

Université de Montréal

FINANCIAL LIBERALIZATION: THE CASE OF MEXICO

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SOMMAIRE

Deux aspects de la récente libéralisation financière au Mexique sont étudiés dans ce papier: premièrement le déroulement du processus de dérèglementation lui-même, et deuxièmement la stabilité de la demande de monnaie tout au long de cette période.

Dans la première partie du papier, nous posons un oeil critique sur la chronologie de la libéralisation financière. Dans cette partie, nous sommes intéressés à examiner comment les réformes ont été faites, quelle a été la séquence suivie par les autorités pour l'application de ces réformes, est-ce que la séquence suivie est théoriquement correcte et justifiable? Finalement, quels ont été les conséquences de ces réformes pour l'ensemble de l'économie.

La deuxième partie du papier se consacre à l'étude des implications de la libéralisation financière sur la demande de monnaie, et ce en s'attaquant à la stabilité et à la prévisibilité des agrégats monétaires Mexicains. Pour réaliser ceci, nous faisons appel à des techniques avancées d'étude de séries temporelles. La demande de monnaie mexicaine est alors analysée par le biais de la cointégration multivariée, et ce dans un cas où il y a rupture de tendance.

ABSTRACT

Two main aspects of Mexico's recent financial liberalization are studied in this paper: first the deregulation process itself and second the effects of the liberalization on the stability of the demand for money.

In the first part of the paper, a critical eye is laid on the chronology of the financial deregulation. In this part we are interested in examining how the reforms were conducted, what was the sequence of the policies being applied, was the sequence correct and justifiable by the theory, and finally what are the results for the economy at large.

The second part of the paper investigates the implications of financial liberalization on money demand, focusing on stability and predictability of Mexico's narrow and broad monetary aggregates. In order to do so, two advanced time series econometric techniques, multivariate cointegration and structural break analysis, were jointly applied.

RÉSUMÉ

Les années 80 ont été des années très difficiles pour plusieurs pays d'Amérique latine. Le Mexique, par exemple, a vécu pendant cette période une crise qui a marqué son histoire économique de manière brutale. Pour combattre les difficultés économiques qui se sont abattues sur le pays au début des années 80, le gouvernement mexicain a entrepris un fort programme d'ajustement structurel. Ce programme visait à stabiliser l'économie ainsi qu'à stimuler l'ouverture commerciale et financière du pays.

Dans ce papier nous nous occupons à étudier la partie de la réforme financière du programme d'ajustement structurel mexicain des dernières années. Le papier est divisé en deux parties. Dans la première partie nous analysons la libéralisation financière mexicaine avec un oeil critique sur la séquence des réformes et sur les résultats obtenus. Dans la deuxième partie, nous évaluons la demande de monnaie mexicaine tout au long de cette période de libéralisation financière, pour voir quel a été l'effet de celle-ci sur la stabilité de la demande de monnaie.

Nous commençons par analyser les bénéfices qu'une libéralisation financière bien réussie peut apporter à l'ensemble de l'économie. Selon plusieurs auteurs (voir Khoury, 1990, *inter alia*) un pays qui a libéralisé son secteur financier profitera d'une politique monétaire et fiscale plus efficace, d'une meilleure allocation de ressources par les marchés financiers, d'un marché financier plus équitable, d'un système bancaire plus stable et compétitif, ainsi que des coûts de transaction plus bas. Tous ces avantages attirent des capitaux internationaux, qui ont, rappelons-nous, fuit le Mexique après la crise de la dette de 1982.

La situation économique mexicaine a commencé à se détériorer vers la fin des années 70 et a eu son coup de grâce en 1982 avec la crise de la dette. Des mesures de stabilisation ont

été prises à partir du début des années 80, mais la plupart d'entre elles ont eu des effets peu significatifs. En 1987 le gouvernement du président Miguel de la Madrid a signé le *Pacto de Solidaridad Económica* (l'accord de solidarité économique). Cet accord qui a été signé par le gouvernement, le secteur industriel et les unions de travailleurs avait l'intention de réduire l'inflation par le contrôle des prix et des salaires. En plus cet accord prévoyait une correction des finances publiques et la libéralisation du commerce extérieur.

Cet accord a été d'une importance profonde pour le changement de l'économie mexicaine. Son succès, particulièrement en ce qui attrait au contrôle de l'inflation, a donné les bases nécessaires pour les réformes entreprises par le président Carlos Salinas de Gortari à partir de 1988.

La libéralisation financière mexicaine a commencé durant l'administration de de la Madrid (1982-1988), mais a été lente jusqu'à 1988. Vers la fin de 1988 les réformes du secteur financier se sont accélérées. En 1989 le gouvernement a commencé à modifier les lois sur les réserves bancaires et a engagé le processus de libéralisation des taux d'intérêts. Selon Leite et Sundararajan (1990a), ces mesures permettent d'augmenter la compétitivité du secteur financier et d'améliorer son efficacité.

Plusieurs réformes institutionnelles ont suivi. Le gouvernement mexicain se préoccupa alors de régler le problème de sa dette internationale. Avec l'aide du plan Brady, signée en 1989, le gouvernement mexicain a pu alléger sa dette internationale. La réduction de la dette prévue dans cet accord a permis au Mexique de récupérer une partie de sa crédibilité internationale et d'augmenter la confiance des investisseurs étrangers. La réduction de la dette extérieure ainsi qu'une politique adéquate du taux de change ont facilité la rentrée d'emprunteurs mexicains dans les marchés de capitaux internationaux, et ce après une exclusion de presque 7 ans.

Enfin, en 1990 le gouvernement et le secteur financier de l'économie étaient prêts à faire face à la privatisation des banques commerciales (nationalisées au sommet de la crise de la dette en 1982). Le processus de privatisation a suivi des règles claires et précises. Entre juin 1991 et juillet 1992, le gouvernement a vendu aux enchères 18 banques commerciales pour une valeur de \$13 milliards (US\$) à des groupes d'investisseurs mexicains.

Les banques privatisées font, aujourd'hui, face à des problèmes d'ordre financier. Ces difficultés, par contre, sembleraient être liées à la période d'ajustement à la nouvelle réalité de marché plus compétitif et à un manque de dispositifs légaux nécessaires pour assurer le bon fonctionnement de ces institutions. Le traité de libre échange nord américain vient mettre plus de pression aux banques mexicaines pour qu'elles s'ajustent rapidement aux nouvelles exigences du marché. Même si les banques nationalisées font face à quelques problèmes d'ordre financier il semblerait que ces problèmes soient transitoires. Le gouvernement mexicain est en train de faire des ajustements et des corrections pour régler les problèmes des banques.

En somme, la libéralisation financière mexicaine a été un processus très dynamique et très rapide. La plupart des réformes du secteur financier ont été réalisées entre les années 1989 et 1991. Les autorités mexicaines ont su stabiliser l'économie avant d'entreprendre les réformes financières, ce qui constituait une condition *sine qua non* au succès des réformes. La libéralisation financière a été accompagnée de réformes dans plusieurs secteurs de l'économie, notamment le commerce extérieur. Mis à part le problème de prêt non performant des banques mexicaines, la réforme du secteur financier au Mexique semble être très bien réussie. Cependant, il faut tenir compte que ces réformes sont récentes et qu'il faudra attendre au moins un cycle économique complet pour pouvoir juger davantage de la réussite de cette libéralisation financière.

Dans la deuxième partie du papier nous analysons les effets de la libéralisation financière sur la stabilité des agrégats monétaires mexicains. Ici, nous utilisons conjointement deux nouveaux concepts économétriques, la cointégration multivariée et les ruptures de tendance. Selon le concept de cointégration multidimensionnelle, il existe une ou des relations d'équilibre à long terme entre des variables qui sont non stationnaires (voir Perron et Campbell, 1992). Conformément à l'idée de rupture de tendance, présenté par Perron (1989), une série stationnaire est caractérisée par un changement structurel de sa moyenne. En combinant ces deux concepts, nous voulons étudier s'il existe une relation d'équilibre à long terme pour les agrégats monétaires mexicains, et ce dans le cas où il y aurait rupture structurelle.

La théorie économique nous dit que pour avoir une politique monétaire efficace, il est essentiel d'avoir de la stabilité entre les agrégats monétaires, l'activité économique, les prix, et les taux d'intérêts. Cependant une libéralisation financière change la qualité de l'environnement économique et peut créer de l'instabilité. Dans cette partie du papier nous voulons voir de quelle manière ce changement a affecté la stabilité de la demande de monnaie mexicaine.

La demande de monnaie est définie comme une fonction de revenus (ou de la richesse), des prix, et des taux d'intérêt. Il est à noter que nous travaillons avec une demande de monnaie réelle (donc l'homogénéité des prix est imposée). Comme nous travaillons avec un modèle de cointégration multivariée, de style Johansen (1989), nous sommes intéressés au rang de la matrice Π , car celui-ci nous donne la dimension du vecteur de cointégration. Rappelons qu'il y a trois possibilités pour le rang de Π :

- a) Rang complet, indiquant que toutes les variables sont stationnaires.
- b) Rang zéro, ce qui montre qu'il n'y a aucun vecteur de cointégration.

c) Rang = r , $0 < r < p$ (le nombre de variables) où il y a r vecteurs de cointégration.

Pour commencer l'analyse il faut premièrement trouver le degré d'intégration des variables. Pour cela nous faisons des tests de racine unitaire sur les séries. Les séries sont testées par les tests de Dickey-Fuller, Augmented Dickey-Fuller et Phillips-Perron. Cependant, après une inspection visuelle des séries (voir figures 8 et 9) il semblerait que certaines séries seraient caractérisées par des ruptures de tendance, ce qui pourrait biaiser les tests de racine unitaire et rejeter l'hypothèse de stationnarité. Nous procédons alors à des tests de racine unitaire en présence de rupture structurelle (voir Perron, 1993b). Deux tests sont alors administrés, le <<Additive Outlier Test>> et le <<Innovation Outlier Test>>. Les deux expérimentations testent pour un changement d'ordonnée et pour un changement de pente. Nous testons donc pour un changement de niveau de la série, qui est suivi par un changement du taux de croissance. Ces tests démontrent clairement une rupture structurelle pour l'inflation et pour les taux d'intérêts (voir figure 10) et ce à la date 1987:4 (ce qui correspond au programme de stabilisation de l'inflation du *Pacto de solidaridad económica*).

Parce que nous avons certaines séries avec une rupture structurelle et certaines séries sans rupture, il faut les ajuster pour faire les tests de cointégration multivariée. La tendance des séries est alors enlevée. Il est à noter que cette modification est faite en prenant en considération la même rupture structurelle, et ce pour toutes les séries.

Une fois la tendance enlevée des séries, la cointégration multidimensionnelle à la Johansen est appliqué. Noter qu'il nous a fallu calculer des valeurs critiques pour les tests de cointégrations car ceux-ci sont réalisés sur des séries qui ont des ruptures structurelles. Les résultats nous démontrent que pour les deux agrégats monétaires utilisés, soient M1 et M2, nous trouvons que

le rang de la matrice Π est complet. Ce qui veut dire que nous pouvons travailler avec les séries en niveaux et qu'il y a une stabilité à long terme pour la demande de monnaie réelle en relation aux taux d'intérêts et au revenu réel.

Les résultats de cointégration complète sont peut-être dus au fait que la rupture structurelle des séries a été prise en considération dans l'analyse de cointégration. Cependant, nous croyons qu'il est important de travailler avec la caractérisation appropriée des séries et que seulement dans ce cas, les résultats deviennent significatifs.

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I. INTRODUCTION

Mexico, the country that Alan Riding once called the *distant neighbour*, is now becoming more and more important to Canada, to the United States and to the global economy. The North American Free Trade Agreement, that has commenced on January first, 1994, is a clear evidence that the once troublesome economy of Mexico has come a long way into recovery. It is interesting to observe the structural adjustment path that this country has taken to emerge from its severe and calamitous financial crisis of the beginning of the 1980's.

In 1982, *la crisis* was devastating the economy. The Mexican government had to announce a moratorium on its' foreign debt, as it had run out of international reserves. High inflation, capital flight, collapse of security prices were just a few symptoms of the fainting economy. By the end of the year the government started to react by signing an agreement with the IMF. The agreement called for public deficit cuts, import compressions, and inflation and wage reduction. The imposition of these restrictive measures led the country into recession (Winters, 1993, p. 506). The Mexican government, however, was disposed to take action in order to correct the structural and macroeconomic disequilibria. It was, thus, imperative that Mexico make a strong and continuous commitment to achieve macroeconomic stability and enter the road of sustained economic growth.

From the end of 1982, Mexico has engaged in a major transformation of its economic structure. At the beginning the changes were slow and modest, however, from 1988 they accelerated and became more important in nature (Kalter and Khor, 1990). For this, Mexico is now achieving significant improvements in its financial performance. The "...inflation rate has

fallen markedly, output and employment have risen substantially, and financial savings have soared. Furthermore, the balance of payments has become stronger" (Loser and Kalter, 1992, p. 1).

It is, therefore, the goal of this paper to study the financial liberalization part of the structural adjustment undertaken by Mexico during the 1980's and up to now. The paper is composed of two parts. In the first part, we review Mexico's financial deregulation with a critical eye on the chronology of events and on their effects overall. In the second part, we try to estimate the long run equilibrium relationship of Mexico's monetary aggregates, to see if the stability was maintained through the financial liberalization period. The analysis is carried out through multivariate cointegration in the presence of structural breaks.

**PART I: FINANCIAL LIBERALIZATION
AND REFORM,
A CRITICAL OVERVIEW**

In this first part of the paper it is our intention to introduce the reader to the financial liberalization that occurred in Mexico in recent years, by analyzing the principal policy changes and try to see if the measures undertaken were adequate. A detailed chronology of the process is given in Appendix 1. Appendix 2 gives a description of the Mexican financial system together with its financial instruments.

"Generally speaking, financial sector reforms aim at achieving greater flexibility of interest rates, and enhanced role for market forces in credit allocation, increased independence for the central bank, and a deepening of money and securities markets." (Khan and Sundararajan, 1991).

Various authors have worked with the appropriate sequencing of financial deregulation in order to avoid any adverse consequences to the financial institutions and to the economy at large (see *inter alia* Leite and Sundararajan, 1990a, 1990b; Caprio and Summers, 1993; McKinnon, 1988; Villanueva and Mirakhor, 1990). Leite and Sundararajan (1990a), for instance, have put forward a set of conditions for a smooth financial liberalization process. They suggest that interest rate liberalization have a better chance of success if the four following issues are taken into account before the liberalization:

- * Will there be adequate competition in the financial markets?

- * Are the money market and monetary policy instruments adequate to influence the marginal cost of funds to banks? And consequently interest rates?
- * Will the market-determined lending and deposit rates respond rapidly to shifts in monetary policy and to developments in international interest rates and exchange rates?
- * Is the banking system sufficiently sound to face interest rate competition? Is the bank supervision mechanism sufficiently strong to anticipate the effects of liberalization and react to it in a timely and efficiently manner?

Furthermore, they say that macroeconomic stability normally constitutes the *sine qua non* condition for a successful structural adjustment in the financial and in the real sectors (Leite and Sundararajan 1990a, 1990b), point which is in accordance with Villanueva and Mirakhor (1990), Dornbusch and Reynoso (1989), and McKinnon (1988). This issue is of direct relevance to Mexico, as it was facing a dramatic debt problem and macroeconomic instability during the early 1980's. Note, however, that Caprio et al (1993), when analyzing financial liberalization, concluded that macroeconomic conditions may never be ideal for such a deregulation. They say that to maximize the benefits of financial reforms, countries should attempt reforms more aggressively during times of positive or neutral macroeconomic and political shocks. Nonetheless, they give some examples of countries who went through financial sector reforms in less favourable circumstances and achieved good results (Indonesia, Malaysia, Chile and to a certain extent the United States).

We will use Leite and Sundararajan's set of conditions as well as information on other countries' experiences, presented by other authors, to try to evaluate if Mexico's liberalization

measures were preceded by the adequate provisions. First, however, the reasons why a financial deregulation should be undertaken are discussed.

A. THE ECONOMICS OF DEREGULATION

According to Khoury (1990, p. 54), a country should view its financial liberalization as an investment in its' financial well-being. He argues that a country that undergoes financial liberalization would probably benefit in the following ways:

- * Increased financial flexibility of firms and households.
- * Reduced transaction costs, improving the operational efficiency of the financial markets.
- * Improved allocation efficiency of the financial markets.
- * New capital attracted to financial intermediaries.
- * Banking institutions that are stronger and more competitive in a global market.
- * Better diversified bank portfolios.
- * A more effective monetary and fiscal policy.
- * A fairer market.

He analyses the liberalization experience of the United States, Canada, England, Australia, Japan, and Hong Kong and concludes that some of these countries have undertaken financial liberalization as a measure to stimulate their economies (p. 214). Dornbusch and Reynoso (1989), explain that growth in *per capita* income comes from two sources: accumulation of physical capital and more efficient use of resources. Financial liberalization affects both channels, influencing the availability of savings and also the intermediation of these savings to investments

that offer higher returns. It is not difficult to see, then, why some authors associate financial developments with more growth in the real sector¹ (see, for instance, Caprio and Summers, 1993; Caprio, Atiyas and Hanson, 1993).

Khoury (1990) cautions, though, that too much opening can make the economy vulnerable to world fluctuations in economic activity. Caprio and Summers (1993), argue that even though a country should liberalize its financial sector, governments must keep a certain level of control as perfect competition is not the best answer for the financial sector. The rationale behind their argument is that government intervention in financial markets should be reduced. However, they warn that a policy of total *laissez faire* is a dangerous one as the financial system has externalities of its own. They favour a gradual withdrawal of the government from financial markets and suggest that the role of government should be limited to providing stable macroeconomic conditions and ensuring that financial operations are safe and sound.

B. CHRONOLOGY OF DEVELOPMENTS: 1952 TO 1988

According to Ibarra (1988, pp. 110-111), during the 1952-72 period, the Mexican economy was growing and integrating itself into the world's financial markets. There were no restrictions on international financial flows and the national currency (the peso) was freely convertible. The exchange rate was fixed with respect to the U.S.A. dollar. Consequently, in order to stabilize the economy, authorities controlled inflation within a range similar to the American

¹ Caprio and Summers (1993) report that Jung (1986) found that the causality (in the sense of Granger) between growth and finance goes both ways. Meaning that a better financial system causes growth and growth causes a better financial system.

one. The intermediation function of the banking sector, however, was plagued by high regulations, ceilings on deposit rates and requirements to channel credit to a specific range of activities. While these policies favoured borrowers with direct access to the bank credit it discouraged financial savings in the formal markets. Furthermore, with a minor exception², no foreign banks could operate in Mexico. The relative openness of the Mexican economy combined with the highly regulated banking system and a fixed exchange rate, implied an imperfect control by the Central Bank over money supply or interest rates. Monetary control, according to Coorey (1992, p. 38), was based mainly on quantitative credit controls rather than on market mechanisms. Thus, economic stability was dependent on fiscal policy, and the efficiency of the financial system to borrow from abroad. Ros (1992) argues that during the 1970's Mexico's macroeconomic objectives were met, by a large extent, by the country's unconstrained foreign credit. In other words by increasing its foreign debt.

"By 1976, external shocks, cumulative peso overvaluations, postponement of tax and banking reforms, agricultural stagnation, and the decreasing growth effects of industrial import substitution broke the delicate financial balance, setting the stage for a deep economic crisis" (Ibarra, 1988, p. 112). Kalter and Khor (1990), note that the Mexican government, then, started an adjustment program backed by the IMF. Program which Coorey (1992, p. 37) believes to be the foundations of the financial liberalization that took place after 1988.

According to the later, the most significant measures that were then undertaken were:

- a) the move from specialized banking to full-service banking (at the time the Mexican banking system was indeed highly fragmented and each bank was specialized in a very

² The Mexico branch of Citybank, Banco de México (1993).

restricted scope of services: commerce, mortgages, and the *financieras* which financed mostly trade and commerce);

- b) the modernization of the securities market. The Securities Market Law (*Ley del Mercado de Valores*) was enacted in 1975 (De Angoitia, 1993); and
- c) the formation of a domestic public debt market (the CETES³ were created in 1978, as an instrument for the government to issue domestic debt and to conduct open market operations⁴).

The year 1982 was a particularly difficult year for the Mexican financial system, at the peak of the debt crises, the commercial banks were nationalized. The years that followed were characterized by financial desintermediation. "The high implicit tax that reserve requirements and credit controls imposed on banks increased the cost of intermediation to such an extent that a parallel informal market for credit developed rapidly, particularly in 1987-88 when inflation picked up" (Coorey, 1992, p. 38). This parallel market helped further deteriorate the

³ See definition on Appendix 2.

⁴ "Open market operations can be conducted either in the primary market or in the secondary market. Many countries have used primary sales of some government securities -- either central bank securities or treasury bills -- as an instrument of monetary policy. By varying the timing and the volume of primary issues and by issuing them at market rates, it is possible to influence bank reserves and interest rates in the short run, which has provided an attractive alternative technique to influence short run interest rates and monetary developments, in the absence of active secondary markets in these securities. This has also served as a transitional device to foster the development of secondary markets. Once a genuine secondary market develops, monetary policy can be implemented by operating in these markets." (Leite and Sundararajan, 1990a, p. 13).

competitiveness of the commercial banks making monetary policy objectives more difficult to be attained.

The years of Miguel de la Madrid (1982-1988), as president of Mexico, were years where Mexico saw consecutive stabilization and structural adjustment policies being tried out. Some have failed but some have formed a necessary and important base for the reforms undertaken under the presidency of Carlos Salinas de Gortari (1988-1994) (Kalter and Khor, 1990, pp. 22-24). Probably one of the most important measures taken by the presidency of de la Madrid was the so called *Pacto de Solidaridad Económica* (the Economic Solidarity Pact). This accord, which was signed on December 15th, 1987, by government, the industrial sector and by union leaders, had the intention of reducing the inflation rate by controlling prices and wages. Aspe (1992) defined this non-orthodox stabilization program as consisting basically of:

- * a strengthened commitment to the permanent correction of public finances,
- * a restrictive monetary policy,
- * agreements on the setting of reference prices and on the wage contracting mechanism, and
- * the thorough trade liberalization.

