Δbs, we constructed the supply of real bonds, bs,

--- $bs_t = bs_{t-1} + \Delta bs_t$ from 1988.4 forward to 1989.4

$bs_{t-1} = bs_t - \Delta bs_t$ from 1988.3 backward to 1978.1

Once bs had been constructed, the nominal Bs was computed as

--- $Bs = bs * P$

5.3 Nominal interest rate, IR, was constructed by using the 30-days-passive interest rates given in DATAFIEL. Additionally, some missing data were computed by using Argentine Central Bank's statistics on nominal interest rates for 70-days-saving accounts which were available in various issues of "INDICADORES DE COYUNTURA" (FIEL),

--- $IR(q1) = [1+IR(m1)]*[1+IR(m2)]*[1+IR(m3)] - 1,$

where q1 denotes the first quarter, and m1, m2 ,m3 denote the first, second and third month respectively. Note that the quarterly interest rate is here a compound rate. Once data on the nominal interest rate had been constructed, data on the real interest rate, ir, were directly constructed according to the definition,

--- $ir = (IR - ri)/(1 + ri)$

where ri is the actual inflation rate.

5.4 Finally, since we did not have information concerning fd, real foreign financial assets held by residents, total real wealth was simply calculated as the sum

-- $ww = bs + ms + kk$

6. Prices, Wages and Expectations

6.1. In this study the wholesale price index (WPI) is used as the price index of tradables. Hence,

--- PT = WPI (1988 : 1.00).

6.2. In contrast to the price index of tradables, the price index of nontradables was constructed from primary DATAFIEL information and Argentine Central Bank statistics as a weighted average of the following components included in the consumer price index (CPI):

A: Housing	computed weight		= 0.2029
B: Health	...	...	= 0.1718
C: Transport and Communication	...	...	= 0.2721
D: Education	...	...	= 0.0644
E: Recreation	...	...	= 0.1480
F: Miscellaneous Goods and Services	...	...	= 0.1408

--- $PN = \Sigma\, w_i * CPI_i \quad i = A, B, ..., F. \quad (1988 = 1.00)$

where w_i is the weight of the ith component, calculated by dividing the sum of this component over all periods by the sum of GDP of nontradables over the same periods.

6.3 The general price index, P, was computed as a weighted average of PT and PN with the weight of 0.42 for PT and 0.58 for PN. These weights were calculated in the same manner as the weights discussed above.

--- $P = 0.42*PT + 0.58*PN \quad (1988 = 1.00)$

6.4 The domestic price index of imported inputs, PZ, was constructed using the equation:

--- $PZ = PZ^{*} * ER * (1+trz)$ (1988 = 1.00)

where PZ^{*} is the foreign price index of imported inputs.

All relative prices and the actual inflation rate were computed according to the following definitions:

--- $pt = PT / P$

--- $pn = PN / P$

--- $pz = PZ / P$

--- $ri_t = (P_t - P_{t-1}) / P_{t-1}$

6.5 A nominal wage rate (index), WR, and the real wage rate, wr, were constructed from primary monthly data given in DATAFIEL as:

--- WR = Monthly average in every quarter (1988 = 1.00)

--- $wr = WR / P$

6.6 The mark-up factor, qf, and the nominal average variable cost of nontradables, VCN, were constructed by using the following 1955 input-output data which are found in "ANALISIS Y PROYECCIONES DEL DESARROLLO ECONOMICO, Vol. V, EL DESARROLLO ECONOMICO DE LA ARGENTINA, Parte 1, CEPAL 1959, pp.106-107."

Production and final demand at prices paid by the users:

A. fuels	2407.4
B. construction	9452.0
C. transportation , communication and trade	21177.2
D. electricity and water	1236.3
E. personnel and financial services	7069.8
D. housing	3920.0
Total	45262.7

	I	II	III
	Inputs and final demand for domestic goods and services	Imported Inputs	Wages (total)
A.	1234.7	365.8	119.3
B.	4559.9	399.7	3446.0
C.	4927.5	263.1	8815.3
D.	487.9	88.7	428.2
E.	1124.7	19.1	2897.0
F.	469.3	23.1	104.0
Subtotal	12804.0	1159.5	16889.8

Given these statistics, we computed three input-output ratios, namely, the input-output ratio of labour (L), the input-output ratio of imported inputs (M), and the input-output ratio of domestically produced inputs (K),

$$L = 16889.8 \ / \ 45262.7 = 0.373$$

$$M = 1159.5 \ / \ 45262.7 = 0.026$$

$$K = 12804.0 \ / \ 45262.7 = 0.283$$

In the second stage, we constructed the average variable cost of the nontradables sector, VCN, under the assumption that these input-output ratios had remained constant throughout the period. Thus, we obtained

--- $VCN = (WR*L + PZ*M + PP*K)*(1 + \delta*IR)$

where δ measures the fraction of total cost which is financed by borrowing. This coefficient was assigned a value of 0.1 in order to maintain consistency with the coefficient in the tradables sector. After we had obtained PN and VCN, the mark-up factor was directly computed from the formula

--- $qf = PN / VCN$

6.7 Three expectation variables are included in the model, namely, the expected devaluation rate (π^e), the expected price (P^e), and the expected inflation rate (ri^e). These variables were assumed to satisfy the corresponding relations,

--- $\pi^e_t = (ER_t - ER_{t-1}) / ER_{t-1}$

--- $P^e_t = P_{t-1}*(1 + \pi^e)$

--- $ri^e_t = (P^e_t - P^e_{t-1}) / P^e_{t-1}$

which underlay the assumption that a simple version of the rational expectation hypothesis holds and that the expected devaluation rate equals the actual devaluation rate.

7. Foreign sector

There are three foreign variables in the model, namely, the foreign price index of tradables (PT^*), the foreign price index of imported inputs (PZ^*), and the foreign nominal interest rate (IR^*). We used the US wholesale price index (data were obtained from the "INTERNATIONAL FINANCIAL STATISTICS", IMF) and the US nominal interest rate (data were obtained from the "FEDERAL RESERVE BULLETIN") to construct PT^* and IR^*. Monthly data on PZ^* in DATAFIEL were used to construct the quarterly figures on PZ^*. Hence,

--- PT^* = WPI of US (1988 = 1.00)

--- PZ^* = quarterly average of (monthly dollar-value of imports)/(monthly tonnage of imports) (1988=1.00)

--- IR^* = US nominal interest rates on 3-month treasury bills.

The various time series data for these variables are presented in Appendix 4.

Appendix 4

STATISTICAL DATA

The statistical data used in estimation and simulations are presented bellow. The following rules are observed:

1. All real variables are measured in (new) pesos at 1988 prices.
2. All indexes, including the nominal wage rate and the exchange rate, are converted to the base year 1988 for which the respective indexes are 1.0.
3. All nominal variables, except foreign debt, are measured in current (new) pesos. The nominal foreign debt, DE, is measured in current US dollars.
4. All percentage rates are given in decimal form. For example, IR=0.036 means IR=3.6%.
5. Finally, a point in time is identified by one digit denoting the quarter followed by four digits denoting the year. For example, 1.1978 and 3.1986 denote the first quarter of 1978 and the third quarter of 1986, respectively.