The program was very effective in reducing the inflation rate, see figure 1. However, as mentioned by Kalter (1992), it affected real GDP growth, which remained at 1.5% and contributed to a substantial rise in real interest rates (probably due to the increase in uncertainty), see figure 1.A.

Figure 1: Mexico's Interest and Inflation Rates, 1978-1993
Percentage and quarterly

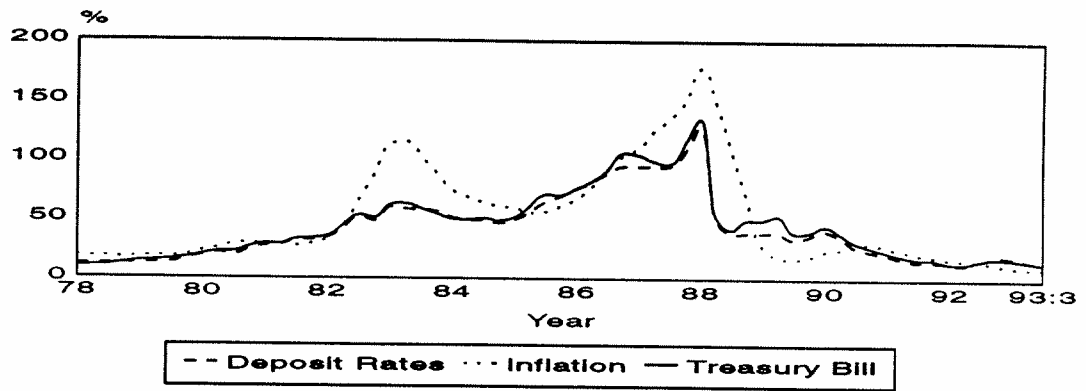
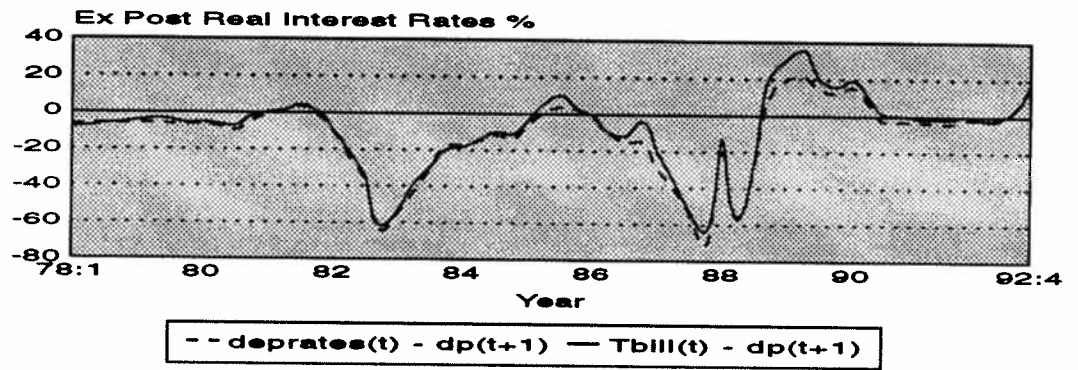


Figure 1.A: Ex Post Real Interest Rates

Three-month Instrument (deposit rates and T.bills) minus the inflation rate observed in the sub-sequent quarter



On December 1988, under President Carlos Salinas de Gortari, the government accelerated the reforms initiated in the de la Madrid's administration. Barnes (1992), summarized the Salina's economic strategy as being: macroeconomic stabilization, structural reforms and the reduction of poverty. "The stabilization strategy was based on macroeconomic programs that included tight fiscal and monetary policies, a revised wage and price control agreement between the government, business and labour, and the strengthening of the balance of payments" (Barnes, 1992, p. 3). Moreover, he notes that the structural reform was aimed at increasing productivity and improving market performances. These reforms were based on: trade liberalization, foreign

investment promotion, privatization of state enterprises, deregulation, and fiscal and financial sector reform.

Many of the proposed reforms were included in the *Pacto de Estabilidad y Crecimiento Económico* (Pact of Stability and Economic Growth) or *PECE* by its Spanish acronym or simply, the *Pacto*. The salient features of the *Pacto* are that it asked for more radical adjustments in public finances and that it implemented structural reforms in the fiscal, budgetary, financial and commercial areas (Aspe, 1992). This program also called for the deregulation of the economy and the divestiture of public sector enterprises.

The success of the *Pactos* in reducing inflation rates proved the government's serious commitment to the stabilization of macroeconomic conditions. As a result, confidence by foreign and domestic investors was regained (see figure 2 and table 1). Successful domestic reform programs were also essential in preparing Mexico for the big challenge of refacing the international capital markets (see section C.2.2).

C. FINANCIAL LIBERALIZATION: 1988 TO THE PRESENT

Starting from late 1988, the Mexican authorities have undertaken major reforms, specially on the financial system⁵. These reforms were to continue the more global strategy of structural adjustment, which aimed at ending Mexico's remaining economic problems, in order to allow it to pursue stable economic growth. The new policies included a medium term solution to the debt problem.

1. Interest Rate Deregulation and Changes in the Reserve Requirement System

Beginning on October 1988, the Mexican government engaged in a series of liberalization policies to help increase banks' intermediation functions as well as to make them more efficient. The government eliminated quantitative restrictions on the issuance of banker's acceptances. Banks saw then an increase in their available resources, they were allowed to invest freely from these resources, condition on maintaining the 30% liquidity ratio in the form of government debt instruments (CETES and BONDES⁶) and interest bearing deposits at the Bank of Mexico (Coorey, 1992, p. 38).

1989 was marked by continuous reforms, the most significative of which, were probably:

⁵ Financial markets are fragmented into four main industries: banking, investment services, securities markets and insurance (Key, 1989, pp. 597-599).

⁶ See definition on Appendix 2.

- * The elimination of controls on interest rates and maturities on all traditional bank instruments and deposits;
- * The reserve requirements on bank deposits were replaced by a 30% liquidity ratio similar to that applicable to bankers' acceptances. Government paper held to satisfy the liquidity ratio would earn market interest rates and would be fully tradable;
- * Restrictions on bank lending to the private sector were removed;
- * The role of providing preferential credit was limited to development banks and trust funds;
- * Mandatory lending at below-market interest rates to the public sector by commercial banks was discontinued; and
- * Greater degree of managerial flexibility was given to banks.

As a consequence of the reforms, banks were now allowed to set their own rates on deposit and credit operations. These measures gave banks more "breathing space" and helped increase the competition among them. Furthermore, as noted by Coorey (1992, p. 38), the government shifted its financing from mandatory subsidized lending to open market operations through the selling of bonds. This measure had the impact of reducing interest rates distortions and of improving the effectiveness of open market operations. He also notes, however, that "the requirement to hold government paper had a negative effect on the yields of these instruments and constituted an implicit tax on the financial system." The problem is that it creates a forced demand for government paper, making interest rates on these securities be at an artificial level, that is lower than if there was no intervention.

It is important to remark that the Mexican government was then preparing the market for the privatization of the commercial banks, which was to take place from 1990. The liberalization of the interest rates prior to the privatization of banks had the intention of differentiating banks in order to increase their competitiveness and market value. The issue of the privatization of the commercial banks will be discussed in greater detail in section C.5.

Note here that one of Leite's and Sundararajan's (1990a) points for a suave financial liberalization is indeed the increased competition in the financial markets. They argue that, there will be significant distortions in the level, structure and responsiveness of interest rates if their liberalization is not accompanied by adequate policy changes to ensure a certain level of competition in the market. According to these authors, in order to have increased competition it is important to have the "interest rates liberalization accompanied by a properly phased freeing and homogenization of various portfolio regulations" (1990a, p. 9). To accomplish that, some necessary measures are: the elimination or reduction of selective credit policies at below market interest rates; the introduction of legislation to allow for more competitive banking; the provision of adequate incentives for borrowers to behave in an interest-sensitive fashion (by eliminating "soft" budgets of state enterprises, for example). Notice that these policies are also in accordance with the idea of a more general liberalization, and even with the idea of the integration of financial markets⁷.

⁷ See for instance, Grandmont (1992, pp. 41-46), who shows the importance for the European Community of having the proper regulations when integrating the European banking system. Folkerts-Landau and Mathieson (1989, pp. 7-11) who show the implications of increased financial liberalization on the integration of European financial markets.

Coorey (1992) notes that in August 1991, the commercial banks started to have problems with the required liquidity constraints. The problems arose basically from two sources: first from an increase in the liquidity constraint level. This increase came from the noticeable expansion of foreign short term borrowing by the commercial banks, which made the authorities impose a liquidity constraint on foreign currency deposits of up to 50%, depending on deposit maturities (the ratio could be satisfied by holding specified high quality currency instruments, such as U.S. Treasury bills). Second from the enlarged demand for private credit that steamed from the reduction of nominal interest rates (see figure 1). The decline in interest rates came from the reduction of the public debt, which contributed to the improvement of the balance of payments due to the positive effects that it had on the confidence of investors in the country (El-Erian, 1990, p. 27). It is relevant to note here the importance of the Brady Deal, signed by Mexico in principle on July 23th, 1989 and implemented on March 28th, 1990. According to Claessens et al (1993), one of the main contributions of the Mexican Brady Deal was the reduction of uncertainty, which encouraged a positive macroeconomic response. The reduction of uncertainty diminished Mexico's country risk premium, see figure 2 and table 1. As a consequence, interest rates fell sharply, and private investment and growth recovered. (A further examination of Mexico's Brady Deal and its implications will be discussed in section 2.1).

TABLE 1: MEXICO'S COUNTRY RISK PREMIUM

YEAR AND QUARTER	MEXICAN T.BILLS (1)	LIBOR (2)	U.S. T. BILLS (3)	COUNTRY RISK	
				(1)-(2)*	(1)-(3)**
1984:1	49.7	10.304	9.13	39.396	40.57
1984:2	49.12	11.49	9.84	37.63	39.28
1984:3	50.24	11.949	10.34	38.291	39.9
1984:4	48.21	10.014	8.97	38.196	39.24
1985:1	51.28	9.031	8.18	42.249	43.1
1985:2	61.26	8.258	7.52	53.002	53.74
1985:3	70.49	8.143	7.1	62.347	63.39
1985:4	69.78	8.151	7.13	61.629	62.65
1986:1	75.99	7.908	6.89	68.082	69.1
1986:2	81.66	7.106	6.13	74.554	75.53
1986:3	91.11	6.274	5.53	84.836	85.58
1986:4	105.52	6.143	5.34	99.377	100.18
1987:1	103.85	6.375	5.53	97.475	98.32
1987:2	98.8	7.149	5.73	91.651	93.07
1987:3	96.25	7.222	6.03	89.028	90.22
1987:4	113.38	7.964	6.00	105.416	107.38
1988:1	134.47	6.984	5.76	127.486	128.71
1988:2	52.06	7.481	6.23	44.579	45.83
1988:3	41.12	8.419	6.99	32.701	34.13
1988:4	48.93	9.019	7.70	39.911	41.23
1989:1	49.24	9.812	8.53	39.428	40.71
1989:2	52.87	9.779	8.44	43.091	44.43
1989:3	38.71	8.929	7.85	29.781	30.86
1989:4	39.15	8.616	7.63	30.534	31.52
1990:1	44.38	8.404	7.76	35.976	36.62
1990:2	37.98	8.463	7.77	29.517	30.21
1990:3	30.18	8.166	7.49	22.014	22.69
1990:4	26.5	8.221	7.02	18.279	19.48
1991:1	22.94	6.874	6.05	16.066	16.89
1991:2	19.54	6.171	5.59	13.369	13.95
1991:3	17.58	5.843	5.41	11.737	12.17
1991:4	17.05	5.053	4.58	11.997	12.47
1992:1	13.9	4.246	3.91	9.654	9.99
1992:2	13.69	4.084	3.72	9.606	9.97
1992:3	16.75	3.469	3.13	13.281	13.62
1992:4	18.14	3.625	3.08	14.515	15.06
1993:1	17.31	3.258	2.99	14.052	14.32
1993:2	15.57	3.215	2.98	12.355	12.59
1993:3	13.75	3.255	3.02	10.495	10.73

(1) Rate of return on 90 days Mexican Treasury Bills (CETES).

(2) 90 days Labor rates.

(3) Rate of return on 90 days U.S. Treasury Bills.

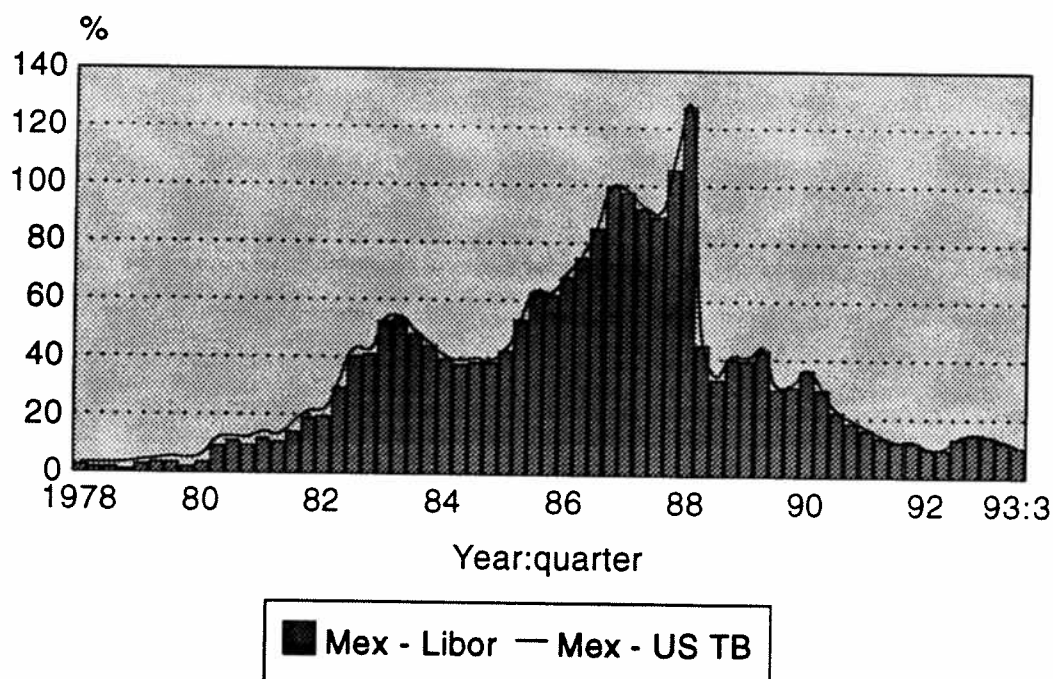
(*) Country risk premium = $[(1+CETES)/(1+Libor)] - 1$

(**) Country risk premium = $[(1+CETES)/(1+US T.B.)] - 1$

source: Author's calculations based on IMF's International Financial Statistics data, and estimation procedure following the directives of the Ministry of Economics and Public Service of Argentina (1993).

Because of the liquidity requirement problems that the commercial banks were facing, in August, 1991, the CETES rates fell to about 16% and the deposit rates increased to around 50% to 60% (Coorey, 1992). The Mexican authorities then took measures to reduce the liquidity coefficient on domestic currency deposits from 30% to 25%, and then in September suppressed the liquidity constraint. The idea behind zero marginal requirement is to reduce the spread between interest rates and to increase the amount of available resources. It is expected that Mexico experience a reduction in its banking spread. Interest rates, then, reflect more the market risks and the improved inter-banking competition rather than the previously profitability set for the nationalized banks.

Figure 2: Mexico's Country Risk Premium
Percentage



source: See table 1 for calculations.

2. Changes in Structure of Government Debt

It is important at this stage to take a look at what is happening with Mexico's international debt. In a paper by Khor and Rojas-Suárez (1991), they show that interest rates in the Mexican domestic market are cointegrated with implicit yield derived from the secondary market for Mexican external debt. These authors also demonstrated that although the latter variable causes the former (in Granger terms), the inverse relationship did not hold.

The policy implication of their findings is that in order for Mexico to have permanent decline in domestic interest rates, the Mexican government must create an atmosphere of confidence in the international market. This can only be achieved through an appropriate exchange rate policy and the improvement of economic fundamentals, which will eventually affect the perception of international investors about the country's creditworthiness.

After the debt crisis Mexico saw its access to international capital markets diminish considerably. This forced and restricted the government to largely finance its fiscal deficits through the sale of government bonds to the domestic market. The composition of the debt was then changing from international to domestic. Rojas-Suárez (1992) reports that this change resulted in sharp increases in the real interest rates of government bonds. Which, in turn, increased the inflation rates. She continues to explain that the crowding out of private investment that resulted from the increased financing of government deficits through the domestic market, and from the massive transfer of real resources negatively affected the economic activity and helped build inflationary pressures and contributed to capital flights.

A period of stabilization and of repeated debt rescheduling followed from 1983 to 1987⁸. During this time the Mexican domestic public debt was constituted (80% to 90%) of *CETES* (which yielded market determined interest rates). Coorey (1992) notes that from 1988 the Mexican authorities started to diversify the composition of their domestic debt, and that since then there has been a rapid growth and diversification of the market for government debt⁹. "The development of this market aided the process of liberalization by providing the public sector with an alternative to forced lending from the banking system. It also has expanded the range of financial assets available to private investors..." (Coorey, 1992, p. 39).

Finally in 1989 future expectations about the debt problem changed. They became positive, and optimistically affected consumer confidence, private investment and contributed to capital inflows. Albeit factors such as the improvement of economic conditions and the reduction of inflation contributed to the changes in expectations, the negotiation of the Mexican Brady deal was clearly a turning point.

2.1 Mexico's Brady Deal

As stated above the importance of the debt-relief package, known as the Brady Deal was profound. Mexico was the first country to beneficiate from a debt and debt service reduction (DDSR) under the Brady initiative. The final package, of the agreement reached on July 23, 1989, was implemented on March 28, 1990. Claessens et al (1993) estimated that the complete package delivered a debt reduction of US\$12 billion, in discounted value terms.

⁸ For a complete examination see, *inter alia*, El-Erian, 1992.

⁹ The domestic debt diversified and today it is mainly composed of four instruments: CETES, BONDES, Ajustabonos, and Bonos de la deuda pública (Coorey, 1992).

According to these authors and to Ortiz (1991) the deal permitted Mexico to reembarc in the trail of growth. Claessens et al (1993) demonstrate by the use of econometric techniques, that the debt reduction had a positive macroeconomic effect. The main determinant was surprisingly not the "debt overhang¹⁰" but the increased confidence in government policy.

The confidence-building effect of the negotiation was probably as important as the financial effects of the reduced resource transfers on the restriction of economic growth. The mere announcement of the agreement precipitated a decline of domestic interest rates of about 20 percentage points (from nominal levels of about 55%) as well as some capital inflows. Ortiz (1991, p. 302)

Claessens et al (1993) are, however, categorical in saying that the debt relief program would not have been effective, in increasing investors' confidence, if there were no successful domestic reforms *prior* to the debt relief package. Moreover, Szymczak (1992) added that the comprehensiveness of the Deal convinced international investors that this was a once-and-for-all operation. This facilitated the acceptance of the view that Mexico was, once again, in a position to responsibly meet all obligations of debt-service and debt maturity on contracted debt as well as on new debt.

2.2 Mexico's Return to International Capital Markets

As we have seen, another important move for the reduction of interest rates in the domestic market is the acceptance of the creditworthiness of Mexican securities in the international markets. Mexico's re-entry into the international capital markets showed that the

¹⁰ Debt overhang refers to benefits to growth of a reduced tax burden (Claessens et al, 1993).

sustained policies of macroeconomic stabilization and market oriented structural reforms (including the negotiations of the North American Free Trade Agreement) were regarded as credible. Hence, an increase in the confidence of international investors followed.

June 1989 marked the end of many years of Mexican exclusion from voluntary international capital market financing, by the issue of a \$100 million five year note by *Bancomext*. This was "the first unsecured¹¹ voluntary public sector issue by a Mexican borrower since 1992" (Szymczak, 1992, p. 65). In order to be accepted, this first instrument had a very high yield (820 basis points over the yield on comparable maturity U.S. Treasury bonds). Its objectives, however, were met as it paved the Mexican way back into international capital market financing (and this for the public and for the private sector).

Szymczak (1992) notes that financing costs have declined over time as Mexican securities became more acceptable by international investors. Mexican securities now face a much lower yield premium above "risk-free" paper and the borrowers were able to increase bond maturities. Moreover, Mexico has diversified its international capital financing options by making increasing use of, among others: equity-linked debt instruments, short-term debt instruments, equity and equity derivatives. According to Khor and Rojas-Suárez (1991), the improved Mexican credibility in the international markets helped decrease the implicit yield derived from the secondary market for Mexico's external debt from 25% (in early 1990) to 16% (in mid 1991).

"In June 1990, the Mexican Stock Market (BMV) was granted the status of an 'Offshore Designated Securities Market' by the Japanese financial authorities. This allows Japanese brokerage houses to deal with securities listed in the BMV" (Szymczak, 1992, p. 71). Szymczak

¹¹ Unsecured or unenhanced bonds are those without collateralization or convertibility options. "Conversion rights provide for conversion into equity in the borrowing enterprise at a prespecified price" (Szymczak, 1992, p.66).

(1992) also notes that similar agreements were concluded with American and British authorities, and that Mexican brokerage houses have been allowed to open foreign subsidiaries and thus be able to trade Mexican securities abroad. Furthermore, from December 1990, Moody's Investors Services started rating Mexican bonds. Interestingly, he notes, the market seems to have ignored Moody's ratings, giving Mexico more favourable terms, what contributes to lower cost borrowing.

Therefore, the increasing confidence of international investors in Mexican securities made possible the decline in the country risk premiums (see figure 2). As international interest rates on Mexican securities decrease domestic interest rates also drop (see figure 1).

Moreover, the return of capital inflows, through international capital financing, permitted the funding of new investment projects. These projects help increase Mexico's infrastructure and industrial base. Consequently, the country's international competitiveness is enriched, what affects its creditworthiness.

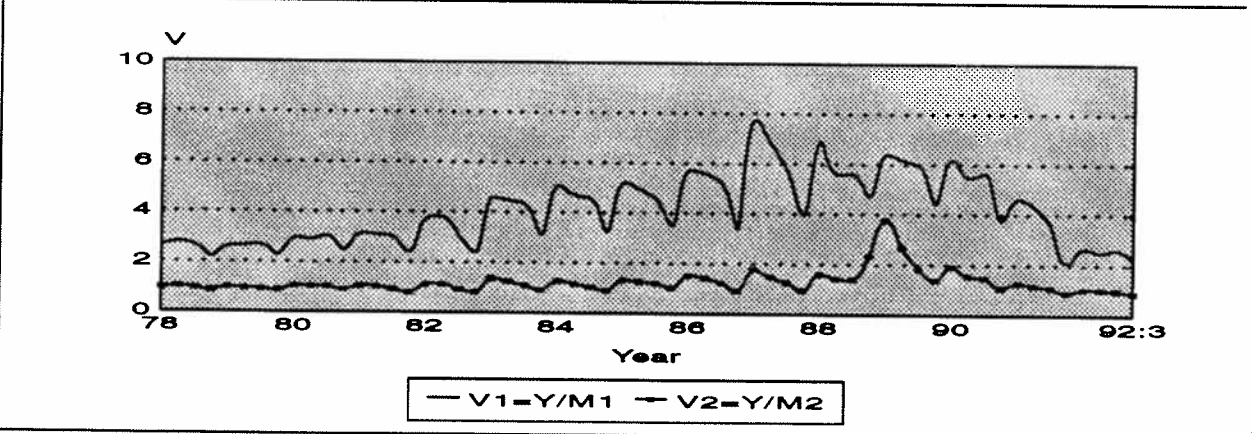
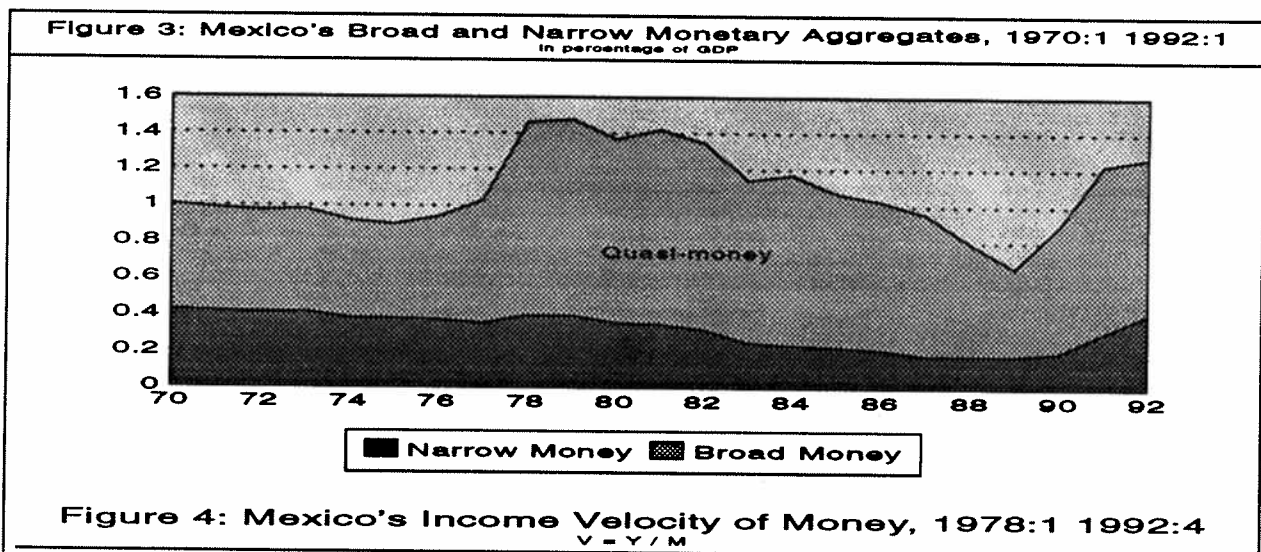
3. Institutional Reforms

Starting in December 1989 the Mexican government initiated a series of reforms aimed at improving the domestic financial system. Five laws governing financial institutions were then changed. Coorey (1992, p. 39) describes these measures as being intended to increase competition and reduce market

segmentation by expanding the scope of permissible activities for different types of financial institutions and by allowing a greater degree of integration in the provision of financial services. In addition, the reforms eliminated government

regulation of insurance premiums and policies, deregulated and simplified the operations of mutual fund societies, strengthened the supervision and regulation of bank and nonbank financial institutions, and relaxed restriction against the participation of foreign investors in the capital of some nonbank financial institutions.

The laws that followed in 1990 were also very important in nature. It was then that the Mexican authorities decided to allow the privatization of commercial banks and to establish the framework for the formation of integrated financial groups. These institutional modifications permitted the financial system to improve its capabilities and to be more competitive (see appendix 2 for a specific description of the Mexican financial system). Moreover, as we can see



from figures 3 and 4, these laws were necessary to deal with the expansion of the quasi-money balances (this point will be further discussed in section F). The important issues of regulation and of bank supervision were also enhanced.

4. Exchange Rate Reforms

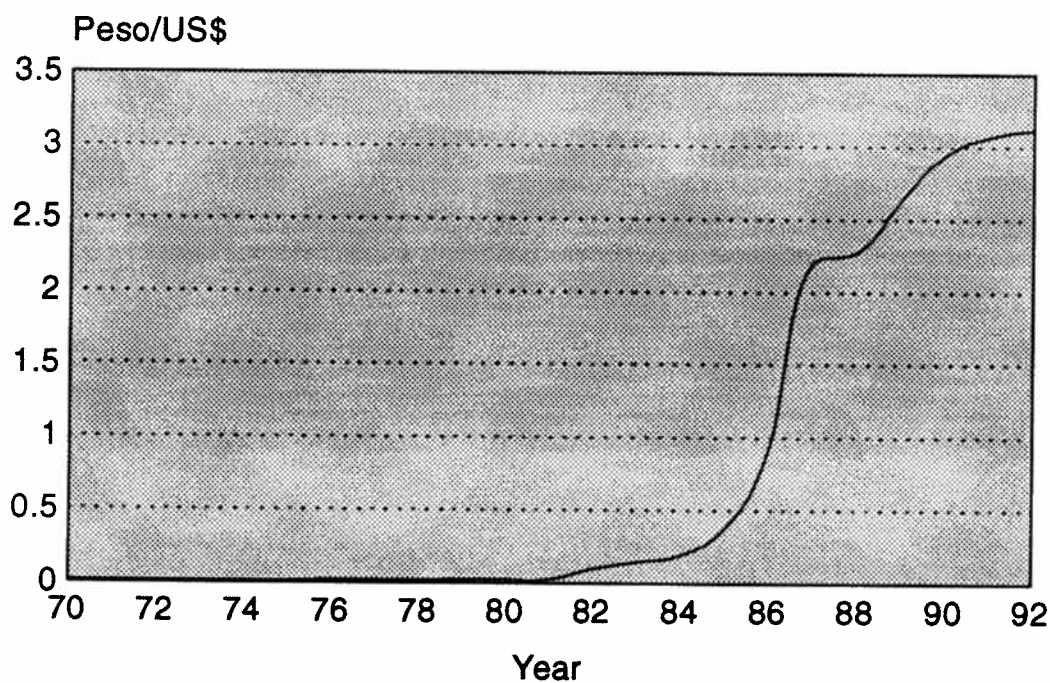
As explained by Rojas-Suárez (1992), a proper policy of exchange rate depreciation was necessary for Mexico in order to solve the credibility problem facing the government. She explains that in order to have a permanent reduction of the inflation rate, Mexico needed a strong balance of payments. This led Mexican authorities to pay close attention to the management of the exchange rates.

Mathieson and Rojas-Suárez (1993) report that from late 1988 the Mexican government introduced an economic program to improve the credibility of the exchange rate policy. The program had two main features: first the announcement of a fixed rate of depreciation of the exchange rate at 1 peso per U.S. dollar a day from January 1989 to May 1990, and second the intensification of the fiscal adjustment that started in 1983. As credibility was being gained, the Mexican authorities started to reduce the depreciation of the exchange rate to 0.80 peso per U.S. dollar a day in May 1990, then to 0.40 peso per U.S. dollar a day in mid-November 1990. In November 1991, the depreciation was further reduced to 0.20 peso per U.S. dollar a day, and on January 1st, 1993, the New Peso was introduced (one new peso was worth 1,000 of the old pesos), see figure 5.

The Mexican experience with preannounced depreciation was somewhat different from the Southern Cone Countries'.

First, although Mexico and the Southern Cone countries preannounced their exchange rate adjustments, the financial liberalization of domestic markets in Mexico was accompanied by an *increase* rate of depreciation of the Mexican peso. Second, and perhaps more important, Mexico further tightened its fiscal and monetary policies to enhance the credibility of the exchange rate policy and made them consistent with a long-run rate of inflation *below* the observed rate. Mathieson and Rojas-Suárez (1993, p. 27).

Figure 5: Mexico's Exchange Rate, Peso per U.S. Dollar



Source: International Financial Statistics (IMF)

Note: On January first, 1993, the new peso (valued at 1,000 old pesos) was instituted

5. The Privatization of Commercial Banks

From June 1991 to July 1992 the Mexican Government auctioned 18 commercial banks¹² for a value of more than US\$13 billion (more than tree times book value) to private groups of Mexican investors (Barnes, 1992).

As we have seen, the guidelines for the divestiture of the banks were established in the presidential decree of September 1990. In an article by Barnes (1992), a member of the Mexican Privatization Committee, he notes that the Mexican Authorities prepared the mechanics of privatization before starting the process. For this author, the success of the Mexican bank privatization could be summarized in nine points (or lessons):

- * Macroeconomic stabilization and economic growth allowed for a stronger financial deepening and a better bank privatization.
- * Bank privatization must be complemented by the structural transformation of the economy, to improve the efficiency and productivity.
- * Financial reform must aim to strengthen competitive economic conditions and to enhance the efficiency of the financial sector. The liberalization has to include operational and legal reforms.
- * The privatization of banks can be carried out only after having a solid and well defined legal structure.
- * Legal reforms should lead to structures that encourage solid and efficient financial intermediation.

¹² Note that since the nationalization of commercial banks in 1982, the number of banks has been reduced from 60 to 18 in 1988.

- * To encourage ample participation and to ensure fairness, the privatization process must be trustworthy -- with clear objectives, precise rules, and transparent procedures.
- * The mechanics of the privatization process should be consistent with the legal framework and specific guidelines of the banking system.
- * The proceeds of privatization should be in cash, which should be used to permanently reduce government outlays.
- * Common sense rules should be followed, such as selling the small banks first, ensuring economic certainty and confidence, centralizing management of the privatization program, and ensuring honesty and transparency in the process.

According to Barnes (1992), the Mexican privatization of banks consisted of 4 main stages:

1. The preparatory phase, consisting of:
 - a) qualification and selection of the bidders by the Committee;
 - b) writing each bank's sale prospectus;
 - c) announcing the auction and its rules.
2. In the second stage the qualified bidders had access to the process and to information on the banks to be auctioned.
3. The closed-bid auction itself was the third phase of the process.
4. Finally, the sale itself.

Coorey (1992), explains that controlling 51% blocks of shares were sold by auction to groups of individuals with Mexican citizenship. The remaining 49% was floated in secondary offerings to institutional investors, companies, funds, and foreign investors (subject to certain

ceilings). He also notes the interesting feature of horizontal integration (in the form of financial groups) that seemed to happen with the sale of the commercial banks. This author is expecting that the new financial groups will pass through a period of adaptation and of rationalization, where they will eliminate many activities which are duplicated and by so doing reduce costs and become more efficient.

5.1 Problems Facing the Privatized Banks

Prior to the auction of the banks the Mexican government restructured the debt of some commercial banks. Coorey (1992, p.40) noted the following:

In July 1991, the Mexican Government restructured some \$1.2 billion of interbank credit lines belonging to the six largest Mexican banks. The restructuring enhanced the market value of these banks and facilitated their privatization by reducing the outstanding value of such debts by about 30 percent on average.

The revamping of these banks' financial conditions, before privatization, made these institutions have a higher price at the auction. What could possibly explain the worries suggested by Griffith (1993, p. 42) that "[s]ome analysts fear too much money was paid for the banks during privatization..."

In her article, Griffith (1993) shows 3 other problems facing Mexican banks after their privatization: first, non-performing loans, which rose from 3% in 1991 to 6% in 1992. Second, the fear of Canadian and American competition resulting from NAFTA's higher competition, higher quality of services, higher technologies (automation), and more efficiency in banking operations. Finally the trouble by at least 3 big banks to meet new net capital requirements.

The literature on financial liberalization recognizes very clearly the problems facing Mexican banks as being the results of improper initial conditions for the financial reform (see Caprio et al, 1993). In explaining the importance of the appropriate initial conditions, these authors give the example of Korea's successful financial liberalization where a great deal of attention was paid to borrower net worth and to the initial conditions of bank portfolios, not to mention the slow pace of the process itself. Mexico's problem with non-performing loans would suggest that authorities probably did not pay enough attention to the condition of bank portfolios. Even though the government restructured part of the banks's debt, it seems that it was not enough. The restructuring of these debts influenced prices to be higher, as mentioned by Griffith, but it also affected the future expectations of banking profits to be higher. It is normal to assume that the investors who paid a higher price were interested in receiving higher profits from a better structured bank, but was the system ready to provide that?

It is important to mention that for Villanueva and Mirakhor (1990) institutional reforms should be in the forefront of the financial sector reforms. For them, a strong supporting infrastructure that provides adequate information flow, credit appraisal and rating, and legal and accounting systems, and the development of equity markets should be in place before reforms are attempted. As the Mexican banks moved from the public sector to the private sector, the managers of these institutions were probably not ready to face the new challenges of fiercer competition and of new credit assessment techniques. Caprio and al (1993) are very clear in defining the banks' stock of human and managerial capital as essential for a successful reform, and McKinnon (1988) says that bank officers must be able to distinguish borrowers in different risk classes.

On the problem of non-performing loans Leite and Sundararajan (1990, p.11) caution that "[i]f many institutions are too weak -- with a large share of nonperforming loans and high operating costs -- then, without adequate bank supervision machinery, unexpected failures of individual units can lead to systemic crisis."

The problem therefore, seems to be that reforms were made too fast and without the appropriate initial conditions on the part of the banks and on the part of the authorities responsible for banking supervision and regulation. McKinnon (1988) and Villanueva and Mirakhor (1990) are categorical in saying that although economic stability is one of the pillars of a successful financial reforms, banking supervision and control are essential elements that cannot be neglected.

The difficulty of some Mexican banks in meeting the appropriate capital requirements and of having non-performing loans brings into the discussion the important concepts of deposit insurance, "moral hazard"¹³ and banking supervision¹⁴. Although it seems that the Mexican banks are not in a very bad position, and that some numbers have been exaggerated (see Griffith, 1993) the problem exists. One cannot simply ignore the possibility of bank failure, specially after the Savings and Loans problem in the U.S.A. and the recent collapse of banks in Venezuela that lead to a huge capital flight.

The Mexican banking industry will need some time and money to adjust. But the question is, will it have enough time, as the NAFTA Agreement calls for opening the market by the year 2000? Or enough money, to be able to give the same services and compete with the big

¹³ *Moral hazard* is referred to being the decision of banks to undertake risky lending in the presence of deposit insurance. (Villanueva and Mirakhor, 1990, p.510).

¹⁴ Although the evaluation of these subjects are beyond the scope of this paper, the interested reader is referred to McKinnon (1988), Villanueva and Mirakhor (1990), Baglioni and Marotta (1992), and Talley (1993).

American and Canadian banks? But the room is not so dark. Although the NAFTA Agreement incites more competition it also "protects" the Mexican banking system, see Appendix I, part VI-A.

On the good side, Griffith (1993) shows that Mexican banks are expected to have a high growth rate, as the credit needs of the private sector tends to be high for some time. She explains that there is a lot of room for growth because "few Mexicans have home mortgages, and less than 8% of all purchases are paid for with credit cards" (p. 42). Moreover, she says, the Mexican banking institutions will benefit from a newly created insurance fund. This fund "is similar to the FDIC system in the US, [where] banks must pay a fee of 0.3% of all deposits" (p. 42). According to her, this measure will bring more stability to the system.

F. EFFECTS OF FINANCIAL LIBERALIZATION

As we have seen, most of the financial liberalization occurred during the period of 1989-91. This part of Mexican economic history, however, was also characterized by significant economic adjustment programs and an increase in economic activity. It becomes, therefore, difficult to differentiate the effects of the financial reform from those resulting from these economic adjustment programs as there is probably a phenomenon of causality feedback¹⁵ between them and the improvement of the economy. Moreover, the financial reforms have been introduced just recently making it too early to evaluate their effectiveness and their success. Thus,

¹⁵ The causality feedback operates as follows: the successful economic adjustment programs will cause an amelioration of the economic system, which will facilitate the success of the financial reforms, which will improve the economic condition and promote the adjustment programs. The successful adjustment programs will influence the success of the financial reforms which influences the adjustment programs and they help improve the economic conditions. So the three factors cause one another.

with these ideas in mind, some results which are believed to be directly related to the financial liberalization will be presented in this section.

As it is shown in figure 1.A, real interest rates were very negative during the period of financial desintermediation, specially during the period of the debt crisis and nationalization of banks (1982-84) and during the 1986-87, when the inflation rate was very high.

They appear to have risen sharply to high levels before the financial liberalization, and then to have increased again immediately after interest rate deregulation in early 1989, before reaching a peak in the middle of that year ... Measured interest rates appear to have increased in the first half of 1988 mostly because there was a sharp deceleration of inflation during this period (...). To the extent that the turnaround in inflation was largely unanticipated and expectations took some time to adjust, the measured real rate is likely to overstate the true real rate in 1988... Thereafter they declined steadily from 36 percent in mid-1989 to about 6 percent by mid-1991 as financial intermediation improved and the economic adjustment program gained credibility. (Coorey, 1992, p. 42)

Coorey (1992) believes that the financial liberalization only had the effect of increasing interest rates temporarily. Although it is too early to see the full impact of financial reforms, our view is that so far financial liberalization affected interest rates in the sense that they became less volatile, specially after 1990. Note from figure 1.A how real interest rates seem to have emerged from the very deep levels of the 1980's. In our opinion there will be two adjustment periods, the first being due to the change in inflation and the interest rate liberalization (period of 1988-90). The second will arise from the "new" banking system and it's new corporate philosophy (period of 1992-95). The second stage might take a little longer to return to equilibrium because banks

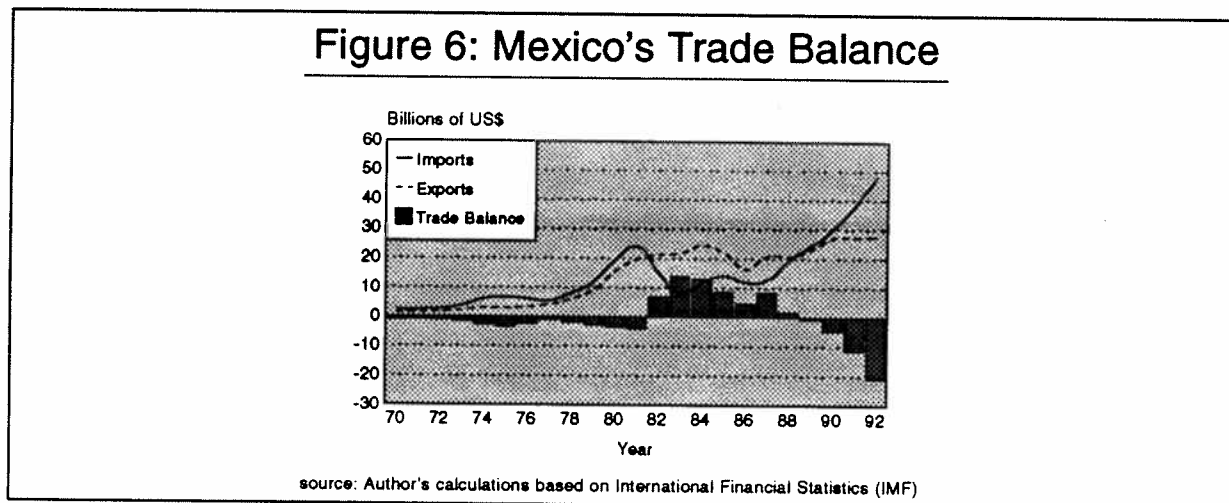
will have to adjust their personnel, infrastructure, and mentality not only to the new market reality but also to be able to compete with the foreign banks, as prescribed by the NAFTA agreement.

From figure 3 we can observe how the behaviour of financial savings have changed after the deregulation of interest rates and the lifting of credit ceilings (in early 1989). The ratio of narrow money¹⁶ (M1) to GDP tended to decrease from 1970 to 1990 and to increase thereafter. The ratio of broad money (M2) to GDP started to decline in 1979 and decreased until 1989 when it increased very rapidly. This rapid expansion of broad money followed by a slower growth of narrow money indicate that the increase in the monetary aggregates is mainly due to an expansion of bank deposits (Coorey, 1992).