Quarter	yts	yns	yys
1.1978	19770488.1788	38568983.8393	58243027.7376
2.1978	21060891.3865	35824361.7582	56804310.7058
3.1978	22265340.7106	36622636.4176	59035591.1632
4.1978	22387428.0739	37924511.4588	60388332.7467
1.1979	21600156.1975	39148124.2784	60960088.3893
2.1979	23649909.9564	38977308.4732	62732852.8199
3.1979	22825957.1233	38270226.3155	61044032.0388
4.1979	21995982.0436	39757889.0651	61943936.0299
1.1980	19961010.1627	39880386.4553	60486770.2951
2.1980	20555570.1473	37678155.5963	58870993.0229
3.1980	21813124.7371	39843637.2382	62527746.9423
4.1980	22360054.2256	43268119.8348	67153929.5309
1.1981	20570899.5023	42672646.4104	65402979.0021
2.1981	20669992.8331	39769458.2631	61849078.2371
3.1981	19987836.5341	39587753.8010	60622671.8727
4.1981	19356048.1159	36936365.8446	57022385.6036
1.1982	19278306.3868	38941920.3383	58748680.1316
2.1982	18464208.1390	34625928.9576	53137456.7686
3.1982	18518955.8356	32959283.9101	50779028.5728
4.1982	20059008.5396	33501675.1322	52933703.8465
1.1983	20492062.8193	37886401.1596	57361598.6786
2.1983	20454834.3856	36041454.3553	55838885.4269
3.1983	20240770.8921	34755912.2994	54398002.6088
4.1983	22272457.9112	35912832.0956	57669098.3231
1.1984	21346126.8855	39419660.1600	59766175.2048
2.1984	21522414.4684	36400780.0331	57286670.1235
3.1984	22033757.9542	38019106.6656	59618248.7499
4.1984	22037590.2930	35043100.6253	56897271.3697
1.1985	19674679.7098	37267789.3392	56797100.3658
2.1985	20304825.6971	36080245.1955	56229379.3549
3.1985	20525458.9142	38223268.9826	58784659.7471
4.1985	22994580.0287	37382800.7777	60448421.8170
1.1986	19135962.3757	36600178.5627	56160471.8422
2.1986	21387187.6579	37797930.8222	59772998.3670
3.1986	23158275.6414	41136665.2457	65108191.3607
4.1986	22853878.4485	38558095.1824	62026714.2446
1.1987	20452097.0008	40264211.6112	62053748.3982
2.1987	21432080.7691	38432875.6280	60880516.7402
3.1987	21807649.9674	40438430.1217	63314396.8278
4.1987	22801320.6599	38654732.0124	61978601.0968
1.1988	21158889.7633	40473818.2566	62214265.6450
2.1988	19434884.7989	34418363.9354	53997362.8296
3.1988	20121968.3906	38125951.6115	58084174.0569
4.1988	21270027.5873	38519984.8832	59697306.7987
1.1989	19327579.3136	38598247.1047	57979483.8665
2.1989	18708382.8656	35951622.9358	52812780.3493
3.1989	19417365.5360	36424598.9701	54966338.3338
4.1989	21841046.0623	36333406.4685	58070843.8563

Quarter	ytd	ynd	yyd
1.1978	19116658.6429	36156465.7938	55192389.7461
2.1978	19869894.6923	36065953.8333	55844753.6220
3.1978	21265567.0264	36518513.6359	57964359.5317
4.1978	22155154.8672	37667947.4804	59900312.1035
1.1979	21288742.2631	37978954.7433	59464060.4354
2.1979	22835972.1786	38660176.3409	61614885.1638
3.1979	22647516.8562	38704411.5096	61293710.4149
4.1979	22337687.2975	40995793.2470	63539254.9033
1.1980	20102015.2919	40130145.0231	60880408.0568
2.1980	20764092.3022	39561893.2408	61073629.7567
3.1980	22200746.9897	41086985.7486	64222456.0297
4.1980	22907330.1216	43598862.7883	67979537.5252
1.1981	20851890.9917	40636467.5691	63281458.7063
2.1981	20539400.4346	39719778.7659	61685248.5843
3.1981	19658046.6836	37714224.2723	58295432.3289
4.1981	19633808.7800	38157937.0412	58581680.9291
1.1982	18728416.9045	37191568.7408	56405964.2296
2.1982	17548180.6823	35134973.6679	52739407.0850
3.1982	18078638.8354	34939658.3847	52073688.4815
4.1982	19841101.6330	36768272.2037	55596600.7349
1.1983	19293170.8701	36236089.0974	54511846.2641
2.1983	19325176.9620	35816195.2655	54371455.8028
3.1983	19361158.5881	35982247.2833	54529885.0358
4.1983	21533661.7135	36996933.9987	57803647.4049
1.1984	19868115.3634	36935685.3036	55848724.7767
2.1984	20158336.4412	36801618.7154	56105736.8312
3.1984	21302694.6867	36494694.6989	57392247.5229
4.1984	21902487.8163	37917025.5071	59514341.9050
1.1985	18752811.0329	36950657.2068	55544337.7848
2.1985	18486580.7725	35759710.3578	54048186.0638
3.1985	18986416.7246	34517722.9296	53534323.7673
4.1985	22123271.9273	36984684.2596	59189159.3065
1.1986	18514949.8489	37353537.5123	56360004.5500
2.1986	20582154.0401	37997329.3518	59260641.0793
3.1986	22823500.2443	37895928.7344	61285900.6279
4.1986	22685136.0984	39054890.1537	62418878.3589
1.1987	20226809.8223	39022904.7240	60483660.5985
2.1987	21098105.2167	39366577.9576	61640562.8223
3.1987	21821651.3038	38852088.9188	61575888.9493
4.1987	22849357.0741	39893316.7354	63350688.8156
1.1988	20617167.0792	39663974.3993	60859508.2238
2.1988	18563027.5519	38854811.0831	57669194.7989
3.1988	19049527.8688	36960184.7816	55840974.0490
4.1988	20349696.1839	38255934.9533	58502720.7214
1.1989	18653794.8669	38680592.5726	57392608.6878
2.1989	16163053.0511	36452501.1534	50035032.9286
3.1989	17235050.5139	34704191.1791	50945779.9348
4.1989	20536460.9018	37356259.6765	57741698.4045

Quarter	ypd	yd	df
1.1978	54521258.9444	51489955.4031	350924.0506
2.1978	55221505.0270	54552066.5161	273592.8926
3.1978	57397927.9528	56041031.9215	220864.4737
4.1978	59483565.5845	57316728.0535	101968.0380
1.1979	59016045.4354	55986709.1546	164518.0328
2.1979	61203533.5298	59376813.6268	107001.1111
3.1979	60851455.3045	58773535.3703	112205.4443
4.1979	63071558.1433	61438686.6707	109914.4921
1.1980	60398100.0823	57769895.5306	138010.2209
2.1980	60527844.9623	58798487.2175	199797.7686
3.1980	63626195.9696	61296569.1562	156956.8890
4.1980	67373639.1884	63908241.0305	260691.0283
1.1981	62731980.8013	58120540.4607	259430.0941
2.1981	61111393.4977	57470128.0426	195519.0037
3.1981	57628865.2782	53452635.7348	337020.8384
4.1981	57891421.1544	55723464.7316	361081.2117
1.1982	55955378.8345	52655445.2522	167006.4928
2.1982	52254289.0516	51881851.2956	133671.5117
3.1982	51637469.9880	50896825.7022	98363.6669
4.1982	54994928.1424	55890987.5692	268766.4346
1.1983	53814536.9634	52937679.7760	332875.0642
2.1983	53396426.5902	53783201.6545	553229.3942
3.1983	53483596.6534	53871022.3776	707683.2926
4.1983	56664513.9740	56531791.5115	872153.4813
1.1984	55085605.5118	53297101.9510	525979.0689
2.1984	55416101.2856	54927785.3561	339225.5100
3.1984	56648228.0388	54138771.5055	377851.8883
4.1984	58779391.5686	58455916.7786	362925.5070
1.1985	55022628.2005	53232886.6067	245350.2962
2.1985	53045733.7251	52233626.2791	679506.7172
3.1985	52739975.7947	50909079.5245	189220.7047
4.1985	57438707.0405	59726791.6605	1001847.6417
1.1986	55393353.3892	56582802.9075	341159.2883
2.1986	58229848.2656	58723466.4785	261529.5687
3.1986	60336106.5075	57632672.4996	190426.9590
4.1986	61415782.0544	60779539.9635	422908.5006
1.1987	59645859.3935	56943256.6268	247906.9168
2.1987	60617271.7606	59849987.0544	377867.9517
3.1987	60633605.5840	57208067.2263	219131.3830
4.1987	62477657.4509	60160549.7878	323484.2609
1.1988	60385382.6107	57956507.4368	145581.2453
2.1988	57255892.6482	57075693.4156	148633.9885
3.1988	55473637.8238	52020411.0491	108653.2004
4.1988	58139172.9901	57020097.9271	143756.1265
1.1989	57020377.8334	55076233.8695	155863.0286
2.1989	49674855.2447	47985324.9067	137192.3135
3.1989	50608867.3309	47334217.3784	-8244.5759
4.1989	57390589.8917	58188200.7639	-48183.7280

Quarter	tx	tz	ty
1.1978	9512.6582	48837.5527	113392.4051
2.1978	5251.7355	46386.7769	138295.3719
3.1978	1929.3421	46835.5263	151383.8158
4.1978	1258.4388	46923.7342	126121.6245
1.1979	1807.6230	41806.8033	116827.6230
2.1979	3443.9869	49283.0065	124345.7516
3.1979	1651.4124	57295.9938	145642.8865
4.1979	1474.9124	84752.3205	144362.9597
1.1980	2925.1217	77039.0490	142347.3231
2.1980	1145.6806	80450.6535	158114.0261
3.1980	2836.7961	94380.2624	186436.8507
4.1980	772.8508	90085.4298	193677.2078
1.1981	6767.4509	77215.3642	204645.8674
2.1981	16993.2072	90957.9977	193259.6959
3.1981	20010.0147	83710.2231	177534.3589
4.1981	3414.8745	76666.9006	180458.6183
1.1982	23998.1082	63053.0946	160227.6917
2.1982	35530.9020	59090.7287	159393.4003
3.1982	44531.1553	45917.0002	149864.2942
4.1982	46897.4185	57973.9788	133106.3613
1.1983	116874.8352	53895.3582	116121.6037
2.1983	111241.9049	66491.3267	141792.0200
3.1983	92717.8051	53953.1907	134878.0451
4.1983	59219.3794	50476.8874	126470.6008
1.1984	83470.3877	36456.7698	98391.6713
2.1984	115996.2785	38570.1386	104696.4625
3.1984	88696.0834	42949.6376	106103.9786
4.1984	44558.3445	46575.0332	103295.6151
1.1985	74714.8907	37831.9611	85546.8884
2.1985	102839.1911	31794.6714	70850.9270
3.1985	152046.6722	60243.3553	120660.4211
4.1985	96362.7127	57038.1944	132597.3183
1.1986	67495.7625	56594.9011	127700.4198
2.1986	86439.9269	65948.9896	146746.5912
3.1986	78096.5030	73222.6392	132811.9932
4.1986	30123.0794	74337.8955	106656.7499
1.1987	22937.6610	68857.9832	98258.5963
2.1987	28800.0842	83118.1803	128927.4121
3.1987	19787.1369	89680.8343	129182.4169
4.1987	12957.7470	82328.6561	109779.1935
1.1988	10254.9869	78234.9373	91948.6190
2.1988	18555.1661	72608.0765	95651.4866
3.1988	20774.9046	69405.1278	88275.3387
4.1988	8508.9470	47842.1830	84176.8481
1.1989	5674.5380	41817.1901	72000.9327
2.1989	105828.6948	37093.1372	35263.6873
3.1989	156844.5359	33032.3806	73043.1980
4.1989	152219.8579	30036.5607	92623.6764

Quarter	ca	kar	bp
1.1978	375820.5049	1519738.1013	1895558.6061
2.1978	913601.8224	644816.0331	1558417.8554
3.1978	656847.7967	34883.4079	691731.2045
4.1978	-164418.3995	-248087.5527	-412505.9523
1.1979	-123955.5326	939669.3033	815713.7706
2.1979	369931.8955	838364.0261	1208295.9216
3.1979	-267769.2335	898029.4248	630260.1913
4.1979	-906119.0068	1135847.2855	229728.2786
1.1980	-804448.6469	761301.2355	-43147.4114
2.1980	-703174.8990	-436629.2636	-1139804.1626
3.1980	-833993.1244	802263.7507	-31729.3737
4.1980	-1181896.6278	26718.8569	-1155177.7709
1.1981	-982357.8918	-402124.0385	-1384481.9303
2.1981	-865532.3726	544905.4504	-320626.9221
3.1981	-848966.5388	86223.6823	-762742.8565
4.1981	-1344617.7189	484231.6663	-860386.0526
1.1982	-891035.6915	378349.6146	-512686.0769
2.1982	-723669.4626	159151.8582	-564517.6044
3.1982	-1178906.9320	675080.6097	-503826.3223
4.1982	-1331922.7424	526608.3575	-805314.3849
1.1983	-448727.7362	1798964.3041	1350236.5678
2.1983	-563221.4107	611387.2607	48165.8500
3.1983	-806673.7774	-86519.2430	-893193.0204
4.1983	-901909.6143	949241.1751	47331.5608
1.1984	-271732.1880	993717.1748	721984.9869
2.1984	-314470.9248	440546.6814	126075.7566
3.1984	-969640.1582	253693.4783	-715946.6799
4.1984	-1535122.4078	1187594.3512	-347528.0566
1.1985	-664923.9893	-120534.8875	-785458.8769
2.1985	347569.8159	101812.8625	449382.6783
3.1985	64464.3514	468303.5964	532767.9478
4.1985	-582577.9564	8913.6379	-573664.3186
1.1986	-713267.6669	173086.2617	-540181.4052
2.1986	-324866.1764	432186.3526	107320.1761
3.1986	-630973.2729	118701.5258	-512271.7471
4.1986	-778408.4665	50343.0216	-728065.4449
1.1987	-791230.4482	520684.4748	-270545.9733
2.1987	-739298.7992	-552628.0549	-1291926.8541
3.1987	-1192679.8969	-81207.7511	-1273887.6480
4.1987	-1343756.8293	351266.2795	-992490.5497
1.1988	-686882.7278	-188812.1034	-875694.8312
2.1988	-434606.0877	-21383.3439	-455989.4315
3.1988	-258605.6425	494293.5739	235687.9314
4.1988	-408933.1942	-146452.7364	-555385.9305
1.1989	-660697.5884	-505515.8336	-1166213.4220
2.1989	-651253.2327	-2570581.1024	-3221834.3351
3.1989	-17396.7416	654206.2930	636809.5514
4.1989	-770789.1299	-4384565.7705	-5155354.9005