Figure 4 shows us that the income velocity of narrow money had a fairly stable tendency, except for the little pick in 1989 when interest rates were liberated. For broad money one finds a downward trend in the income velocity after 1989. Normally that would suggest that money is growing at a faster rate than income. However, the view that agents are facing a higher increase in wealth than in income, which would reflect the higher savings rate, is preferred. This theory is explained by Tseng and Corker (1991), who analyzed financial liberalization in Asian countries. So, the better financial economic atmosphere that reigns in Mexico is affecting the financial situation of its agents. The agents have increased their savings in the form of time deposits, as their wealth increased. Moreover, as inflation is becoming less of a threat, agents may prefer to place their money in more liquid assets, such as time and savings deposits instead of spending it right away on durable goods.

¹⁶ See appendix 3 for definitions on M1 and M2.

Another aspect of financial developments in Mexico has been the fact that the country is back on the international capital markets. With the success of the economic policies Mexico was able, once again, to borrow from abroad. As shown in figure 2, it's county risk premium has been falling since 1988. The increase in investors's confidence resulted in important foreign capital in-flights. As we can see from figure 7, foreign direct investment has been increasing since 1988 and portfolio investment is attaining levels never seen before¹⁷. Because Mexico has decided to partially sterilize these capital inflows, it was able to develop it's industrial base. As we can see



from figure 6, from 1989 Mexico is experiencing a negative trade balance. Note, however, that since 1988 both imports and exports have been rising. This coupled with the increase in foreign direct investment suggests that *de facto* the industrial base has been widening and the country is probably importing equipment and materials to build it's industries.

¹⁷ The large increase in capital inflows to Mexico has forced the government to partly sterilize these inflows. In Griffith (1993), Mr. Mancera Agauayo, Mexico' Central Bank president, explained that they have decided to use partial sterilization, by issuing treasury bills to reduce the amount of money in the market. In explaining why they chose to partially sterilize he notes that not sterilizing would create inflation, and by completely sterilizing no money would be left to expand the industrial plant.

The problems associated with high capital inflows are several. They are, however, beyond the scope of this paper. The interested reader is referred to Corbo and Hernández (1993).

Figure 7.a: Foreign Direct Investment (FDI) in Mexico 1975:1 to 1993:2
in Billions of U.S. dollars

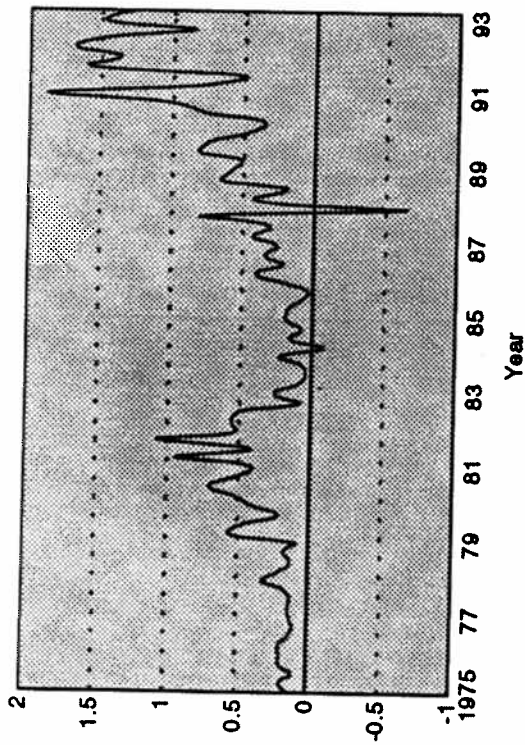


Figure 7.b: Portfolio Investement (PI) in Mexico 1975:1 to 1993:2
in Billions of U.S. dollars

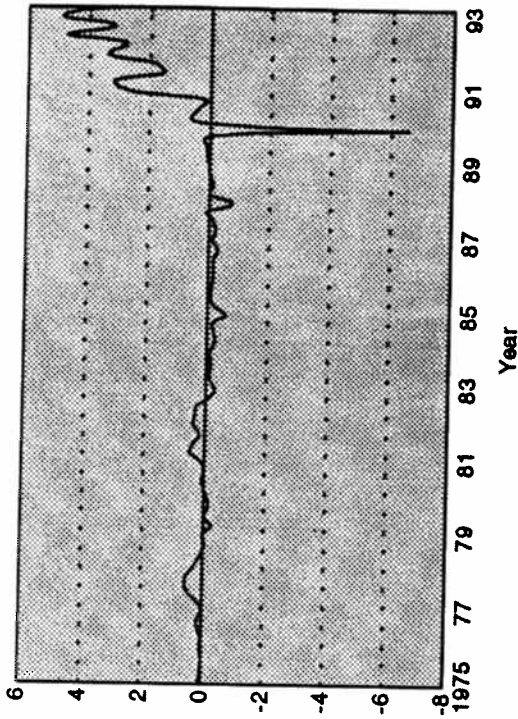


Figure 7.c: Other Capital Investment (OCI) in Mexico 1975:1 to 1993:2
in Billions of U.S. dollars

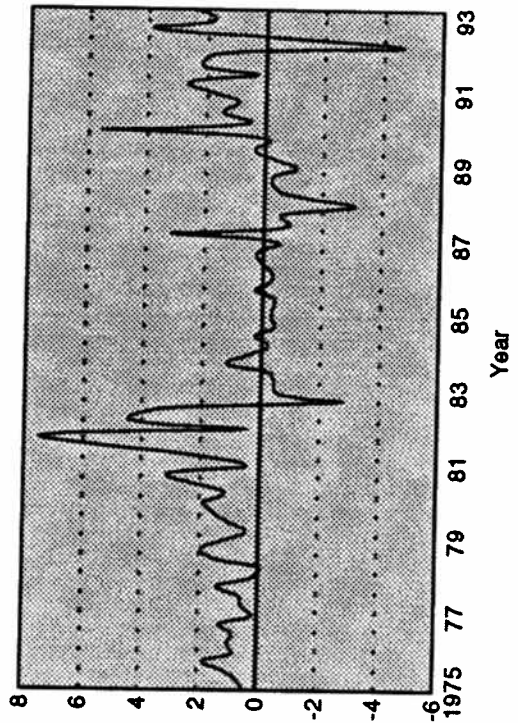
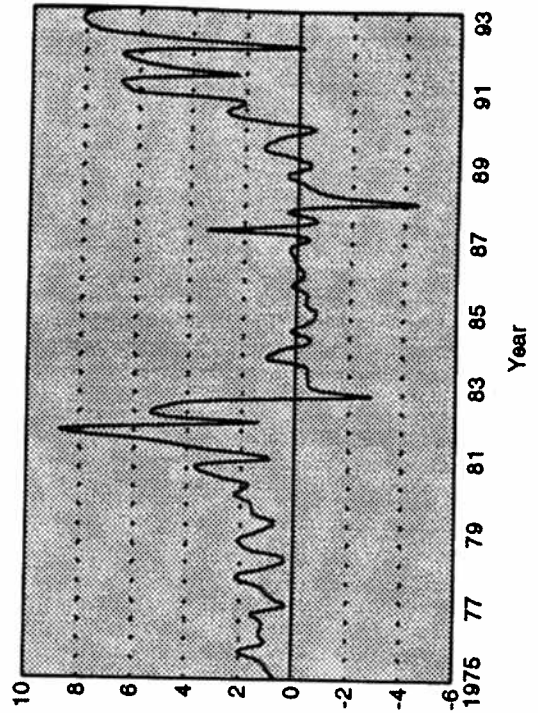


Figure 7.d: Total of FDI, PI, and OCI in Mexico 1975:1 to 1993:2
in Billions of U.S. dollars



source: International Financial Statistics (IMF)

G. CONCLUSION OF THE FIRST PART

As we have seen, Mexico has accomplished a great deal of reforms in its financial sector in the last years. The reforms were, in general, very successful. Mexico's success is due to clearly defined financial liberalization strategies, which were executed in a gradual and ordered way. For instance, the removal of credit ceilings and the deregulation of interest rates, in early 1989, allowed banks to differentiate themselves and increase their competitiveness. This measure improved the position of banks before their privatization. Recall that Leite and Sundararajan (1990a) are specific in saying that improved competition in the financial system is an essential criteria that must be in place before the financial reform.

Mexico, therefore, followed a clear path to financial liberalization. It started by improving the fundamental conditions of the economy through stabilization and macroeconomic adjustment programs. As soon as the reforms were set in motion and the economy started to adjust, deregulation policies were implanted. These policies of deregulation tackled serious problems such as international trade and financial services. A distinct feature, hence, of the Mexican economic reform was the speed at which the changes were implemented.

The Mexican authorities have, however, provided the economy with the necessary requirements for a fruitful financial liberalization. Although the privatized banks are facing some portfolio problems, it is our view that, to a certain extent, it is normal and that they will probably recuperate very fast. The financial reforms have been successful in every front. As a result, Mexico has made monetary policy more effective, has increased real interest rates levels, has augmented financial intermediation, and increased competition in the financial sector. As a consequence of the sounder financial system, foreign capital poured into Mexico, helping improve the economic base and hence the economy.

The future seems promising. Mexico embarked 1994 with the North American Free Trade Agreement and has just been admitted into the OECD. These will bring more credibility to the country and will help consolidate and strengthen the social, political, economical and financial reforms undertaken recently.

**PART II: MULTIVARIATE COINTEGRATION
IN THE PRESENCE OF STRUCTURAL
BREAKS: THE CASE OF MONEY DEMAND
IN MEXICO**

The purpose of this part of the paper is to investigate the implications of financial liberalization on money demand, focusing on stability and predictability of narrow and broad monetary aggregates. The study gravitates around the important econometric concept that most macroeconomic time series are characterized by a unit root; which implies that random shocks have a permanent effect on the system (Nelson and Plosser, 1982). Two influential concepts that followed from work on unit roots, and that are jointly used in this paper, are: first the concept of cointegration, whereby two or more time series move together in a long run equilibrium relationship (see for instance Engle and Granger (1987), for the univariate case; and Johansen (1988, 1989), for the multivariate case). Second the concept of structural breaks, first introduced by Perron (1989, 1993a), and whereby a stationary time series is characterized by a structural change in its mean level. The study at hands, therefore, combines cointegration analysis with variables that exhibit tendency breaks, or simply putting, the existence of a long run equilibrium relationship of the studied variables around a deterministic trend which is *de facto* broken. The investigation is carried out by the utilization of Johansen's maximum likelihood multivariate cointegration technique in the presence of structural changes. The paper is divided into four parts. The first section is dedicated to discuss the theoretical issues behind the estimation. The

specification is addressed in section B and its implementation in Section C. Section D concludes, with appendixes on data, critical values calculation and on results of the cointegration analysis.

A. THEORETICAL ISSUES ON THE EFFECTS OF FINANCIAL LIBERALIZATION ON MONEY DEMAND

The existence of a stable and predictable relationship between monetary aggregates, economic activity, prices, and interest rates is a crucial element in the formulation of monetary policy. Financial liberalization that improves the quality of economic signals, alters the institutional environment, and expands the array of financial opportunities creates potential for instability in money demand (Tseng and Corker, 1991, p.11).

Because of the changes associated with the liberalization, one could expect to see shifts in the level of money holdings. These changes will occur basically as a result of fundamental changes in:

- a) interest rates, which will after the change, be liberalized and thus better define the degree of riskiness of the market and of the borrowers.
- b) improved money market and monetary policy instruments to influence interest rates. These measures make money more demand oriented, as opposed to be supply determined (by means of direct credit controls, for example).
- c) improved competition in the financial markets, which will lower the transaction costs and increase efficiency, what will affect the speed of adjustment of money demand in relation

to interest rates differentials (domestically and internationally) (Leite and Sundararajan, 1990a, p. 9; and Tseng and Corker, 1991, p. 11).

As we have seen in the first part of the paper, Mexico has, in recent years, undertaken an important structural adjustment of its entire economy. A significant part of the financial liberalization, took place after 1988, and it is around then that we can see a more discrete shift in the behaviour of money demand. As illustrated in figure 3, the ratio of broad money (defined here as currency plus demand and time deposits in the banking system) to income tended to decrease from 1979 until 1988¹⁸ and to increase thereafter, reflecting rapid growth in quasi-money balances. The ratio of narrow money (currency plus demand deposits in the banking system) to income shows a downward trend from 1970 up to 1990 and an increasing trend thereafter. Figure 3 seems to indicate instability in the trend of the monetary aggregates during the period 1978 - 92. Thus, in order to estimate the magnitude of the instability, some econometric techniques, following on work done by Perron (1989 and 1993b) will be used.

1. The Notion of Stability

Tseng and Corker (1991) explain that money demand will tend to be a stable function of income, prices and interest rates only in an unchanging institutional environment. Changes in the institutional environment are believed to cause long-run cycles in the income velocity of money. Thus, a country which is in its early stages of economic development and have immature

¹⁸ This is the period that comprises the debt crisis and the stabilization programs, which started in 1982, but were very slow up to 1988. After 1988 the liberalization process accelerated, as seen in the first part of the paper.

financial markets will typically have money growth exceeding income growth due to the monetization of the economy, hence money velocity will trend downwards. The opposite will also be true (upward trend in velocity of money) because as the degree of sophistication of the economy increases, financial market innovations permit agents to economize on their holdings of money. As we know, monetization is a phenomenon usually associated with narrow monetary aggregates, however, after the financial deregulation (mainly after 1988), Mexico seems to be in a stage of monetization for broad money, see figures 3 and 4. Tseng and Corker (1991) also found, for 7 of the 9 countries that they studied, that countries would tend to have rapid growth of quasi-money balances after financial liberalization. In general, then, these authors conclude that a rapid growth of quasi-money balances associated with a decrease in the income velocity of money reflect growth in wealth in excess of growth in income.

A financial liberalization will affect the institutional environment, and consequently possibly affect the stability of money demand relationships both in the long and short runs. Furthermore, as explained by Christiano (1991), positive changes in the growth rate of money supply will affect interest rates depending on which force is greater: the *liquidity effect*¹⁹ or the *anticipated inflation effect*²⁰. If the liquidity effect is greater than the anticipated inflation effect, the extra money in the economy will tend to push down interest rates which stimulates economic activity. As can be seen from figures 8.a and 8.b, after 1988 there was indeed an increase in

¹⁹ *Liquidity effect*: when an increase in money supply pushes down interest rates, which stimulates the economy (Christiano, 1991).

²⁰ *Anticipated inflation effect*: when an increase in money supply leads people to expect further increases in money supply, and so more inflation. The expectation of higher inflation makes borrowers put a premium for inflation in interest rates, pushing interest rates up and maybe depress economic activity (Christiano, 1991).

Mexico's money supply. From figures 8.e, 8.f and 8.g we can see the decrease in interest rates, what would illustrate the liquidity effect.

By using a multivariate cointegration estimation procedure we will, investigate the stability of the money demand functions. A rejection of cointegration means that money, income, price and interest rates have not shown a predictable and stable relationship over the span of the data sample. One of the reasons that may explain the rejection of cointegration is a change in institutional environment. Note, however, that the test is performed in a sample that goes from the first quarter of 1978 to the fourth quarter of 1992, being therefore an indicator of medium-term stability. It is relevant to point out that it is possible to have some instability which is not covered by the tests, and that it would be wrong to attribute this instability to the financial liberalization process. For instance, such instability may have occurred due to a misspecification of the demand function for money or because behavioral properties cannot be deducted using available data or even to inappropriate treatment of expectations. Thus one must be very careful, and sometimes even have to do some additional judgemental procedures to trace the source of the instability.

Figure 8.a: M1, In Levels

$$M1 = \ln(M1) - \ln(p)$$

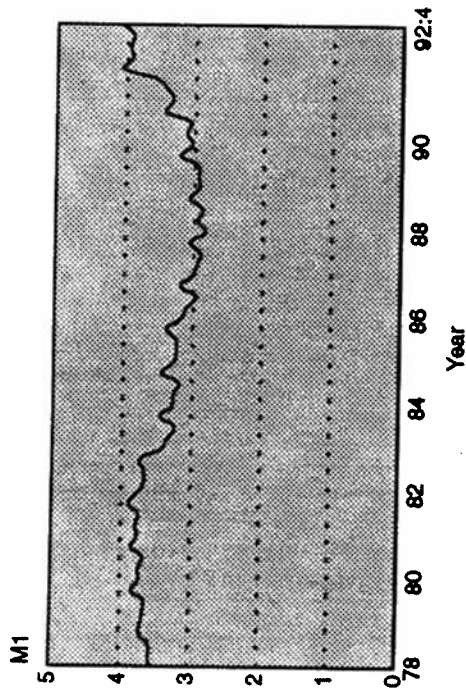


Figure 8.b: M2, In Levels

$$M2 = \ln(M2) - \ln(p)$$

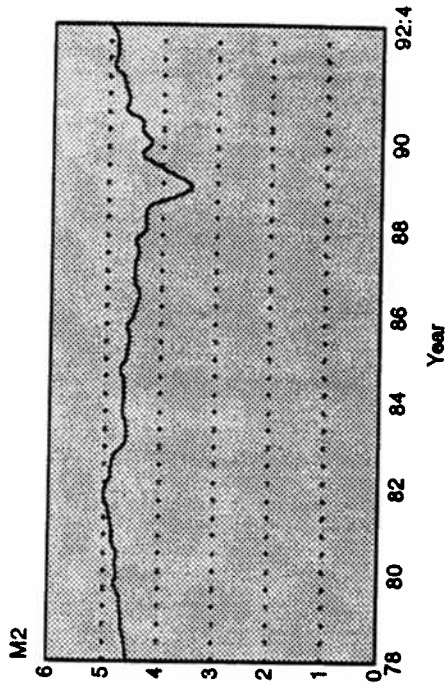


Figure 8.c: Real GDP, In Levels

$$y = \ln(gdp) - \ln(p)$$

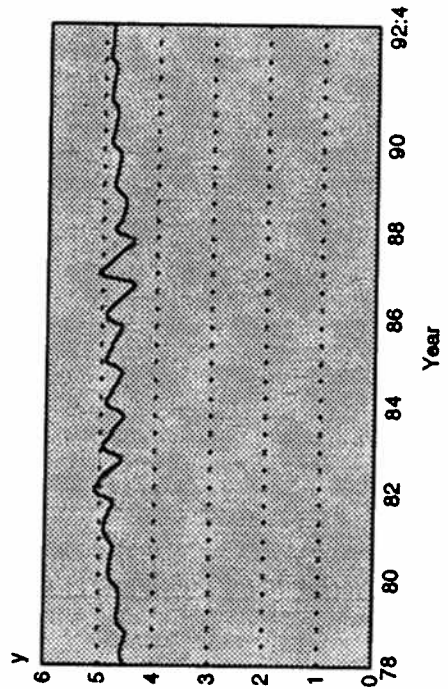


Figure 8.d: Prices, in Levels

$$p = \ln(cpi)$$

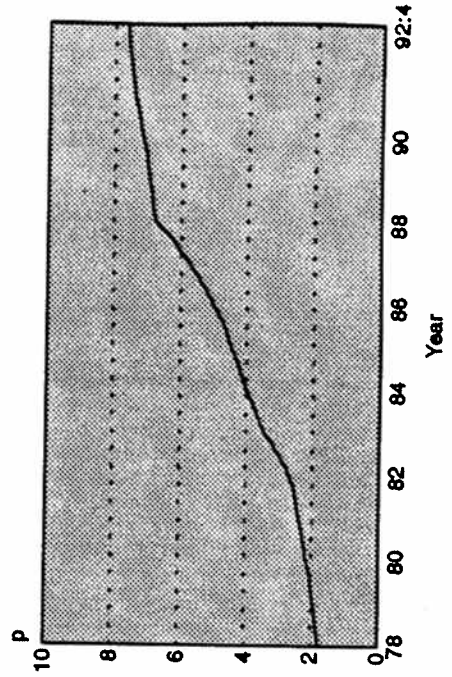


Figure 8.e: NRa, In Levels

NRa = deposit rates

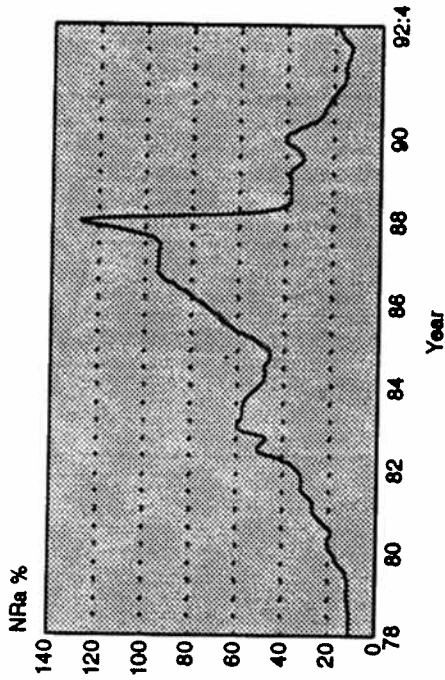


Figure 8.f: BRa, In Levels

BRa = (treasury bills' rates - deposit rates)*[(M2-M1)/M2]

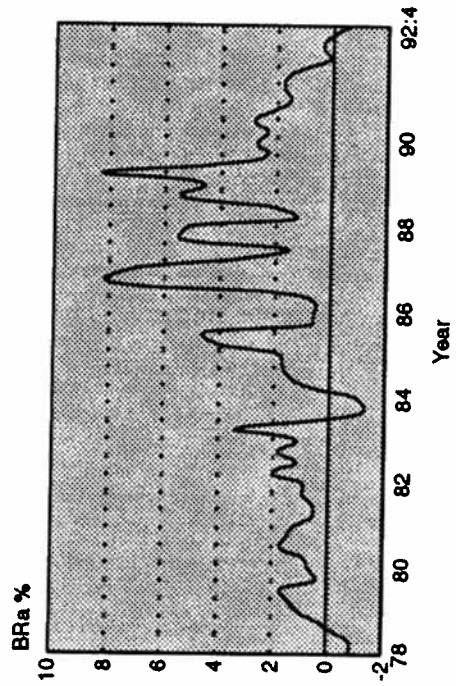


Figure 8.g: BRo, In Levels

BRo = deposit rates*[(M2-M1)/M2]