Quarter	xt	zt	ER	rp
1.1978	1842358.6498	1188529.1139	0.000007	0.0201
2.1978	2298102.4793	1107105.7851	0.000009	0.0204
3.1978	2136472.8947	1136699.2105	0.000009	0.0209
4.1978	1278985.2321	1046712.0253	0.000011	0.0205
1.1979	1378229.0984	1066815.1639	0.000012	0.0206
2.1979	1933812.2876	1119874.5098	0.000014	0.0204
3.1979	1554876.6821	1376436.4150	0.000016	0.0205
4.1979	1166417.3380	1508122.5919	0.000018	0.0209
1.1980	1301926.2823	1442931.4115	0.000019	0.0220
2.1980	1108277.9726	1316800.1275	0.000021	0.0226
3.1980	1057907.3811	1445529.6337	0.000022	0.0209
4.1980	922261.2321	1469537.1281	0.000022	0.0186
1.1981	896110.6792	1177102.1686	0.000025	0.0202
2.1981	1645695.3582	1515102.9597	0.000041	0.0294
3.1981	1711256.8767	1381467.0262	0.000059	0.0348
4.1981	1066654.7539	1344415.4181	0.000078	0.0421
1.1982	1739446.3215	1189556.8392	0.000117	0.0514
2.1982	2121421.9283	1205394.4716	0.000156	0.0675
3.1982	1756940.5611	1316623.5609	0.000279	0.0888
4.1982	1795310.7911	1577403.8845	0.000448	0.0998
1.1983	2422839.1115	1223947.1623	0.000667	0.0961
2.1983	2581549.0148	1451891.5912	0.000892	0.0973
3.1983	2221769.7919	1342157.4879	0.001226	0.0912
4.1983	2007063.0036	1268266.8059	0.002031	0.0875
1.1984	2466017.6787	988006.1566	0.003173	0.0867
2.1984	2474538.5842	1110460.5570	0.004693	0.0805
3.1984	2015023.3902	1283960.1228	0.007900	0.0746
4.1984	1544962.1926	1409859.7160	0.015182	0.0885
1.1985	2012262.9835	1090394.3067	0.028490	0.0923
2.1985	2844120.1802	1025875.2557	0.063005	0.0940
3.1985	2671064.9571	1132022.7675	0.091289	0.0955
4.1985	1908632.7080	1037324.6066	0.091289	0.0909
1.1986	1587148.5693	966136.0425	0.091289	0.0932
2.1986	1946322.0638	1141288.4459	0.096912	0.0833
3.1986	1759193.7072	1424418.3101	0.110896	0.0725
4.1986	1374178.0336	1205435.6835	0.131342	0.0773
1.1987	1347049.0633	1121761.8848	0.160201	0.0801
2.1987	1606219.4383	1272243.8859	0.183792	0.0832
3.1987	1510277.4857	1524278.8221	0.245666	0.0834
4.1987	1561183.4645	1609219.8788	0.390846	0.0942
1.1988	1693377.6604	1151654.9763	0.496186	0.0927
2.1988	2239419.2833	1367562.0363	0.780812	0.1050
3.1988	2359369.1481	1286928.6262	1.278471	0.0886
4.1988	1955904.3042	1035572.9009	1.444533	0.0782
1.1989	1503057.6121	829273.1653	1.650652	0.0729
2.1989	4285985.2566	1740655.4420	14.662097	0.1938
3.1989	3433362.5041	1251047.4819	71.331492	0.1378
4.1989	2431746.7392	1127161.5787	92.965567	0.1264

Quarter	ww	bs=bd	ms=md
1.1978	111773751.7939	819170.6875	12477426.1603
2.1978	127884008.9626	1149361.2500	13040991.7355
3.1978	134129460.7402	1461409.8750	13595921.0526
4.1978	134589444.3110	1656160.2500	13682067.5105
1.1979	127796776.5504	1764888.5000	13856065.5738
2.1979	142315825.9727	1915112.2500	14570261.4379
3.1979	140766800.9473	1964159.6250	15041961.9928
4.1979	140894861.6835	2069653.0000	17002189.1419
1.1980	128225871.9157	2224691.0000	18179221.2654
2.1980	135920573.1238	2345738.2500	17456168.3137
3.1980	140980321.3286	2443660.7500	17676599.2346
4.1980	140713434.1563	2333486.5000	17440618.4118
1.1981	122602831.4996	2146228.2500	16509963.1751
2.1981	127657355.8358	2252832.2500	14717176.1281
3.1981	117469488.7333	2189345.2500	13952279.9706
4.1981	124432682.8741	2463465.2500	14352767.3453
1.1982	113972285.8087	2192961.0000	13871724.4064
2.1982	117301142.0247	2262637.7500	14432859.4101
3.1982	119240496.8105	2157404.5000	11583388.5575
4.1982	130196294.5919	2178090.7500	10240783.0694
1.1983	117067078.1414	1926362.8750	10410203.7322
2.1983	120876062.6610	1442295.1250	10449212.0131
3.1983	123737303.1240	1654162.8750	9707680.0973
4.1983	134335696.7997	1748101.5000	9763451.5343
1.1984	118976588.2762	1193696.1250	11079490.6513
2.1984	127747121.1580	1201530.0000	9877920.9913
3.1984	123311994.7223	1182523.3750	8738207.7310
4.1984	136493207.0390	1249901.8750	8082913.6613
1.1985	113311981.3272	1286274.6250	7512447.9322
2.1985	116225120.5436	1200009.8750	7141498.2069
3.1985	107723404.5475	1150634.0000	8089743.9051
4.1985	133058304.2871	1310139.6250	9684405.5711
1.1986	117557639.3241	1584413.5000	11001974.7405
2.1986	128583070.3702	1846313.1250	11425448.9301
3.1986	127353090.5810	2257096.5000	11041228.7798
4.1986	138235682.6944	2345310.5000	11783262.7816
1.1987	120475698.9232	2744514.5000	11937895.8539
2.1987	133164194.6985	3024864.7500	12291448.8201
3.1987	126964562.8100	3376415.0000	11603155.4640
4.1987	140511179.3029	3620961.5000	10745629.7646
1.1988	126282807.3205	3985811.5000	11363037.1170
2.1988	132843653.2717	4338482.0000	10416550.5939
3.1988	118627215.3625	4368121.0000	9998318.5345
4.1988	129823840.1292	4454146.5000	12134029.9656
1.1989	122314742.6008	4614357.0000	13797783.2487
2.1989	116956799.5486	4765490.0000	10302699.0367
3.1989	110831875.0925	5170712.5000	6913909.6155
4.1989	126534970.0665	5224671.5000	6215104.7845