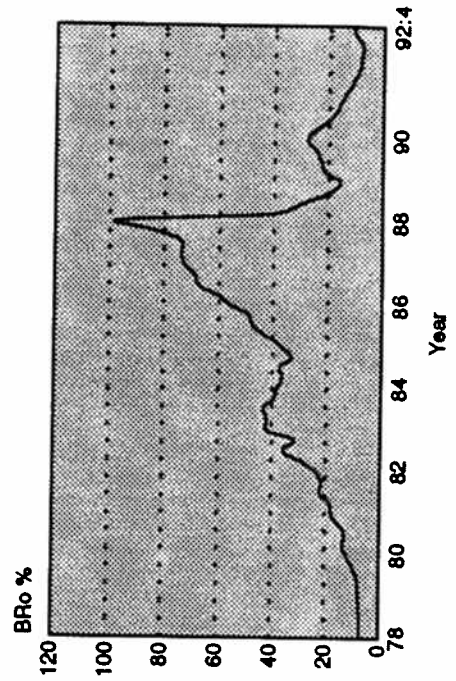


Figure 9.a: M1, in First Differences $dM1 = M1 - M1(-1)$

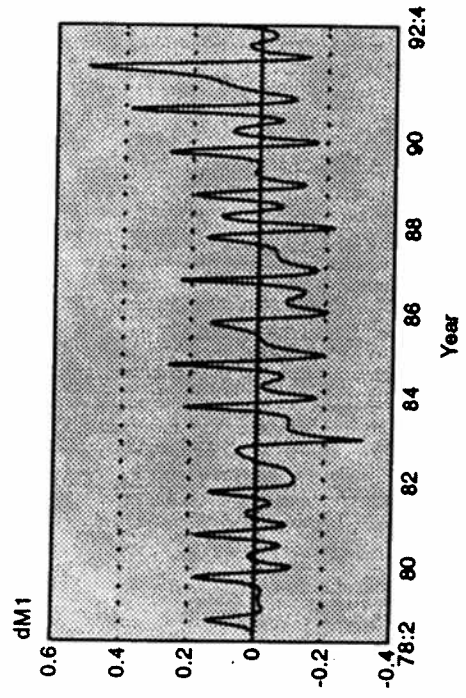


Figure 9.b: M2, in First Differences $dM2 = M2 - M2(-1)$

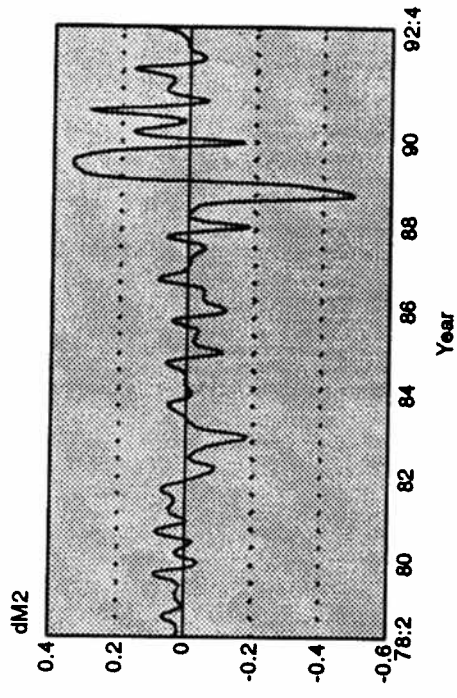


Figure 9.c: Real GDP, in First Differences $dy = y - y(-1)$

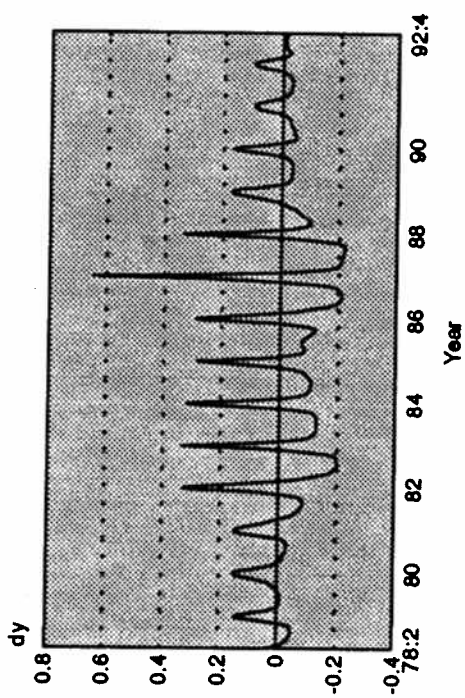


Figure 9.d: Prices, in First Differences $dp = p - p(-1)$

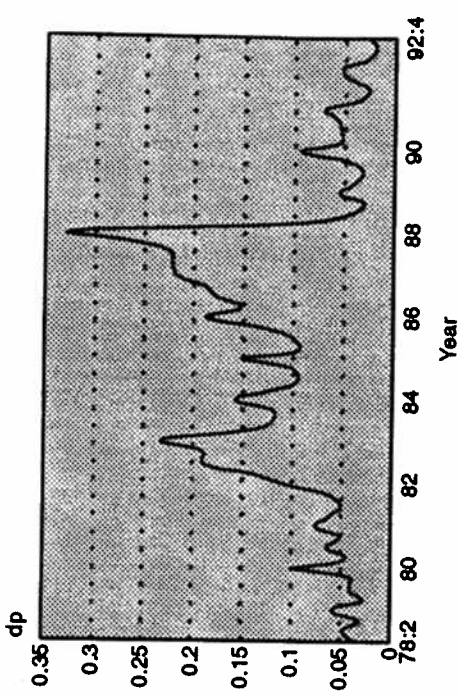


Figure 9.e: NRa, in First Differences

$$dNRa = NRa - NRa(-1)$$

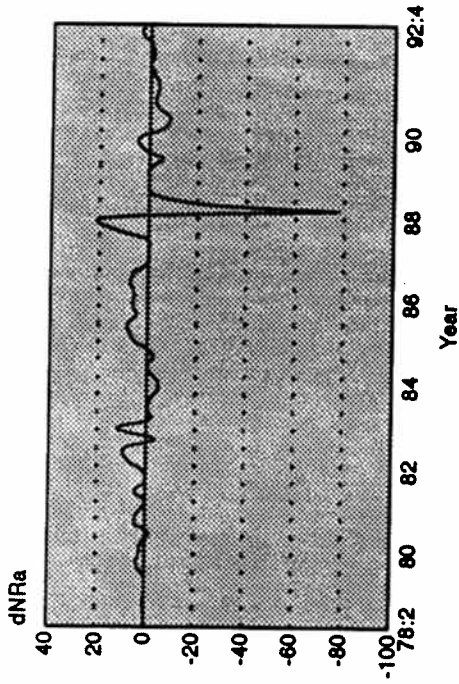


Figure 9.f: BRa, in First Differences

$$dBRa = BRa - BRa(-1)$$

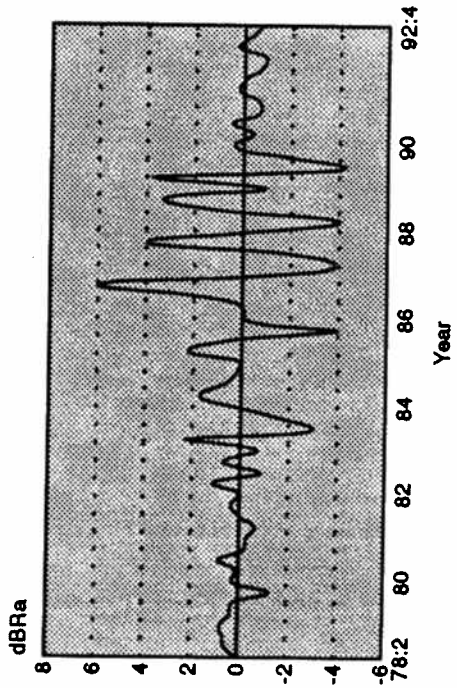
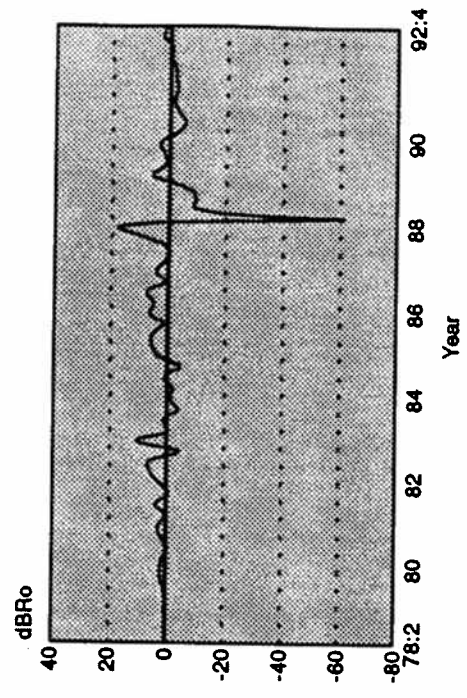


Figure 9.g: BRo, in First Differences

$$dBRo = BRo - BRo(-1)$$



B. SPECIFICATION AND ESTIMATION ISSUES

1. Specification Issues

Many studies in the past years have dealt with the cointegration relationship, univariate or multivariate, of the demand for money equation. Johansen (1989); Johansen and Juselius (1990); Hendry and Ericsson (1991); Tseng and Corker (1991); King et al. (1991); Baba, Hendry and Starr (1992); *inter alia*, found a cointegration relationship for the demand for money. The money demand model to be used here, as in Tseng and Corker (1992), is in accordance with the general specification of money demand, in which it is a function of income (or wealth), prices, and interest rates. Specification which is in harmony with Blanchard and Fischer (1989, pp. 512-513) and with Dornbusch, Fischer and Sparks (1989, pp. 332-333). With this simple model we are interested in examining the stability and predictability of money demand.

Thus, our general cointegrating regression is defined as:

$$M = \alpha_0 + \alpha_1 P + \alpha_2 (Y/P) + \alpha_3 Ra + \alpha_4 Ro \quad (1)$$

Where²¹:

M: money (narrow, and broad), in natural logarithms

P: the general price level, in natural logarithms

Y: aggregate incomes, in natural logarithms

²¹ Please refer to Appendix 3 for precise sources and definitions, as well as for data restrictions.

Ra: interest rate on alternative assets

for M1 (narrow money): $NRa = \text{deposit rates}$

for M2 (broad money): $BRa = \text{treasury bill rate minus deposit rates weighted by the share of quasi-money in broad money}$

Ro: return on money

for M1 (narrow money): $NRo = \text{zero}$

for M2 (broad money): $BRo = \text{deposit rate multiplied by the share of quasi-money in broad money}$

Price homogeneity is imposed ($\alpha_1 = 1$), and therefore, a real demand for money is the one being estimated. Variables, except for interest rates, are expressed in natural logarithms.

Equation (1) assumes that the level of money demanded adjusts instantaneously to changes in the variables. In reality, however, this is not the case as there is a time lag for the adjustment to take place. There are probably two reasons for this slowness: firstly there is a cost associated to adjusting financial portfolios and secondly the slow adjustment in expectations in response to new information. To attempt to capture the sluggish adjustment of money demand toward desired equilibrium holdings an error correction dynamic specification is used. The error correction equation "can be thought of as a more general, intertemporal version of partial adjustment in which expectations are based on available information" (Tseng and Corker, 1991, p. 13).

As our analysis is in the style of Johansen's multivariate cointegration, the vector autoregressive process (VAR), which includes a constant and independent Gaussian errors, has the following statistical model:

$$H_1: X_t = \Pi_1 X_{t-1} + \dots + \Pi_k X_{t-k} + \gamma_t + \epsilon_t \quad (t = 1, \dots, T) \quad (2)$$

Where the sequence $\{\epsilon_t\}$ is an i.i.d. p -dimensional Gaussian random variables with mean zero and variance matrix Λ , $\epsilon_t \sim \text{iid}(0, \Lambda)$, and where X_{k+1}, \dots, X_0 are fixed.

In the case where there is cointegration, the error correction model is specified as being equation (2) in first differences plus the term ΠX_{t-k} , that is:

$$\Delta X_t = \Gamma_1 \Delta X_{t-1} + \dots + \Gamma_{k-1} \Delta X_{t-k+1} + \Pi X_{t-k} + \gamma_t + \epsilon_t \quad (3)$$

where,

$$\Gamma_i = -I + \Pi_1 + \dots + \Pi_i, \quad (i = 1, \dots, k-1)$$

and

$$\Pi = -(I - \Pi_1 - \dots - \Pi_k). \quad (4)$$

Johansen (1989), and Johansen and Juselius (1990) explain that the coefficient matrix Π is the one which will convey information on a possible long-run equilibrium relationship among the variables in the data vector. The rank of Π will equal the dimension of the cointegrating space, so there are three possible cases:

- (i) $\text{Rank}(\Pi) = p$ (the number of variables), i.e. the matrix Π has full rank, indicating that all variables are $I(0)$ and that the vector process X_t is stationary; a cointegration investigation becomes, therefore, redundant.
- (ii) $\text{Rank}(\Pi) = 0$, i.e. the matrix Π is the null matrix and (3) corresponds to a traditional differenced vector time series model, without a stationary process.
- (iii) $0 < \text{Rank}(\Pi) = r < p$, implying that there are $p \times r$ matrices α and β such that $\Pi = \alpha\beta'$. Here the linear combinations given by $\beta'X_t$ are stationary (even though X_t itself is non-stationary), that is X_t is cointegrated with cointegrating vectors β and adjustment coefficients α . So, in this case (3) can be interpreted as an error correction model.

Thus the main hypothesis to be considered in this study is the hypothesis of r cointegrating vectors:

$$H_2: \Pi = \alpha\beta' \quad (4)$$

2. Estimation Procedure

The maximum likelihood procedure suggested by Johansen (1989), will be used here to calculate the parameters of equation (3). The rationale behind the estimation are the notions of non-stationarity²² integration²³ and cointegration²⁴. In this paper, however, we follow the definition of cointegration suggested by Campbell and Perron (1991) and by Perron and Campbell (1992):

²² Nelson and Plosser (1982) defined a time series with *non-stationarity* in the mean as being a series without fixed long term mean, "or put positively, [the series] has a tendency to move farther away from any given initial state as time goes on." These authors also defined two important non-stationary processes:

Trend-stationary process (TS): process consisting of a deterministic function of time, called a trend, plus a *stationary* stochastic process with mean zero. The TS process is fundamentally deterministic in nature.

Difference-stationary process (DS): process in which the first or higher order differences is a stationary and invertible autoregressive moving-average (ARMA) process. The DS process is purely stochastic in nature.

Furthermore, their empirical work demonstrates that macroeconomic time series are mainly DS processes.

²³ *Integration*: "A series with no deterministic component which has a stationary, invertible, ARMA representation after differentiating d times, is said to be *integrated* of order d , denoted $x_t \sim I(d)$ " Engle and Granger (1987, p. 252).

²⁴ *Cointegration*: "The components of the vector x_t are said to be *co-integrated of order d , b* , denoted $x_t \sim CI(d,b)$, if (i) all components of x_t are $I(d)$; (ii) there exists a vector $\alpha (\neq 0)$ so that $z_t = \alpha'x_t \sim I(d-b)$, $b > 0$. The vector α is called the *co-integrating vector*" Engle and Granger (1987, p. 253). So, if two or more series are cointegrated, that means that they share a common stochastic trend (Stock and Watson, 1988, p. 164). Or simply, that integrated series may have stationary linear combination of their variables.

A vector of variables [...] is said to be cointegrated if there exists at least one non zero n -element vector β_i such that $\beta_i'y_t$ is trend-stationary. β_i is called a cointegrating vector. If there exists r such linearly independent vectors, β_i ($i = 1, \dots, r$), we say that $\{y_t\}$ is cointegrated with cointegrating rank r . We then define the $(n \times r)$ matrix of cointegrating vectors $\beta = (\beta_1, \dots, \beta_r)$. The r elements of the vector $\beta'y_t$ are trend-stationary and β is called the cointegrating matrix (Campbell and Perron, 1991, p. 164).

As noted by these authors, two important consequences follow from this definition:

First, this definition allows the linear combinations of the variables that eliminate the unit roots to have non zero linear trends. This corresponds to the notion of "stochastic cointegration" in Ogaki and Park (1990). A stronger definition of cointegration, called "deterministic cointegration"²⁵ by Ogaki and Park, would require that the same vectors β_i that eliminate the unit roots also eliminate the deterministic trend from the data. [...]

Second, the definition [1] does not require that each of the individual series be integrated of order one; some or all series can be trend-stationary. In this respect definition [1] differs from the definition given in Engle and Granger (1987) (Campbell and Perron, 1991, p. 165).

²⁵ According to Ogaki and Park's definitions, we have:
stochastic cointegration:

$$y(t) = \theta_c + \nu_c t + \gamma_x' X(t) + \varepsilon_c(t)$$

deterministic cointegration:

$$y(t) = \theta_c + \gamma_x' X(t) + \varepsilon_c(t)$$

Ogaki and Park (1989, pp. 12,13).

The second consequence of the definition has a special relevance, as it allows series with different orders of integration to be cointegrated.

In our analysis, the series will be first tested for their degree of integratedness, as for possible structural breaks in their trends. The investigation is however, centred in the evaluation and testing of deterministic cointegrating equilibrium vectors in our demand for money systems. The study follows Johansen's multivariate cointegration technique, as applied in Johansen (1989), and a brief summary of the procedure is as follows:

After regressing ΔX_t and X_{t-k} on $\Delta X_{t-1}, \dots, \Delta X_{t-k+1}, D_t$, and 1, and taking the residuals (R_{0t} and R_{kt} , respectively), the matrices S_{00} , S_{kk} , S_{k0} and S_{0k} are formed by:

$$S_{ij} = T^{-1} \sum_{t=1}^T R_{it} R'_{jt} \quad (i, j = 0, k) \quad (5)$$

The maximum likelihood estimator of β is then found by solving the following eigenvalue problem:

$$|\lambda S_{kk} - S_{k0} S^{-1}_{00} S_{0k}| = 0 \quad (6)$$

which gives $\lambda_1 > \dots > \lambda_p$ eigenvalues and $V = (v_1, \dots, v_p)$ eigenvectors, which are normalized to have $V' S_{kk} V = I$. The choice of β is now: $\beta = (v_1, \dots, v_r)$, which gives:

$$L^{-2T}_{\max} (H_2) = |S_{00}| \prod_{i=1}^r (1-\lambda_i) \quad (7)$$

The likelihood test statistic for the hypothesis H_2 in H_1 , since H_1 is a special case of H_2 for the choice $r = p$, is estimated by using the calculated eigenvalues in the following trace statistic test:

$$-2\ln(Q;H(r) | H(p)) = -T \sum_{i=r+1}^p \ln(1-\lambda_i) \quad (8)$$

The number of cointegrating vectors is then tested in a sequential way starting with $r = 0$ and going up to $r \leq p - 1$.

The critical values with which to compare these trace statistics (table A.2) had to be computed by simulation. The reason being that in the study at hands, the cointegration analysis is carried out in the presence of structural breaks. Thus, the asymptotic distribution of the likelihood ratio test, the trace statistics, has to account for the rupture. The simulation²⁶ was done by using Nielsen's cointegration rank test statistical software, DisCo Version 1.1 (1993).

C. EMPIRICAL ANALYSIS

1. Test for a Unit Root in the Series

In this first part, the individual series are tested for stationarity. Here is where we estimate whether the trend is stochastic, through the presence of a unit root, or deterministic, through the presence of a polynomial trend (Phillips and Perron, 1988).

The first results are from the tests for unit roots in the series. The tests that were used are: the Dickey-Fuller test (Dickey and Fuller, 1979); the Augmented Dickey-Fuller test (Said and Dickey, 1984) and the Phillips-Perron test (Phillips and Perron, 1988).

After a visual inspection of the series, see figures 8 and 9, we have decided to include in the tests for unit roots, a drift and a polynomial trend that goes up to order two, as well as to test

²⁶ Please refer to Appendix 4, for information regarding the simulation of the critical values for the trace statistics test, as well as for the table of critical values itself.

for structural breaks. It is relevant to note that there are important differences between a second order polynomial trend series and a series characterized by a structural break. First, in series which are distinguished by a one tendency break, the rupture is much more severe than in series which have second order polynomial trends. Second, in the light of cointegration, the detrending of the series is done differently if there are structural breaks. When there is a break in trend for a certain series, which is used in conjunction with others in cointegration analysis, the break has to be taken into account when detrending all series, and this in order to have a uniform and consistent detrending of the series (this issue is further discussed in section C.2).

It is important for the Augmented Dickey-Fuller test as well as for the Phillips-Perron test, to have the proper truncation lag parameter k (see for instance Perron, 1992). Therefore, we follow the general to specific directives²⁷ suggested by Perron (1992), and Campbell and Perron (1991), for the selection of k ; the results are found in table 2.