Quarter	Bs=Bd	Ms=Md	IR	ir
1.1978	3.8829	59.1430	0.2788	-0.0422
2.1978	6.9536	78.8980	0.2224	-0.0423
3.1978	11.1067	103.3290	0.2120	-0.0352
4.1978	15.7004	129.7060	0.2152	-0.0258
1.1979	21.5316	169.0440	0.2076	-0.0616
2.1979	29.3012	222.9250	0.2086	-0.0363
3.1979	38.2422	292.8670	0.2323	-0.0316
4.1979	47.2709	388.3300	0.2054	0.0275
1.1980	59.4215	485.5670	0.1661	-0.0028
2.1980	73.5858	547.6000	0.1504	-0.0205
3.1980	89.3891	646.6100	0.1613	-0.0041
4.1980	99.6165	744.5400	0.1505	-0.0141
1.1981	104.9076	807.0070	0.2176	0.0634
2.1981	139.2926	909.9630	0.2786	0.0108
3.1981	178.6068	1138.2270	0.3242	0.0036
4.1981	249.2534	1452.2130	0.2279	-0.0100
1.1982	281.6858	1781.8230	0.2274	-0.0332
2.1982	342.1561	2182.5370	0.2298	0.0446
3.1982	488.3285	2621.9000	0.2028	-0.1964
4.1982	707.0518	3324.3630	0.2588	-0.1223
1.1983	900.1508	4864.4800	0.3368	-0.0713
2.1983	921.5833	6676.7330	0.3176	-0.0364
3.1983	1604.8192	9418.1000	0.4107	-0.0709
4.1983	2782.3483	15539.9000	0.5011	-0.0850
1.1984	2909.3120	27003.2670	0.3492	-0.1189
2.1984	4896.8355	40257.4670	0.4429	-0.1371
3.1984	8465.6494	62556.5670	0.5408	-0.1229
4.1984	15282.0628	98826.6330	0.6016	-0.0622
1.1985	28810.8280	168268.7670	0.6638	-0.0918
2.1985	59946.5533	356753.9000	0.8699	-0.1616
3.1985	79707.1442	560395.7330	0.1087	-0.2005
4.1985	94185.7280	696210.3670	0.0959	0.0560
1.1986	120982.4559	840087.4670	0.0959	0.0317
2.1986	158748.0334	982372.6670	0.1002	-0.0229
3.1986	236830.4096	1158523.2330	0.1367	-0.0685
4.1986	289918.3249	1456601.9330	0.1687	-0.0080
1.1987	412692.3160	1795099.9670	0.1500	-0.0546
2.1987	528740.6111	2148521.9000	0.1630	0.0004
3.1987	779719.4664	2679530.2670	0.3096	-0.0087
4.1987	1240842.0583	3682344.9670	0.3276	-0.1053
1.1988	1755417.6288	5004470.4000	0.3905	0.0819
2.1988	3058070.4929	7342325.2670	0.5263	-0.0464
3.1988	5551425.4534	12706818.3330	0.4167	-0.2143
4.1988	7054422.9752	19217728.8670	0.3075	0.0492
1.1989	9412997.5755	28146608.5670	0.4822	0.1508
2.1989	36418942.4310	78735534.6670	2.8129	0.0178
3.1989	265153712.8465	354544717.9330	0.4780	-0.7797
4.1989	367516756.2433	437186366.6670	0.3858	0.0103

Quarter	PN	PT	PZ	P	P^e
1.1978	0.000005	0.000005	0.000006	0.000005	0.000004
2.1978	0.000006	0.000006	0.000009	0.000006	0.000006
3.1978	0.000008	0.000007	0.000007	0.000008	0.000006
4.1978	0.000010	0.000009	0.000008	0.000009	0.000009
1.1979	0.000012	0.000012	0.000014	0.000012	0.000011
2.1979	0.000016	0.000015	0.000013	0.000015	0.000014
3.1979	0.000019	0.000020	0.000017	0.000019	0.000017
4.1979	0.000023	0.000022	0.000021	0.000023	0.000022
1.1980	0.000028	0.000025	0.000035	0.000027	0.000025
2.1980	0.000034	0.000028	0.000029	0.000031	0.000029
3.1980	0.000040	0.000032	0.000046	0.000037	0.000033
4.1980	0.000048	0.000035	0.000043	0.000043	0.000038
1.1981	0.000056	0.000039	0.000057	0.000049	0.000048
2.1981	0.000070	0.000051	0.000076	0.000062	0.000079
3.1981	0.000089	0.000072	0.000095	0.000082	0.000089
4.1981	0.000108	0.000091	0.000128	0.000101	0.000108
1.1982	0.000134	0.000121	0.000182	0.000128	0.000153
2.1982	0.000152	0.000150	0.000208	0.000151	0.000171
3.1982	0.000205	0.000256	0.000313	0.000226	0.000271
4.1982	0.000290	0.000373	0.000563	0.000325	0.000363
1.1983	0.000418	0.000536	0.001073	0.000467	0.000484
2.1983	0.000585	0.000713	0.001084	0.000639	0.000625
3.1983	0.000885	0.001088	0.001424	0.000970	0.000878
4.1983	0.001432	0.001812	0.002551	0.001592	0.001606
1.1984	0.002192	0.002776	0.003881	0.002437	0.002487
2.1984	0.003687	0.004612	0.005695	0.004076	0.003605
3.1984	0.006749	0.007725	0.008553	0.007159	0.006860
4.1984	0.011740	0.012898	0.018365	0.012227	0.013758
1.1985	0.022076	0.022844	0.039216	0.022399	0.022944
2.1985	0.048988	0.051291	0.078369	0.049955	0.049534
3.1985	0.069524	0.068924	0.092104	0.069272	0.072380
4.1985	0.072797	0.070637	0.081337	0.071890	0.069272
1.1986	0.079542	0.071960	0.094784	0.076358	0.071890
2.1986	0.092098	0.077534	0.101501	0.085981	0.081061
3.1986	0.114247	0.092057	0.127147	0.104927	0.098388
4.1986	0.134475	0.108620	0.144398	0.123616	0.124272
1.1987	0.167100	0.127266	0.186767	0.150370	0.150777
2.1987	0.194888	0.147055	0.217190	0.174798	0.172514
3.1987	0.254830	0.197928	0.237856	0.230931	0.233644
4.1987	0.367667	0.308181	0.484811	0.342683	0.367404
1.1988	0.463175	0.408989	0.519253	0.440417	0.435042
2.1988	0.718273	0.686364	0.741637	0.704871	0.693053
3.1988	1.250766	1.298693	1.312009	1.270896	1.154128
4.1988	1.567736	1.605954	1.729519	1.583788	1.435974
1.1989	2.049129	2.027243	1.857660	2.039937	1.809777
2.1989	6.246753	9.569303	16.292172	7.642224	18.119962
3.1989	46.607559	57.732223	51.761929	51.279918	37.179623
4.1989	69.161719	71.973239	100.731787	70.342558	66.832566