²⁷ "Start with some upper bound on k , say k_{\max} , chosen a priori. Estimate an autoregression of order k_{\max} . If the last included lag is significant (using the standard normal asymptotic distribution), select $k = k_{\max}$. If not, reduce the order of the estimated autoregression by one until the coefficient on the last included lag is significant. If none is significant, select $k = 0$." (Campbell and Perron, 1991, p. 155)

**Table 2: Results For The Truncation Lag Parameter k
 k -maximum = 4**

A) Series in Levels							
Series	M1	M2	Y	P	NRa	BRa	BRo
k^*	4	4	4	1	0	2	0

B) Series in First Differences							
Series	dM1	dM2	dY	dP	dNRa	dBRa	dBRo
k^*	3	3	3	4	0	1	0

Results for the unit roots tests on the series, in levels and in first differences, are found in table 3. Summarizing, all tests demonstrated that NRa and BRo are integrated of order 1, I(1). Y and BRa are stationary processes, I(0), according to the DF tests and the PP tests; the ADF tests suggest, however, that these series in levels have a unit root, I(1). M1 was characterized as an I(1) process by the DF and PP tests, and as an I(2) by the ADF tests. Two unit roots, I(2), were found for consumer prices under all tests, except for the ADF t^2 who characterises the series as an I(1) process around a second order polynomial trend. ADF t^2 also differentiated itself in the case of M2 where it found the series to be I(2), all other tests suggested a single unit root.

Underlined tests results are the ones that have been chosen, as we believe that they best characterise the series in question. Note that, even if the results are the same, the tests without trend were preferred to the ones with one trend, as the former represent a more parsimonious regression. The series for which no results are underlined, namely interest rates and inflation rates, are the ones we believe to have structural breaks (see figures 8 and 9). Thus a more detailed analysis of these series is required.

Table 3: Unit Root Test Results, *t*-statistic for the Series' Regression Series in Levels

Series	k	DF (1)	DF t (2)	DF t^2 (3)	ADF (4)	ADF t (5)	ADF t^2 (6)	PP (7)	PP t (8)
M1	4	-1.2042	-0.7755	-2.4246	<u>-2.5219</u>	-2.3989	-2.7564	-1.0608	-0.3651
M2	4	-1.4256	-1.2741	-1.7469	<u>-1.9907</u>	-1.9138	-2.1860	-1.6621	-1.5580
P	1	-0.3581	-0.5064	-0.3829	-1.0317	-1.7198	-1.6158	-0.3687	-1.4312
Y	4	-5.6035*	-5.6531*	-5.5845*	<u>-2.4782</u>	-2.4330	-2.3819	-5.7056*	-5.8322*
NRa	0	-1.6878	-1.4945	-2.7618	-2.7924	-2.6162	-3.2231	-1.7401	-1.4959
BRa	2	-3.6639*	-3.6346*	-4.1790*				-3.5482*	-3.5548*
BR0	0	-1.6720	-1.4931	-2.6629				-1.8006	-1.5892

Series in First Differences

Series	k	DF (1)	DF t (2)	DF t^2 (3)	ADF (4)	ADF t (5)	ADF t^2 (6)	PP (7)	PP t (8)
dM1	3	-10.6134*	-10.9106*	-11.8945*	-1.7561	-2.1316	-1.9043	-10.521*	-11.1462*
dM2	3	-6.1115*	-6.0985*	-6.3554*	<u>-2.9321*</u>	-5.2669*	-3.3723	<u>-6.1220*</u>	-6.1641*
dP	4	-2.4194	-2.4162	-3.3867	-2.4770	-2.4716	-3.8763*	-2.4939	-2.4710
dY	3	-9.9197*	-9.8354*	-9.7729*	<u>-3.8334*</u>	-3.7981*	-4.2786*	-13.907*	-13.9680*
dNRa	0	<u>-7.5745*</u>	-7.6710*	-7.6010*				-7.7230*	-7.9375*
dBRa	1	-7.9775*	-7.9736*	-7.9157*	<u>-7.8964*</u>	-7.9434*	-7.9434*	-9.3348*	-9.6502*
dBR0	0	<u>-7.7259*</u>	-7.8174*	-7.7493*				-7.8588*	-8.0309*

(1) Dickey-Fuller's *t*-Test Results. Regressing with a constant: $X_t = \alpha + \beta X_{t-1} + \xi_t$
(2) Dickey-Fuller's *t*-Test Results. Regressing with a constant and a trend: $X_t = \alpha + \Theta t + \beta X_{t-1} + \xi_t$
(3) Dickey-Fuller's *t*-Test Results. Regressing with a constant and a second order polynomial trend: $X_t = \alpha + \Theta t + \phi t^2 + \beta X_{t-1} + \xi_t$
(4) Augmented Dickey-Fuller's *t*-Test Results. Regressing with a constant: $X_t = \alpha + \beta X_{t-1} + \sum_{i=1}^k \delta_i \Delta X_{t-i} + \xi_t$
(5) Augmented Dickey-Fuller's *t*-Test Results. Regressing with a constant and a trend: $X_t = \alpha + \Theta t + \beta X_{t-1} + \sum_{i=1}^k \delta_i \Delta X_{t-i} + \xi_t$
(6) Augmented Dickey-Fuller's *t*-Test Results. Regressing with a constant and a second order polynomial trend: $X_t = \alpha + \Theta t + \phi t^2 + \beta X_{t-1} + \sum_{i=1}^k \delta_i \Delta X_{t-i} + \xi_t$
(7) Phillips-Perron's *t*-test Results. Regressing with a constant.
(8) Phillips-Perron's *t*-test Results. Regressing with a constant and a trend.
Critical values (n=50): for (1), (4) and (7): -2.93 (Fuller, 1976).
for (2), (5) and (8): -3.50 (Fuller, 1976).
for (3) and (6): -3.82 (Ouliaris, Park and Phillips, 1989).
(*) Denotes statistical significance, on at least a 5% level, for stationarity.
Note: for ADF $k=k^*$, for PP $k=k_{max}$, ($k_{max}=4$). As $k=0$ for some series, the ADF test becomes the DF test.

1.1 Unit Root Tests with Structural Changes in the Series

According to most of the results of the conventional stationarity tests (DF, ADF and PP) reported in table 3, the three interest rates series would be $I(1)$, and prices would be $I(2)$. A visual inspection of these series (see figures 8 and 9) indicates, however, that the structural changes that the Mexican economy has been undertaking (as exposed in the first part of this paper), may have altered the long term economic fundamentals, and therefore the trends of the respective series. As demonstrated by the seminal work of Perron (1989), tests of the unit root hypothesis against trend stationary alternatives are biased towards non-rejecting the unit root when there are one-time changes (breaks) in the tendency of a trend-stationary series. These changes are, normally, the results of a "big shock" or of an unusual event that have permanent effects on the level of the series.

The literature on structural breaks has been showing the importance of the correct characterization of the economic time series when doing applied work²⁸ (see *inter alia* Zivot and Andrews, 1992; Perron and Vogelsang, 1992; Banerjee, Lumsdaine and Stock, 1992). New tests have been developed to estimate the precise moment of rupture, so to avoid the *a priori* date specification problem denounced by Christiano (1992). In this paper we follow Perron's (1993b) statistical procedures for testing for a unit root while allowing for the possible presence of a one-

²⁸ Note that on the paper by Tseng and Corker (1991), they seemed to face structural changes, due to financial liberalization, in the Philippines, Myanmar and Indonesia. Although no formal tests for structural breaks were performed, they tried to account for the changes by imposing up to two intercept shift dummies in the monetary equations. These dummies were introduced at pre-specified dates.

time change in trend, and this at an unknown date. In his article, two general models are suggested:

- a) the "additive outlier" model (AO); appropriate when the change is sudden,
- b) the "innovation outlier" model (IO); adequate when the change is gradual.

There are three qualifications for the AO model, (of which only 1 and 2 apply to the IO model):

1. The *crash* model, which allows for a one-time change in the intercept of the trend function.
2. The *sudden change in level followed by a different growth path* model, allowing for both a change in the intercept and the slope of the trend function to take place simultaneously.
3. The *changing growth* model, which allows for a change in the slope of the trend function without any sudden change in the level at the time of the break.

The second specification is the one being used in our estimations, as it has a more complete representation. The null hypothesis specifies the presence of a unit root, while the alternative hypothesis specifies trend-stationarity. "Note that the changes in the trend function are allowed to occur under both the null and the alternative" (Perron, 1993b, p. 5).

For the AO model, the procedure consists of a two step approach, where in the first, the trend function of the series is estimated and removed from the original series through the following regression:

$$y_t = \nu + \beta t + \theta DU_t + \gamma DT_t^* + \check{y}_t \quad (9)$$

Where $DU_t = 1$ and $DT_t^* = (t - T_b)$ if $t > T_b$ (zero otherwise), and where \check{y}_t is defined as the detrended series. DU_t accounts for the change in level while DT_t^* for the change in slope. For

the second step, the test is based on the value of the t -statistic for testing that the sum of the autoregressive coefficients is equal to 1 ($\alpha = 1$) in the following autoregression applied to the estimated noise component \check{y}_t :

$$\check{y}_t = \alpha\check{y}_{t-1} + \sum_{j=0}^k d_j D(T_b)_{t-j} + \sum_{i=1}^k a_i \Delta\check{y}_{t-1} + e_t \quad (10)$$

where $D(T_b) = 1$ if $t = T_b + 1$ and zero otherwise.

For the IO model, the test is based on the following regression:

$$y_t = \nu + \beta t + \theta DU_t + \gamma DT_t^* + \delta D(T_b)_t + \alpha y_{t-1} + \sum_{i=1}^k a_i \Delta y_{t-1} + e_t \quad (11)$$

where DU_t , DT_t^* and $D(T_b)$ follow the same pattern as in the AO model.

The construction of the test statistics of interest, namely the t -statistic for testing $\alpha = 1$ in [9] - [10] and [11] depends on two parameters that are in general unknown: the break date T_b and the truncation lag parameter k . (Perron, 1993b, pp. 14-15).

The time of the break is estimated endogenously through a procedure whereby T_b is selected as the value, over all possible break points, which minimizes the t -statistic for testing $\alpha = 1$ in the appropriate autoregression. The truncation lag parameter k was set to 4 ($k_{max} = 4$) for all series.

Table 4 presents the empirical results for the series in levels and in first differences. Columns 1 and 2 list the series and the model of the trend function that was used. Columns 3 and 4 give the date of the break in the trend function and the relative time of the break in relation to the total sample size. Column 5 shows the value of the truncation lag parameter k being selected by the t -statistic to test for the significance of the last lag. β , θ and γ are the estimated values of the coefficients of equations (9) or (11), their corresponding t -statistics are

in parenthesis. β is the estimate of the initial (pre-break) slope of the trend function, θ is the estimate of the change in the intercept of the trend function and γ is the estimate of the change in the slope of the trend function. Columns 9 and 10 present the estimate of the sum of the autoregressive coefficients, α , and its associated t -statistic for testing that $\alpha = 1$, t_{α} .

Note that only in the case where there is a rejection of the unit root, the t -statistic on the change in slope and/or intercept is asymptotically normally distributed. Moreover, stationarity makes the selected value of T_b be a consistent estimate of the time of the break (Perron, 1993b).

As the two models (AO and IO) were employed, one has to select the appropriate one for each series. Because M1, dM1, M2, dM2, Y, dY and P were already characterized (see table 3), the structural break analysis will primarily focus on the interest and inflation rates. It is relevant to note, however, that in general, under both models, the results obtained in table 3 are confirmed for these variables (M1, dM1, M2, dM2, Y, dY and P). The only exceptions may be M2 and Y for which one of the models implies stationarity at level of the series, while the other suggests a unit root. Due to the ambiguity of the results, and after a visual inspection of the series (see figures 8.b and 8.c), we have decided to characterize these series as I(1) processes without break. Our decision is based on the fact that, for both series, the break appears to be very shallow and may not be significant in a larger sample analysis.

Table 4: Results of the Unit Root Test with Structural Changes in the Series

Series	Model	T_b	$\lambda=T_b/T$	k	β	θ	γ	α	t_{α}
M1	AO2	1986:2	0.57	4	-0.017 (-5.14)	-2.676 (-10.51)	0.061 (10.01)	0.679	-3.791
	IO2	1988:4	0.73	4	-0.01 (-3.57)	-1.869 (-2.97)	0.041 (3.11)	0.555	-4.024
dM1	AO2	1984:2	0.44	4	-0.004 (-1.01)	-0.219 (-1.60)	0.008 (-1.75)	-0.606	-3.429
	IO2	1982:2	0.30	4	-0.007 (-0.97)	-0.318 (-2.19)	0.013 (1.57)	-0.406	-3.228
M2	AO2	1987:2	0.63	4	-0.006 (-2.10)	-2.510 (-7.07)	0.049 (6.48)	0.528	-4.372
	IO2	1988:2	0.70	4	-0.008 (-4.89)	-3.097 (-6.39)	0.006 (6.47)	0.324	-6.589 ^a
dM2	AO2	1987:3	0.66	4	-0.001 (-0.88)	-0.393 (-1.66)	0.009 (1.89)	-0.239	-5.187 ^c
	IO2	1988:4	0.73	2	-0.004 (-3.30)	0.667 (2.09)	-0.007 (-1.15)	-0.695	-9.226 ^a
Y	AO2	1986:4	0.60	4	-0.001 (-2.54)	0.089 (1.59)	-0.000 (-0.36)	0.189	-5.477 ^b
	IO2	1987:3	0.65	4	-0.001 (-0.87)	-0.463 (-2.39)	0.009 (2.45)	0.490	-3.243
dY	AO2	1981:1	0.22	4	0.003 (0.23)	-0.025 (-0.18)	-0.002 (-0.19)	-1.960	-5.077
	IO2	1982:1	0.28	4	-0.002 (-0.26)	-0.229 (-2.08)	0.004 (0.60)	-2.144	-5.288 ^c

Table 4: Results of the Unit Root Test with Structural Changes in the Series (Continued)

Series	Model	T _b	$\lambda = T_b/T$	k	β	θ	γ	α	t _{α}
P	AO2	1985:3	0.51	4	0.101 (18.91)	0.928 (3.14)	-0.004 (-0.566)	0.902	-3.256
	IO2	1986:3	0.58	1	0.011 (3.95)	0.394 (4.06)	-0.008 (-4.05)	0.914	-3.534
dP	AO2	1986:4	0.66	4	0.004 (4.86)	0.493 (6.70)	-0.129 (-7.72)	0.258	-5.240 ^c
	IO2	1987:4	0.67	4	0.003 (4.99)	0.104 (1.16)	-0.005 (-2.47)	0.245	<u>-6.447^a</u>
NRa	AO2	1987:3	0.65	0	2.277 (12.42)	215.407 (9.07)	-5.849 (-11.72)	0.558	-4.334
	IO2	1987:4	0.67	0	1.161 (9.357)	57.670 (3.10)	-2.392 (-5.29)	0.332	<u>-10.016^a</u>
dNRa	AO2	1987:4	0.67	0	0.096 (0.62)	-46.833 (-2.14)	0.736 (1.63)	-0.274	-10.953 ^a
	IO2	1988:1	0.68	0	0.145 (2.29)	-1.972 (-0.17)	-0.110 (-0.48)	0.158	-13.610 ^a
BRa	AO2	1986:1	0.55	1	0.050 (1.68)	10.752 (5.31)	-0.222 (-4.39)	-0.030	-7.399 ^a
	IO2	1986:2	0.57	1	0.035 (1.37)	13.889 (5.64)	-0.270 (-4.94)	-0.031	<u>-7.408^a</u>
dBRa	AO2	1989:1	0.76	1	0.000 (0.01)	0.268 (0.04)	-0.014 (-0.12)	-0.499	-9.311 ^a
	IO2	1989:1	0.76	2	-0.003 (-0.15)	-5.937 (-1.08)	0.091 (0.88)	-1.022	-8.260 ^a

Table 4: Results of the Unit Root Tests with Structural Changes in the Series (Continued)

Series	Model	T _b	λ=T _b /T	k	β	θ	γ	α	t _α
BR0	AO2	1987:2	0.63	2	1.750 (10.77)	172.349 (9.18)	-4.632 (-11.49)	0.324	-6.326*
	IO2	1987:4	0.67	3	1.473 (9.532)	59.933 (3.32)	-2.271 (-5.33)	0.240	<u>-9.755*</u>
dBR0	AO2	1986:3	0.57	0	0.097 (0.612)	-7.684 (-0.60)	0.016 (0.05)	-0.096	-8.242*
	IO2	1987:3	0.65	0	0.075 (0.55)	-41.837 (-2.33)	0.663 (1.79)	-0.162	-8.749*

Note: Results for the Additive Outlier Model for testing for unit roots with structural breaks (Model 2 in Perron, 1993b). The coefficients correspond to the coefficients of the 2 step regression test:

$$y_t = v + bt + \theta DU_t + \gamma DT_t^* + \dot{y}_t$$

$$\dot{y}_t = \alpha \dot{y}_{t-1} + \sum_{j=0}^k d_j D(T)_{t,j} + \sum_{i=1}^k a_i \Delta \dot{y}_{t-1} + e_t$$

Results for the Innovation Outlier Model for testing for unit roots with structural breaks (Model 2 in Perron, 1993b). The coefficients correspond to the coefficients of the regression test:

$$y_t = v + bt + \theta DU_t + \gamma DT_t^* + \delta D(T)_{t,1} + \alpha y_{t-1} + \sum_{i=1}^k a_i \Delta y_{t-1} + e_t$$

t-statistics are in parenthesis, except for the column labeled t_α. The k value is selected using the t-statistic to test for the significance of the last lag (k_{max} is set equal to 4).

a, b and c indicate that the unit root hypothesis is rejected at the 1%, 2.5% and 5% level respectively.

The critical values for AO2 and for IO2 are: -5.57, -5.30 and -5.08 for 1%, 2.5% and 5% respectively (Perron, 1993b).

The underlined results are the ones chosen for the respective series.

In the case of the inflation rates, we have decided to choose the results of the IO model. Firstly because the critical value for the rejection of the unit root is much higher. Secondly because an IO model, that describes a gradual change, better portrays the wage and price controls of the *Economic Solidarity Pact*²⁹ that was signed on December 1987. Note how figure 10.d tends to indicate that the inflation rates seem be returning to the pre oil-shock, debt-crisis level.

For the NRa, the judgment obviously favours the IO model as it depicts the notorious break in the series (see figure 8.e). It is relevant to note that the t_{α} on the AO model is somewhat ambiguous, not being high enough to reject the unit root but being close. The problem being, probably, with the power of the test. The IO model is also selected for BRa and BRo. Note that the IO model is preferred for the interest rates because of its nature of gradual transition to the new trend.

Therefore, table 4 tells us that by choosing T_b minimizing the t -statistic on α and by choosing k using the recursive t -statistic on the last lag, we reject the null hypothesis of unit root in favour of the alternative hypothesis of stationary fluctuations around a broken trend function for the interest rates series (NRa, BRa, BRo) and for the inflation rates³⁰ (dP). The t -statistics associated with the change in slope and intercept are, in general, highly significant, confirming the breaks and justifying the selection of specification 2.

²⁹ See section B of the Part I.

³⁰ Note that Haldrup (1991) found prices in Mexico to be integrated of order 2, I(2). It is relevant to mention that his tests did not take into account possible structural breaks; and that the tests were performed on quarterly data covering the period 1948:1 to 1988:4, which may be insufficient to detect the break of 1987:4.

Figure 10.a: Structural Break in NRa Figure 10.b: Structural Break in BRa
 In Levels (break date: 1987:4) In Levels (break date 1986:2)

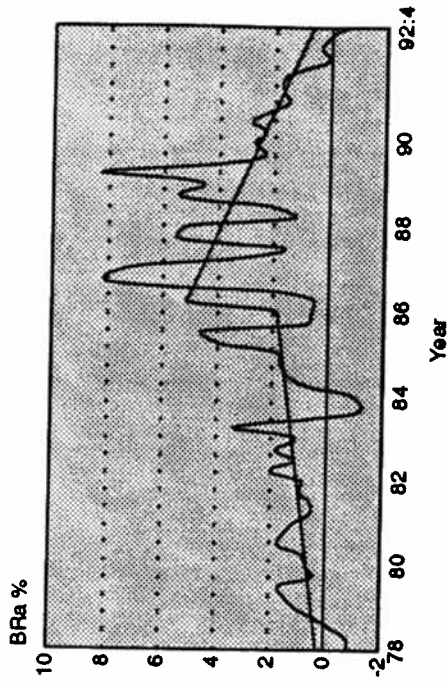
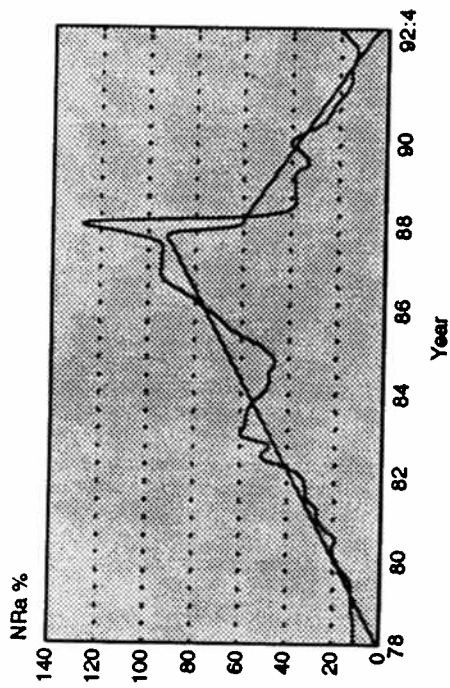


Figure 10.c: Structural Break in BRo Figure 10.d: Structural Break in Inflation
 In Levels (break date: 1987:4) Prices in first differences (break date: 1987:4)

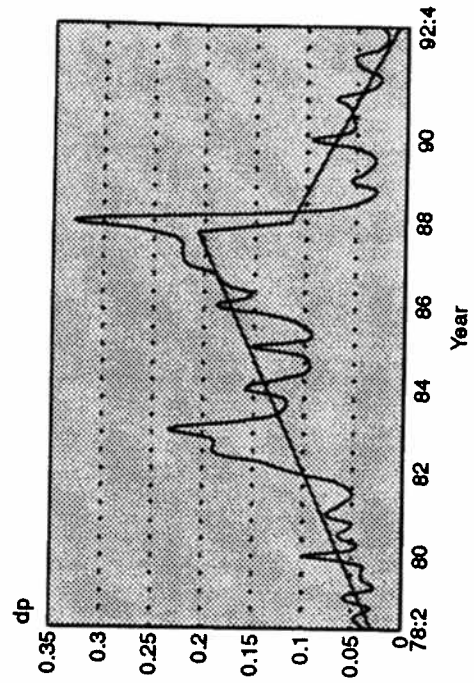
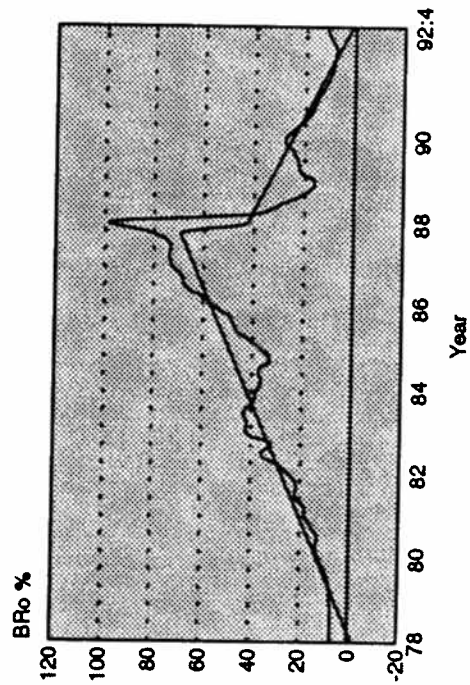


Figure 10³¹ shows the structural breaks in the series. It is very relevant to note that the IO model suggests a non-linear trend function, in order to show the gradual adjustment to the new path after the break date. In this study, however, we are analyzing the cointegration relationship of these variables, and as mentioned before, in the process, we have to account for the structural breaks. Therefore, critical values for the cointegration rank statistics test had to be calculated. These were computed with Johansen and Nielsen's DisCo software. This software is, however, limited to linear drift functions, what constrains us to impose linearity in the IO model.

Thus, as can be seen in figures 11 and 12, where trends were fitted on the series, the series are characterized as follows:

Table 5: Characterization of the Series

Series	Degree of Integratedness	Structural Break in Trend
M1	I(1)	No
M2	I(1)	No
Y	I(1)	No
P	I(1)	Yes, in dP
NRa	I(0)	Yes
BRa	I(0)	Yes
BRo	I(0)	Yes

³¹ The breaks in Figure 10, are constructed by regressing:

$$y_t = \text{constant} + \text{trend} + DU_t + DT_t^*$$
and by taking the fitted values. The fit becomes the broken trend.

Figure 11.a: M1 with a Deterministic Trend Figure 11.b: M2 with a Deterministic Trend

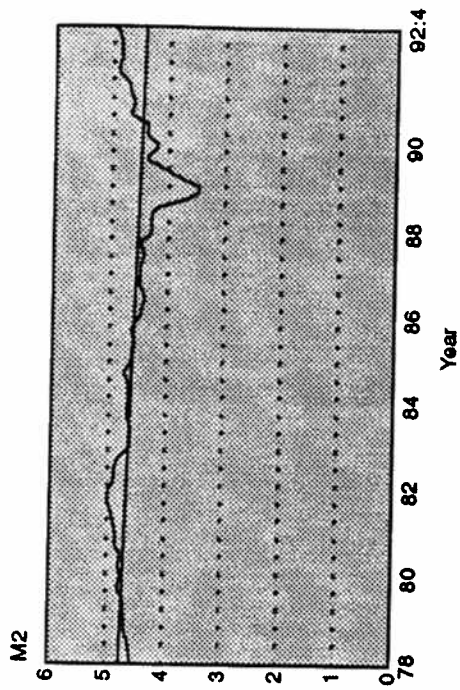
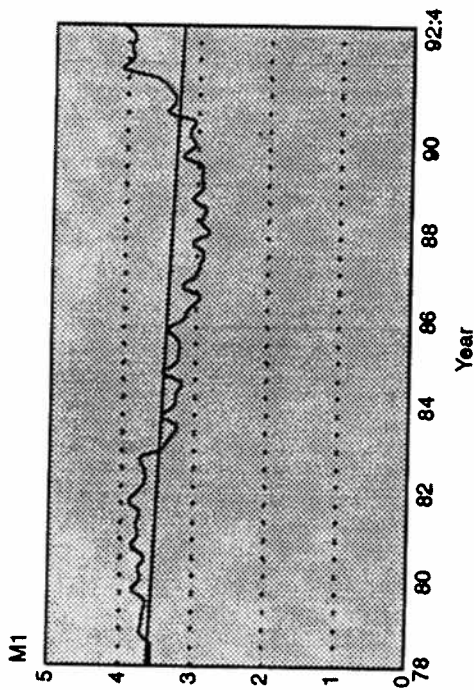


Figure 11.c: Real GDP with a Deterministic Trend Figure 11.d: Prices with a Deterministic Trend

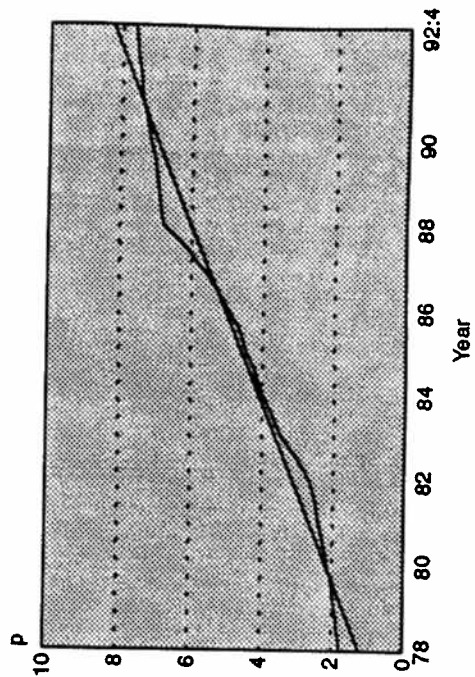
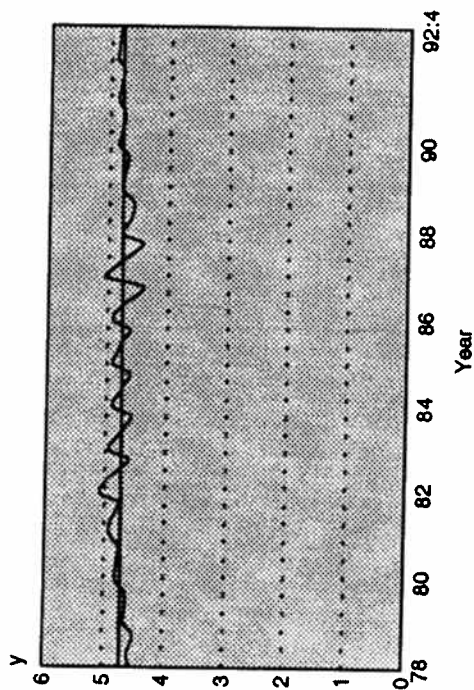


Figure 11.e: Structural Break in NRa
 In Levels (break date: 1987:4)

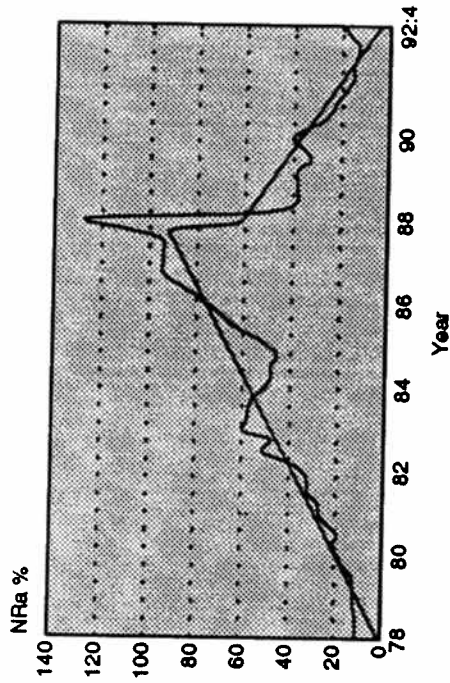


Figure 11.f: Structural Break in BRa **Figure 11.g: Structural Break in BRo**
 In Levels (break date 1986:2) In Levels (break date: 1987:4)

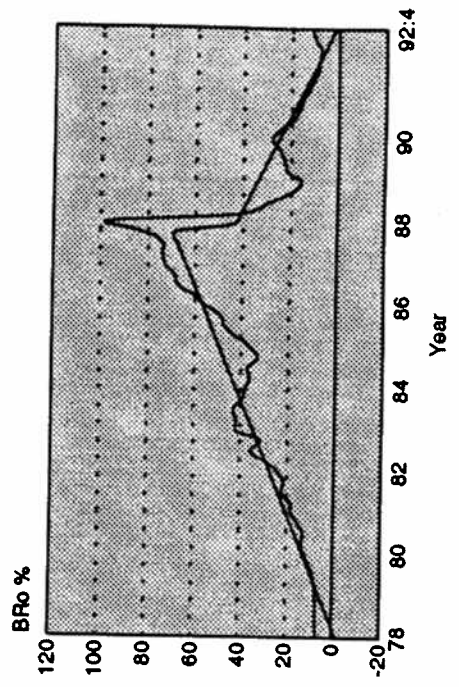
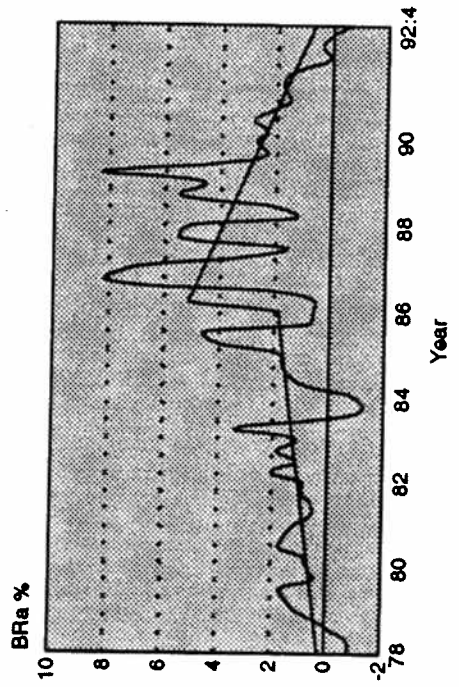


Figure 12.a: M1, in First Differences with a Trend

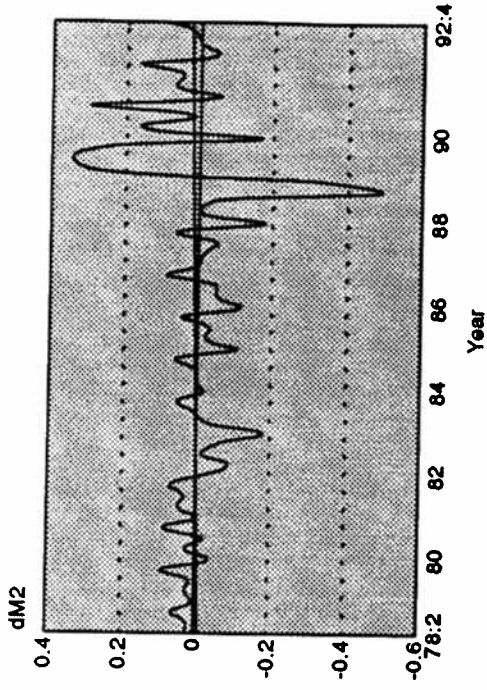
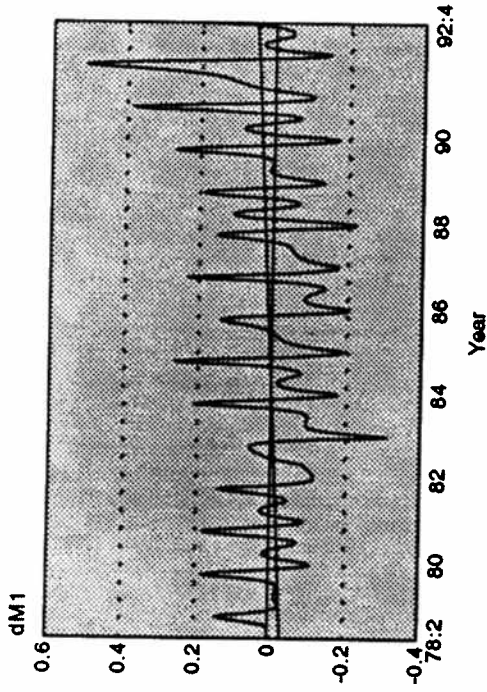


Figure 12.c: Real GDP, in First Differences with a Trend

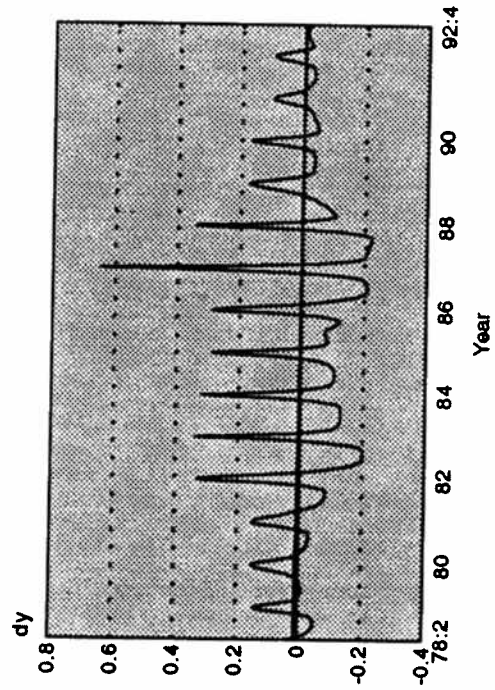


Figure 12.d: Structural Break in Inflation
Prices in first differences (break date: 1987:4)

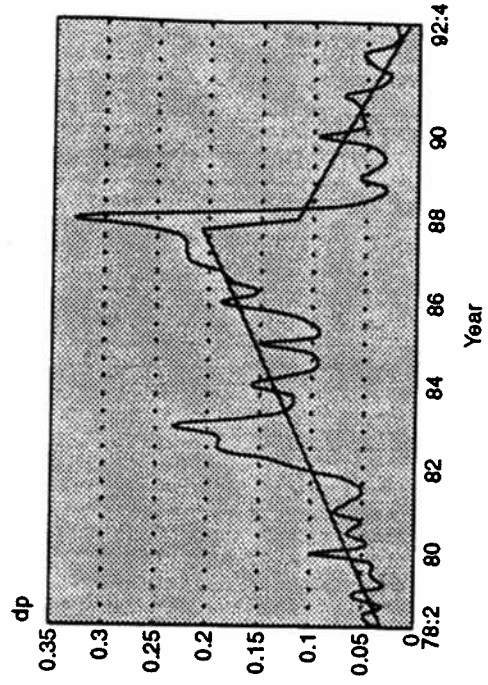


Figure 12.e: NRa, in First Differences with a Trend

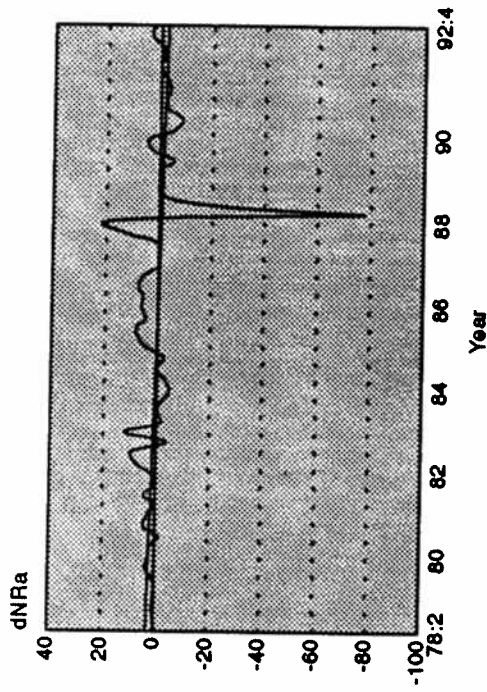


Figure 12.f: BRa, in First Differences with a Trend

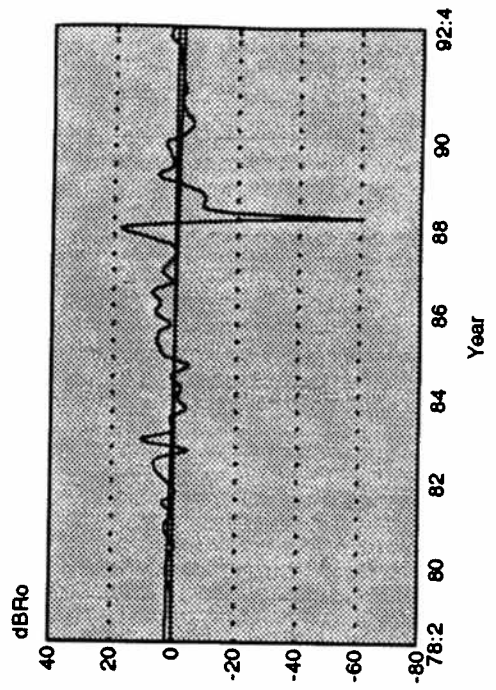
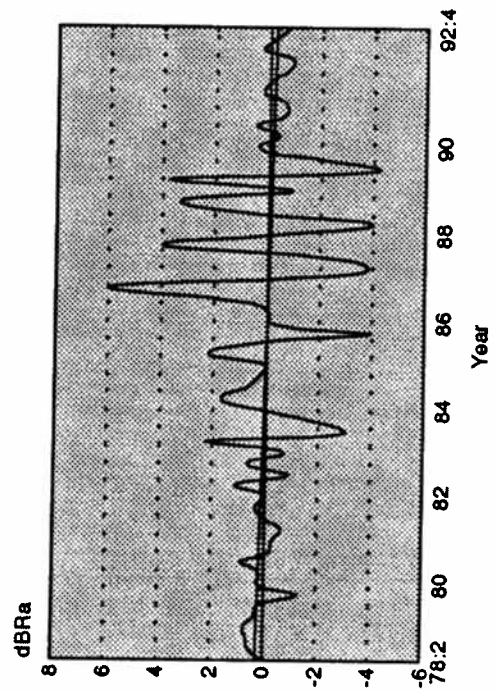


Figure 13.a: M1 Detrended
In Levels

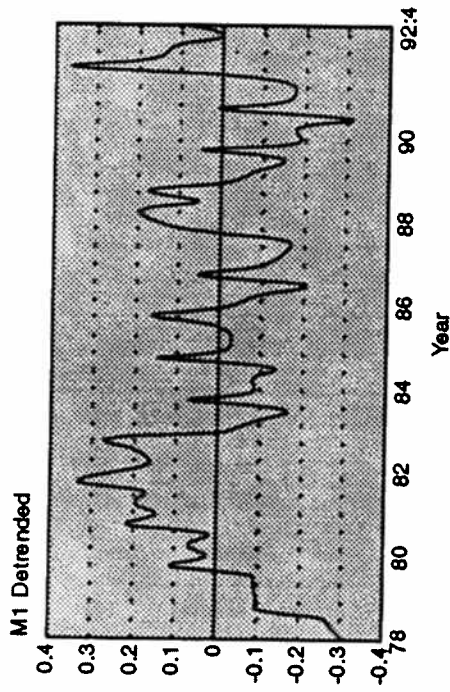


Figure 13.b: M2 Detrended
In Levels

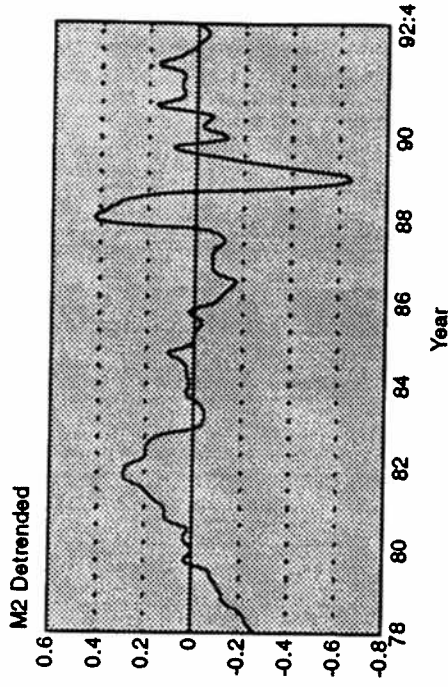


Figure 13.c: Real GDP Detrended
In Levels

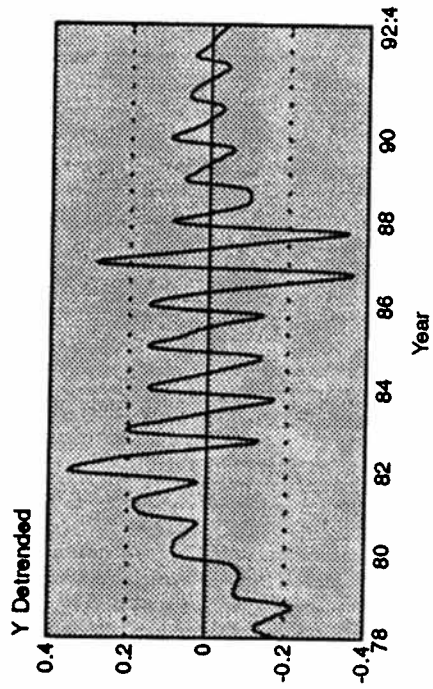
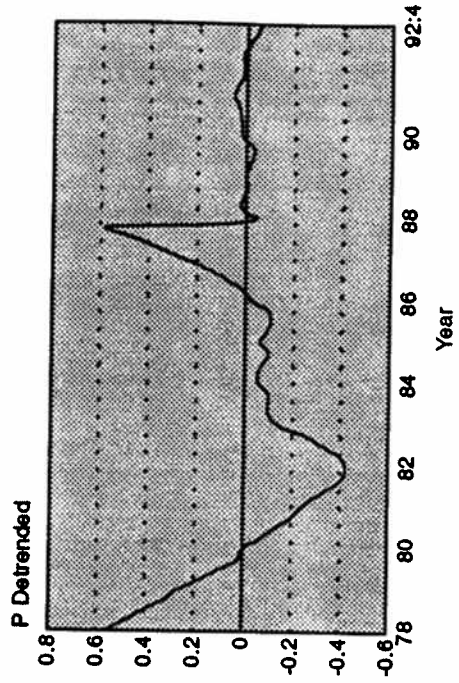


Figure 13.d: Prices Detrended
In Levels



All detrendings account for a break on 1987:4.