Quarter	pn	pt	pz	WR	wr
1.1978	0.988989	1.016603	1.215492	0.000004	0.843882
2.1978	0.993504	1.007207	1.507910	0.000005	0.839669
3.1978	1.025510	0.964671	0.970054	0.000006	0.850000
4.1978	1.011753	0.983502	0.791709	0.000009	0.928270
1.1979	1.020489	0.972672	1.127579	0.000012	0.943443
2.1979	1.016340	0.977536	0.833940	0.000015	0.956209
3.1979	0.991172	1.012517	0.854344	0.000019	1.000000
4.1979	1.020567	0.971467	0.911351	0.000027	1.164186
1.1980	1.052722	0.926997	1.322912	0.000031	1.148259
2.1980	1.069205	0.904150	0.930855	0.000036	1.133886
3.1980	1.090153	0.875257	1.256047	0.000043	1.170312
4.1980	1.123244	0.829752	1.006228	0.000052	1.226517
1.1981	1.151134	0.791461	1.160342	0.000057	1.174509
2.1981	1.125746	0.826259	1.233879	0.000064	1.032023
3.1981	1.087388	0.879306	1.163976	0.000075	0.922530
4.1981	1.071563	0.901151	1.269929	0.000100	0.984483
1.1982	1.042843	0.940870	1.415209	0.000113	0.879253
2.1982	1.005066	0.993063	1.375824	0.000117	0.773178
3.1982	0.905203	1.130960	1.384077	0.000175	0.773227
4.1982	0.891860	1.149353	1.735159	0.000297	0.913745
1.1983	0.893966	1.146416	2.297045	0.000411	0.879944
2.1983	0.915693	1.116411	1.697182	0.000636	0.995086
3.1983	0.911991	1.121544	1.467894	0.001058	1.090592
4.1983	0.899849	1.138310	1.602458	0.001923	1.208087
1.1984	0.899462	1.138834	1.592218	0.003187	1.307759
2.1984	0.904710	1.131589	1.397384	0.005516	1.353353
3.1984	0.942754	1.079052	1.194726	0.009388	1.311373
4.1984	0.960218	1.054936	1.502079	0.017509	1.432072
1.1985	0.985604	1.019881	1.750814	0.028191	1.258589
2.1985	0.980636	1.026740	1.568793	0.053680	1.074572
3.1985	1.003637	0.994977	1.329598	0.066115	0.954423
4.1985	1.012622	0.982570	1.131413	0.075880	1.055502
1.1986	1.041706	0.942406	1.241316	0.084827	1.110909
2.1986	1.071144	0.901753	1.180503	0.092963	1.081200
3.1986	1.088820	0.877344	1.211764	0.122406	1.166584
4.1986	1.087846	0.878689	1.168114	0.145834	1.179728
1.1987	1.111260	0.846355	1.242052	0.164629	1.094828
2.1987	1.114932	0.841284	1.242517	0.189642	1.084920
3.1987	1.103488	0.857088	1.029988	0.245389	1.062606
4.1987	1.072908	0.899317	1.414750	0.350506	1.022829
1.1988	1.051674	0.928641	1.179005	0.469763	1.066632
2.1988	1.019013	0.973744	1.052160	0.666492	0.945551
3.1988	0.984161	1.021872	1.032350	1.131061	0.889972
4.1988	0.989865	1.013996	1.092014	1.732684	1.094013
1.1989	1.004506	0.993777	0.910646	2.275005	1.115233
2.1989	0.817400	1.252162	2.131863	5.813494	0.760707
3.1989	0.908885	1.125825	1.009400	31.611690	0.616454
4.1989	0.983213	1.023182	1.432018	61.322214	0.871765

Quarter	π^e	ri	ri^e	qf	VCN
1.1978	0.220900	0.335200	0.302774	1.443000	0.000003
2.1978	0.171185	0.276400	0.280836	1.449588	0.000004
3.1978	0.073992	0.256200	0.170462	1.496287	0.000005
4.1978	0.134520	0.247400	0.326993	1.476216	0.000006
1.1979	0.158485	0.286900	0.273706	1.488961	0.000008
2.1979	0.143805	0.254100	0.270615	1.482909	0.000010
3.1979	0.128302	0.272500	0.237101	1.446186	0.000014
4.1979	0.107574	0.173100	0.249175	1.489075	0.000017
1.1980	0.088489	0.169400	0.152872	1.535992	0.000020
2.1980	0.069927	0.174500	0.149499	1.560041	0.000023
3.1980	0.051854	0.166100	0.154627	1.590606	0.000028
4.1980	0.034671	0.167000	0.147033	1.638887	0.000033
1.1981	0.119241	0.145000	0.262419	1.679581	0.000038
2.1981	0.623188	0.264900	0.660543	1.642539	0.000045
3.1981	0.437080	0.319400	0.119903	1.586572	0.000056
4.1981	0.325335	0.240300	0.216827	1.563482	0.000071
1.1982	0.513108	0.269500	0.415975	1.521577	0.000085
2.1982	0.328076	0.177300	0.114274	1.466458	0.000094
3.1982	0.790784	0.496800	0.587434	1.320751	0.000141
4.1982	0.604805	0.434200	0.341375	1.301284	0.000223
1.1983	0.489606	0.439500	0.331202	1.304357	0.000320
2.1983	0.337368	0.367400	0.292354	1.336057	0.000465
3.1983	0.374579	0.518300	0.405471	1.330656	0.000753
4.1983	0.655616	0.640600	0.828763	1.312940	0.001339
1.1984	0.562480	0.531300	0.548288	1.312375	0.002089
2.1984	0.479266	0.672200	0.449718	1.320032	0.003628
3.1984	0.683341	0.756600	0.902875	1.375541	0.006362
4.1984	0.921716	0.707900	1.005333	1.401023	0.011633
1.1985	0.876564	0.832000	0.667745	1.438062	0.019908
2.1985	1.211481	1.230300	1.158916	1.430814	0.042154
3.1985	0.448900	0.386700	0.461210	1.464374	0.047074
4.1985	0.300000	0.037800	-0.042933	1.477483	0.051416
1.1986	0.200000	0.062200	0.037785	1.519919	0.056161
2.1986	0.061598	0.126000	0.127578	1.562871	0.062215
3.1986	0.144303	0.220300	0.213752	1.588661	0.079821
4.1986	0.184369	0.178100	0.263079	1.587239	0.095300
1.1987	0.219718	0.216400	0.213278	1.621403	0.110451
2.1987	0.147262	0.162500	0.144165	1.626760	0.128038
3.1987	0.336651	0.321100	0.354351	1.610062	0.172486
4.1987	0.590967	0.483900	0.572494	1.565445	0.252804
1.1988	0.269516	0.285200	0.184097	1.534462	0.337471
2.1988	0.573629	0.600500	0.593072	1.486808	0.520187
3.1988	0.637360	0.803000	0.665282	1.435957	0.889239
4.1988	0.129891	0.246200	0.244207	1.444279	1.211834
1.1989	0.142689	0.288000	0.260314	1.465641	1.635707
2.1989	7.882608	2.746300	9.012261	1.192641	7.586745
3.1989	3.865026	5.710100	1.051860	1.326124	30.852812
4.1989	0.303289	0.371700	0.797559	1.434573	48.495250

Quarter	IR*	PT*	PZ*	DE
1.1978	0.064100	0.629890	0.739844	846600000.00
2.1978	0.064800	0.648994	0.999542	910700000.00
3.1978	0.075300	0.658819	0.752462	1133000000.00
4.1978	0.086800	0.674103	0.672600	1249600000.00
1.1979	0.093600	0.698665	1.070146	1413100000.00
2.1979	0.093800	0.723228	0.863706	1576600000.00
3.1979	0.096300	0.746153	0.999959	1740100000.00
4.1979	0.118000	0.772353	1.114691	1903400000.00
1.1980	0.134600	0.807832	1.742547	2106700000.00
2.1980	0.100500	0.824207	1.336551	2309900000.00
3.1980	0.092400	0.851498	1.991236	2513100000.00
4.1980	0.137100	0.869511	1.806099	2716200000.00
1.1981	0.143700	0.894619	2.121403	2929000000.00
2.1981	0.148300	0.916452	1.767438	3141700000.00
3.1981	0.150900	0.923548	1.529938	3354400000.00
4.1981	0.120200	0.923002	1.567497	3567100000.00
1.1982	0.129000	0.930622	1.471095	3766200000.00
2.1982	0.123600	0.931460	1.272649	3965300000.00
3.1982	0.097100	0.935652	1.084736	4166200000.00
4.1982	0.079300	0.930622	1.213047	4363400000.00
1.1983	0.080800	0.937329	1.540998	4399400000.00
2.1983	0.084200	0.939844	1.162198	4435200000.00
3.1983	0.091900	0.949067	1.116288	4471100000.00
4.1983	0.087900	0.954097	1.208015	4506900000.00
1.1984	0.091300	0.964158	1.179612	4535000000.00
2.1984	0.098400	0.970865	1.172731	4563000000.00
3.1984	0.103400	0.968350	1.047578	4591100000.00
4.1984	0.089700	0.965835	1.170987	4619100000.00
1.1985	0.081800	0.964158	1.330314	4697800000.00
2.1985	0.075200	0.964996	1.206455	4776400000.00
3.1985	0.071000	0.958289	0.957957	4854600000.00
4.1985	0.071500	0.964158	0.844550	4932600000.00
1.1986	0.068900	0.949905	0.980836	4989600000.00
2.1986	0.061300	0.931460	0.990139	5037400000.00
3.1986	0.055300	0.927268	1.090480	5089900000.00
4.1986	0.053400	0.930622	1.035539	5142200000.00
1.1987	0.055300	0.941521	1.098408	5314800000.00
2.1987	0.057300	0.956612	1.109244	5487400000.00
3.1987	0.060300	0.967512	0.914411	5660000000.00
4.1987	0.060000	0.971704	1.180041	5832400000.00
1.1988	0.057600	0.976734	0.979921	5831900000.00
2.1988	0.062300	0.994340	0.901941	5831400000.00
3.1988	0.069900	1.007755	0.973719	5830900000.00
4.1988	0.077000	1.021169	1.144415	5830300000.00
1.1989	0.085300	1.035118	1.071384	5955600000.00
2.1989	0.084400	1.053413	1.087991	6080900000.00
3.1989	0.078500	1.049561	0.706986	6205300000.00
4.1989	0.076400	1.053413	1.055414	6331400000.00

Quarter	ged	trs	ta
1.1978	671130.8017	118587.1941	148464.1350
2.1978	623248.5950	137618.7273	159721.8182
3.1978	566431.5789	136468.0263	145418.4211
4.1978	416746.5190	135433.8608	140474.6835
1.1979	448015.0000	184174.8631	123054.9180
2.1979	411351.6340	222015.9046	127277.7778
3.1979	442255.1104	241783.7704	125459.3734
4.1979	467696.7601	251391.4190	127192.0753
1.1980	482307.9745	196240.9835	121986.2598
2.1980	545784.7944	227137.6050	106276.6656
3.1980	596260.0601	249803.9913	155649.2619
4.1980	605898.3368	291418.7552	60671.8201
1.1981	549477.9051	228289.7574	1419.1285
2.1981	573855.0865	238478.7322	77125.1820
3.1981	666567.0507	276199.5587	48291.6156
4.1981	690259.7747	320400.2108	68638.1696
1.1982	450585.3951	194505.5404	36300.0078
2.1982	485118.0333	202891.2622	97431.4905
3.1982	436218.4935	173512.5838	97542.3769
4.1982	601672.5926	282361.7768	94928.3994
1.1983	697309.3006	377738.5080	77542.4392
2.1983	975029.2126	489666.0667	102274.5669
3.1983	1046288.3824	282917.2894	57056.0489
4.1983	1139133.4309	464239.0030	30813.0821
1.1984	763119.2649	322384.8796	18821.3673
2.1984	689635.5456	359544.9066	91147.1559
3.1984	744019.4841	279848.5769	128417.8961
4.1984	734950.3364	192153.5214	177595.8367
1.1985	521709.5844	220891.2557	78265.5480
2.1985	1002452.3387	309917.2716	117460.8320
3.1985	794347.9726	306531.5459	272176.8193
4.1985	1750452.2660	366339.6664	462606.3989
1.1986	966651.1607	328475.1576	373700.7890
2.1986	1030792.8138	535847.9945	470127.7374
3.1986	949794.1204	495861.4727	475236.0260
4.1986	1003096.3045	393450.6524	369070.0791
1.1987	837801.2050	337324.2035	399840.0478
2.1987	1023291.0617	237050.2502	404577.4334
3.1987	942283.3652	309985.1498	484501.5941
4.1987	873031.3647	275461.5541	344481.5072
1.1988	474125.6132	147078.7668	148105.8246
2.1988	413302.1507	127663.6289	77853.4329
3.1988	367336.2252	95253.5676	80227.6539
4.1988	363547.7313	71425.3083	79263.6268
1.1989	372230.8544	120291.1005	96875.1649
2.1989	360177.6838	93211.8267	44799.8510
3.1989	336912.6039	81783.9361	82237.0654
4.1989	351108.5127	99980.5988	124412.1457

Quarter	trx	trz	try	zrd
1.1978	0.005163	0.041091	0.001947	118852.911392
2.1978	0.002285	0.041899	0.002435	110710.578512
3.1978	0.000903	0.041203	0.002564	113669.921053
4.1978	0.000984	0.044830	0.002089	104671.202532
1.1979	0.001312	0.039188	0.001916	106681.516393
2.1979	0.001781	0.044008	0.001982	111987.450980
3.1979	0.001062	0.041626	0.002386	137643.641500
4.1979	0.001264	0.056197	0.002331	150812.259194
1.1980	0.002247	0.053391	0.002353	144293.141146
2.1980	0.001034	0.061096	0.002686	131680.012751
3.1980	0.002682	0.065291	0.002982	144552.963368
4.1980	0.000838	0.061302	0.002884	146953.712813
1.1981	0.007552	0.065598	0.003129	117710.216858
2.1981	0.010326	0.060034	0.003125	151510.295973
3.1981	0.011693	0.060595	0.002929	138146.702623
4.1981	0.003201	0.057026	0.003165	134441.541807
1.1982	0.013796	0.053006	0.002727	118955.683924
2.1982	0.016749	0.049022	0.003000	120539.447163
3.1982	0.025346	0.034875	0.002951	131662.356086
4.1982	0.026122	0.036753	0.002515	157740.388454
1.1983	0.048239	0.044034	0.002024	122394.716230
2.1983	0.043091	0.045796	0.002539	145189.159115
3.1983	0.041732	0.040199	0.002479	134215.748786
4.1983	0.029505	0.039800	0.002193	126826.680594
1.1984	0.033848	0.036899	0.001646	98800.615658
2.1984	0.046876	0.034733	0.001828	111046.055699
3.1984	0.044017	0.033451	0.001780	128396.012276
4.1984	0.028841	0.033035	0.001815	140985.971598
1.1985	0.037130	0.034696	0.001506	109039.430667
2.1985	0.036159	0.030993	0.001260	102587.525567
3.1985	0.056924	0.053217	0.002053	113202.276752
4.1985	0.050488	0.054986	0.002194	103732.460665
1.1986	0.042526	0.058579	0.002274	96613.604254
2.1986	0.044412	0.057785	0.002455	114128.844595
3.1986	0.044393	0.051405	0.002040	142441.831010
4.1986	0.021921	0.061669	0.001720	120543.568351
1.1987	0.017028	0.061384	0.001583	112176.188476
2.1987	0.017930	0.065332	0.002118	127224.388595
3.1987	0.013102	0.058835	0.002040	152427.882208
4.1987	0.008300	0.051161	0.001771	160921.987879
1.1988	0.006056	0.067933	0.001478	115165.497627
2.1988	0.008286	0.053093	0.001771	136756.203626
3.1988	0.008805	0.053931	0.001520	128692.862622
4.1988	0.004350	0.046199	0.001410	103557.290086
1.1989	0.003775	0.050426	0.001242	82927.316527
2.1989	0.024692	0.021310	0.000668	174065.544198
3.1989	0.045682	0.026404	0.001329	125104.748193
4.1989	0.062597	0.026648	0.001595	112716.157867

Quarter	kt	kn	kk
1.1978	41360405.0773	57116749.8687	98477154.9460
2.1978	47751335.5104	65942320.4667	113693655.9771
3.1978	50010294.5213	69061835.2913	119072129.8125
4.1978	50085510.9512	69165705.5993	119251216.5505
1.1979	47113845.4402	65061977.0364	112175822.4766
2.1979	52848789.9596	72981662.3252	125830452.2847
3.1979	51979485.3184	71781194.0111	123760679.3295
4.1979	51165668.2075	70657351.3342	121823019.5417
1.1980	45285223.0531	62536736.5971	107821959.6502
2.1980	48769839.9552	67348826.6049	116118666.5601
3.1980	50761225.7645	70098835.5795	120860061.3440
4.1980	50794518.2827	70144810.9618	120939329.2445
1.1981	43657588.8313	60289051.2432	103946640.0745
2.1981	46488685.9323	64198661.5255	110687347.4578
3.1981	42557702.6753	58770160.8374	101327863.5127
4.1981	45198909.1171	62417541.1617	107616450.2788
1.1982	41121192.1690	56786408.2333	97907600.4023
2.1982	42254370.8431	58351274.0214	100605644.8645
3.1982	44309875.5762	61189828.1767	105499703.7530
4.1982	49466516.7244	68310904.0480	117777420.7724
1.1983	43986814.8443	60743696.6898	104730511.5341
2.1983	45773513.3196	63211042.2033	108984555.5230
3.1983	47197693.2637	65177766.8880	112375460.1517
4.1983	51586140.3815	71238003.3839	122824143.7654
1.1984	44815428.6300	61887972.8700	106703401.5000
2.1984	49000421.4700	67667248.6967	116667670.1667
3.1984	47624330.7188	65766932.8974	113391263.6163
4.1984	53407364.4312	73753027.0716	127160391.5028
1.1985	43895568.6834	60617690.0866	104513258.7701
2.1985	45311117.2339	62572495.2278	107883612.4617
3.1985	41362871.1898	57120155.4526	98483026.6424
4.1985	51266778.8182	70796980.2728	122063759.0911
1.1986	44087925.4551	60883325.6285	104971251.0835
2.1986	48430749.4924	66880558.8228	115311308.3152
3.1986	47903001.4265	66151763.8747	114054765.3012
4.1986	52124985.9534	71982123.4594	124107109.4128
1.1987	44433181.1991	61360107.3702	105793288.5693
2.1987	49496110.0739	68351771.0545	117847881.1284
3.1987	47033696.7853	64951295.5607	111984992.3460
4.1987	52980726.9761	73163861.0622	126144588.0382
1.1988	46592262.6555	64341696.0480	110933958.7035
2.1988	49597220.6847	68491399.9931	118088620.6778
3.1988	43789525.8478	60471249.9802	104260775.8280
4.1988	47558978.7387	65676684.9249	113235663.6636
1.1989	43639092.9879	60263509.3642	103902602.3521
2.1989	42793216.4150	59095394.0969	101888610.5119
3.1989	41473846.2504	57273406.7267	98747252.9771
4.1989	50534343.4184	69785521.8635	120319865.2820

Appendix 5

THE PERCENTAGE RELATIONSHIP BETWEEN PN AND ER

In Chapter 3, we have postulated a linear relationship between percentage changes in the nontradables price (PN) and the nominal exchange rate (ER), and this linear relationship satisfies our theoretical conclusions that PN and ER are positively related and that percentage changes in PN and ER need not be equal or proportional. The derivation of this relationship is presented in this appendix. First, we rewrite equation (3.29) below

1. PN = ER*qf*[n*(1+trz)]+qf*(WR*m+k)

where PN, ER, qf, trz, WR, n, m, and k denote, respectively, the nontradables price, the nominal exchange rate, the mark-up factor, the import tax rate, the nominal wage rate, the input-output ratios of imported inputs, of labour, and of capital. Assuming that all terms in equation (1), except PN and ER, are constant in the short-run, we can rewrite equation (1) as

2. PN = a*ER + b

where a=qf*n*(1+trz) and b=qf*(WR*m+k). Given equation (2), since dPN/dER=a, dPN=a*dER, dPN/PN=a*dER/PN, and PN=a*ER+b, the relationship of percentage changes in PN and ER can be expressed as

3. $(dPN/PN) = (dER/ER)[a*ER/(a*ER+b)]$

Expanding (3) by Taylor series around ER=1, we obtain the following linear relationship,

4. $(dPN/PN) = (dER/ER)\{(a^2-ab)/(a+b)^2 + [ab/(a+b)^2]*ER\}$

Thus, equation (4) can be expressed as

5. $(dPN/PN) = h_0 + h_1(dER/ER)$

where $h_0 = [ab/(a+b)^2]*dER$, $h_1 = (a^2-ab)/(a+b)^2$. Note that if dER=0, h_0=0, i.e., if dER=0, the relationship of percentage changes between PN and ER does not exist. Moreover, the critical value, defined as $h_0/(1-h_1)$, varies as dER varies. Finally, one should be aware that the linear form of the relationship between percentage changes in PN and ER, which is derived in this appendix, is valid only as a local approximation as far as the underlying assumption - short run invariance of all terms except PN and ER - is admittedly strong.

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