Figure 13.e: NRa Detrended
In Levels

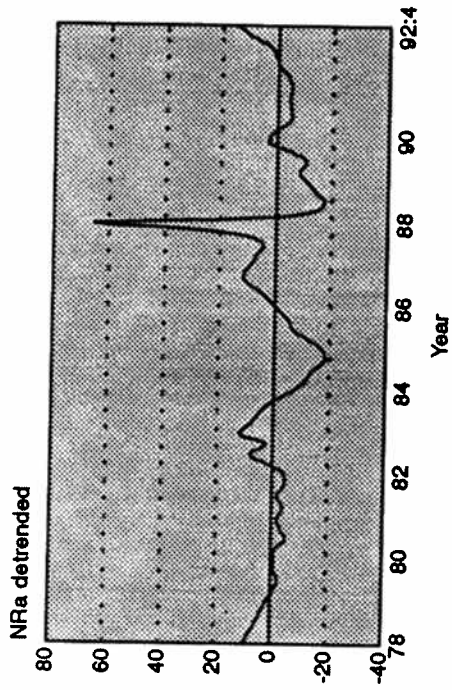


Figure 13.f: BRa Detrended In Levels Figure 13.g: BRo Detrended In Levels

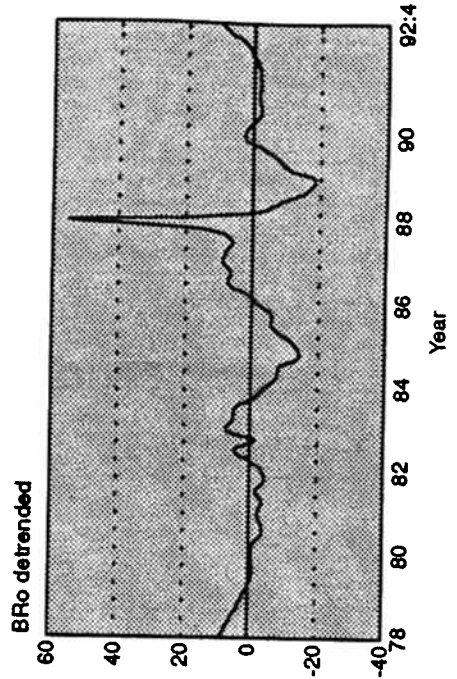
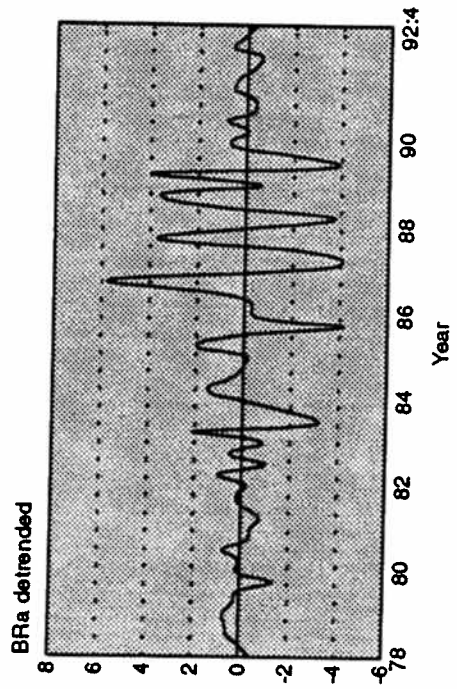


Figure 14.a: M1 Detrended
In First Differences

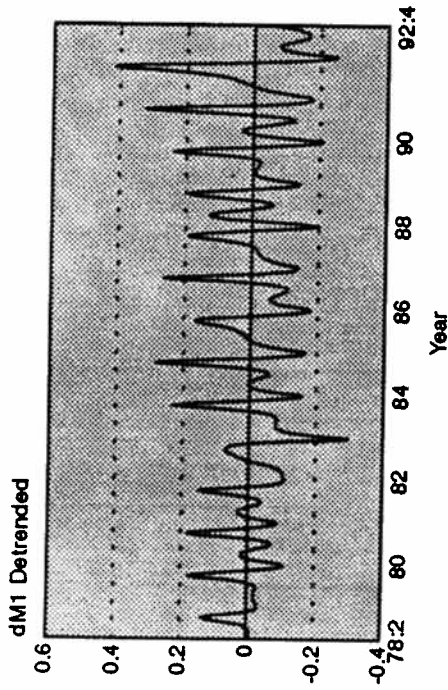


Figure 14.b: M2 Detrended
In First Differences

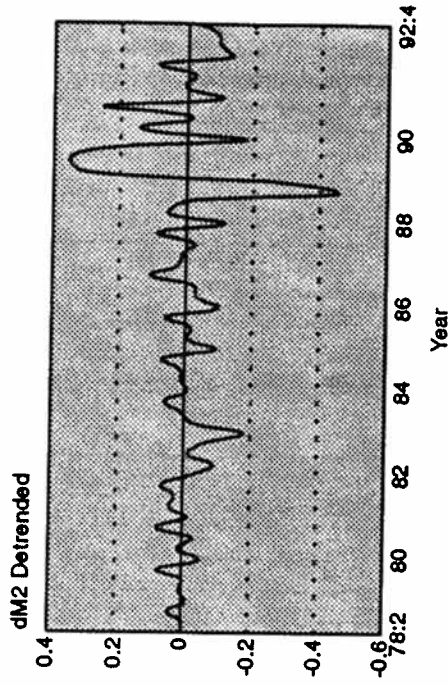


Figure 14.c: Real GDP Detrended
In First Differences

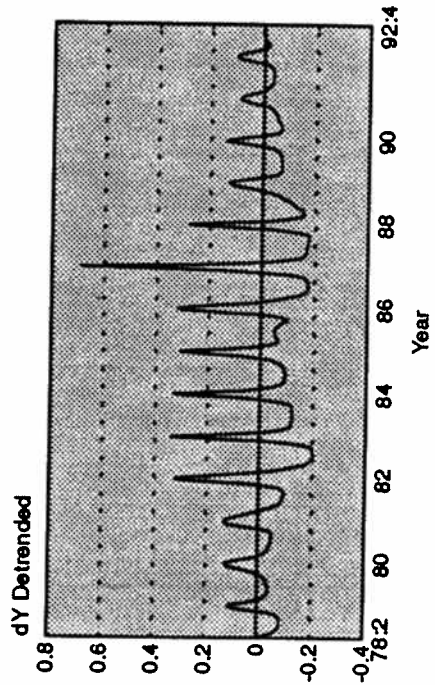
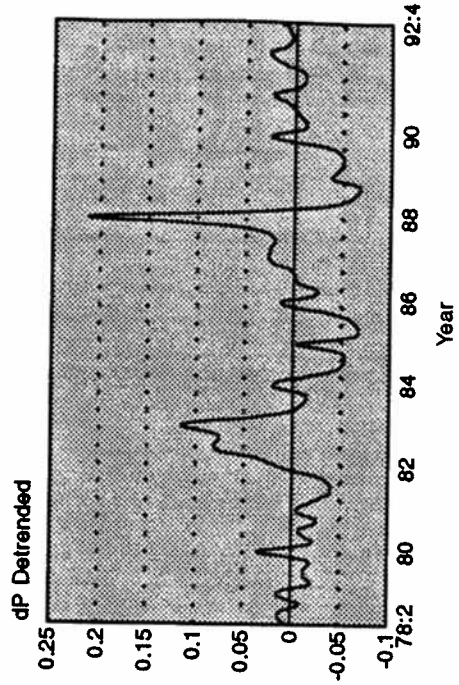


Figure 14.d: Prices Detrended
In First Differences



All detrendings account for a break on 1987:4.

Figure 14.e: NRa Detrended
In First Differences

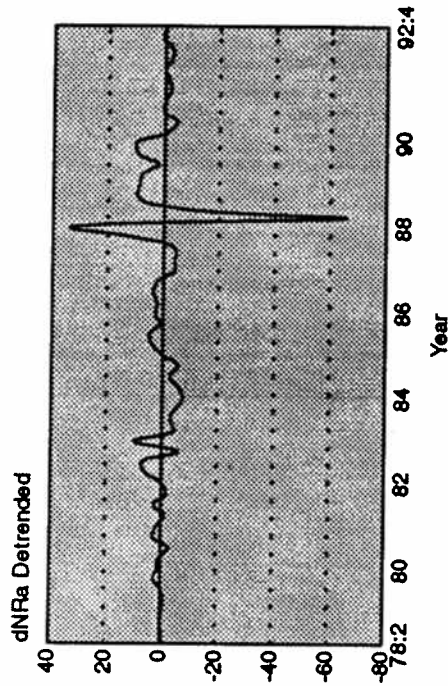


Figure 14.f: BRa Detrended
In First Differences

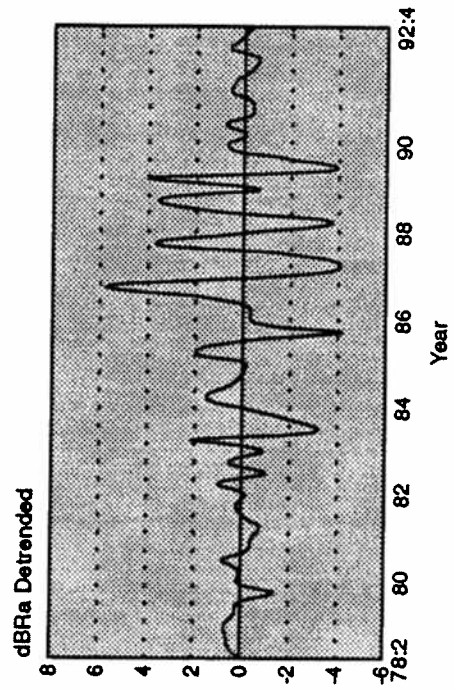
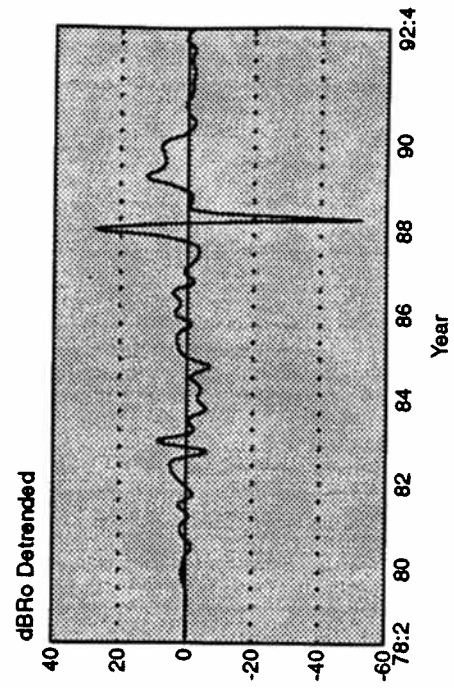


Figure 14.g: BRo Detrended
In First Differences



2. Detrending the Series

After having established the nature of the data series, we have found that some series are characterized by structural changes. It is therefore, important to properly detrend the series, by accounting for the breaks. Note that only after having detrended all series with respect to the same broken trend we can perform the deterministic cointegration tests. If the breaks were not considered in the detrending, deterministic cointegration could not be used. Stochastic multivariate cointegration would then have to be used, and the structural breaks would have to be modelled into the trend function, what would complicate considerably the estimation procedures³². If instead the breaks were completely disregarded, it would be like imposing deterministic cointegration where one should have stochastic cointegration. As presented by Perron and Campbell (1993), this improper model characterization would lead to incorrect inferences on the cointegrating relations and on the causality relations.

Following from the examination of the series when the correct trend is introduced, see figure 10, the break date of 1987:4 (which distinguishes NRa and BRo) was selected to be the one to be used in the detrending. There are some distinct idiosyncrasies that make the selection of the 1987:4 break date evident. Firstly, as we plot the trends, including the breaks (see figure 10), on the series, we can see that NRa and BRo are the ones that display the best fit. Secondly, the break date is the same for both series and for the inflation rates. Thirdly, it is very convenient to have a structural break with the same date for the M1 equation and for the M2 equation, although it was coincidental. This advantage is reflected in the calculation of the critical values

³² See Perron and Campbell (1993) for stochastic multivariate cointegration estimation.

for the cointegration rank test. Because the date of the break is the same, we can use the same critical values for both equations (see appendix 4 for details on the calculations). Finally, the break date truly confirms two major macroeconomic changes in the Mexican economy, the first being the control of inflation and its intrinsic economic and financial consequences. The second being the acceleration of the financial liberalization process.

The procedure of detrending is done by regressing every series on a constant, a linear trend and on DU_t and DT_t^* , where $DU_t = 1$ and $DT_t^* = t - T_b$ if $t > T_b$ (zero otherwise), and $T_b = 1987:4$. The residuals of these regressions become the detrended series (see figures 13 and 14) to be used in the cointegration analysis. Throughout the rest of the paper we use an asterisk (*) on the series name to represent the detrended series.

3. Estimation Results

Equation (3) was calculated for broad and narrow money, and by using the detrended series. Because of possible seasonality in dY^* (see figure 14.c), with periodicity in the fourth lag, the estimation was performed with 4 lags. It was found that with 4 lags, the residuals for both equations passed the Box-Pierce Q test for autocorrelation (see Appendix 5), so there is no need to increase the number of lags any further. The estimates of equation 3 are given in Appendix 5.

By using the detrended series, the eigenvalues and eigenvectors for Mexico's two demand for money equations were calculated following the procedure elaborated in section B.2. Results are reported in table 6.

Table 6: The Eigenvalues λ and eigenvectors V for Mexico's Money Demand Equations

M1				M2				
Eigenvalues λ				Eigenvalues λ				
(0.3892 0.1917 0.1196)				(0.6901 0.2773 0.1574 0.1027)				
Eigenvectors V				Eigenvectors V				
M1*	-10.178	7.873	-2.161	M2*	-0.976	11.585	12.032	-0.944
Y*	12.677	-4.239	16.145	Y*	1.650	-10.728	-22.439	-11.876
NRa*	0.112	0.090	0.003	BRa*	-1.116	0.866	-0.047	0.195
				BRO*	0.116	0.002	-0.205	0.019

Note that because the equations have a different number of parameters, the narrow money equation may have at most 2 cointegrating vectors, while the broad money equation may have 3 cointegrating vectors. Recall from Johansen (1989), that there may be as many as $(p - 1)$ linear combinations of p data series that are cointegrated.

Table 7 has information on the calculated likelihood ratio test statistics and on the 95% quantiles of the appropriate limiting distribution. Note that the critical values have to account for the structural break in the series, thus, the asymptotic distributions of the statistics were calculated and are tabulated in table A.2, in Appendix 4.

Table 7: Trace Test Statistics for the Hypothesis H_2 and the General Alternative H_1 for Mexico's Demand For Money Equations

Narrow Money (M1)			Broad Money(M2)		
H_2	Trace	Trace(95%)	H_2	Trace	Trace(95%)
$r \leq 2$	7.132	3.953	$r \leq 3$	6.071	3.953
$r \leq 1$	19.057	12.834	$r \leq 2$	15.665	12.834
$r = 0$	46.666	25.040	$r \leq 1$	33.858	25.040
			$r = 0$	99.464	41.824

The eigenvalues reported in table 6 were used to calculate trace statistics through equation (8).

3.1 Multivariate Cointegration Results and Discussion

To estimate the dimensions of the cointegrating vector, the sequential approach, is used. The null hypotheses, of r cointegrating vectors, are tested sequentially, from $r = 0$ to $r \leq p - 1$. $r+1$ cointegrating vectors are selected if r is the last significant statistic.

Narrow Money Demand Equation (M1): the hypothesis of zero cointegrating vectors was first tested and rejected as the comparison with the 95% quantile in the asymptotic distribution for $r = 0$ shows that this value is significant. If we test the hypothesis that $r \leq 1$, we get a test value of 19.057, which is greater than the critical value of 12.834, making us reject the hypothesis of only one cointegration relation. We then test for $r \leq 2$, where we get a value of 7.132, which is much greater than the critical value of 3.953, telling us that there are 3 cointegrating vectors.

The Broad Money Demand Equation (M2): here, as well, after performing the sequential approach to determine the dimension of the cointegrating space, we notice that there are 4 cointegrating vectors, as the hypothesis of $r \leq 3$ is accepted.

The results of having all vectors cointegrating in both equations is somewhat perplexing. For both equations we have fallen in the extreme case of having a full rank matrix Π . Remember from section B.1 that the matrix Π is the one which conveys information on the long-run equilibrium relationship among the variables in the data vector. Having the matrix Π being full rank means that all elements of X_t are stationary around a trend vector (Campbell and Perron, 1991). In our particular case, this trend vector has a break, taking the form of $\beta t + \Theta DU_t + \gamma DT_t^*$.

The interesting insinuation of having the vector process X_t stationary is that it implies that all variables are $I(0)$ around a trend that has a break at 1987:4. Now, as we have seen by the battery of unit root tests performed in the series, interest rates were $I(0)$ around a broken trend, but M1, M2 and Y seemed to be integrated processes of order one without structural breaks.

Recall that, even though the structural break tests suggested contradictory results for Y and M2 (see table 4), none of them implied that the break was at 1987:4, as was "imposed" in the detrending. And for the M1 case, both AO and IO tests did not find any structural break (not even at the 10% level).

What seems to be happening here is that when the detrending (including the break at 1987:4) was imposed, the variables became stationary. As there was already an ambiguous result for M2 and Y, the imposition of the break intrinsically selected stationarity for these variables. Note that according to the tests presented in table 4, the breaks on M2 and Y would be separated from the 1987:4 break by a maximum of one year, which is not much. The surprise is really M1.

Although we did not find any indication of a possible break in the unit root tests, when the rupture was imposed in the series it was accepted, changing the characterization of M1 to an $I(0)$ process with a break. Therefore, we are probably facing a *type II error* (not rejecting the null hypothesis of unit root with break, when in fact it is false) in the test for unit roots in the presence of structural changes.

We conclude by saying that we do believe the series were correctly characterized in section C.1 (see table 5). However, the imposition of the break in the detrending, necessary for the multivariate cointegration analysis, changed the structure of the series. This helped the series, which were already prone to have a rupture, to exhibit such a break. In the multivariate cointegration analysis, we have found that, for both equations, the cointegrating matrix is of full rank. Campbell and Perron (1991) note that in a situation where the matrix Π is of full rank, no restrictions are imposed on the reduced form representation. It is, thus, a case for the standard VAR model, where the "standard VAR analysis applied to the level of the series³³ is the appropriate estimation strategy" (Campbell and Perron, 1991, p. 168).

³³ Note that here we are referring to the detrended series, including the break of 1987:4.

D. CONCLUSION OF THE SECOND PART

In this second part of the paper, extensive use of econometric techniques were applied to investigate whether or not the financial liberalization in Mexico has affected the long run equilibrium relationship in the demand for narrow and broad money. Tendency breaks were present for some series, notably for inflation and interest rates, reflecting the impact of the macroeconomic structural changes undergone in the last decade. Although it is difficult to link any instability to precise financial reforms, as these were taken in various fronts, it is reasonable to say that the structural breaks in interest rates are largely due to the reduction of inflation and to the improvement of the financial system that followed. The inflation rates fell mainly because of the wage and price freezes stipulated by the Economic Solidarity Pact of 1987. Private sector expectations about lower inflation and economic optimism not only permitted but contributed to the success of the reforms.

Accounting for the structural breaks, the stability of the money demand equations were studied by means of Johansen's multivariate cointegration analysis. All possible cointegration relationships were found for each equation, implying that both monetary aggregates (M1 and M2) have been related in a stable long-run fashion to real income and interest rates. As the matrix Π was found to be of full rank, a cointegration analysis would be redundant and one can estimate Mexico's broad and narrow monetary equations directly by using the break detrended series in levels.

The interesting factor here is that these results were obtained only after a tendency break was imposed in the detrending of series. This revealed that some series, which were characterized

as being integrated processes of order 1, $I(1)$, were in fact stationary processes around a broken trend. This outcome shows the relevance of working with series which are correctly characterized. Therefore, the importance of the unit root tests that account for structural breaks cannot be stressed enough.

In sum, we can say that the stabilization program undergone by Mexico and the financial liberalization that took place in the last few years did not disrupt the equilibrium demand for money equations. The results may be due to the fact that structural breaks were permitted and accounted for in the cointegration analysis. However, it is our view that the correct characterization of the series has to be emphasized and that only then results become meaningful. Furthermore, the breaks that were found are due to important macroeconomic reforms. These changes are so notorious, that we are convinced that they will be significantly apparent in any long term analysis that takes into account a larger sample size.

CONCLUSION

In this paper we have examined the financial liberalization process of Mexico's macroeconomic structural adjustment. In the first part of the paper the mechanics of the financial liberalization was studied. We then examined how the reforms were conducted, what was the sequence of the policies being applied, was the sequence correct and justifiable by the theory, and finally what are the results for the economy at large.

In the second part of the paper, we dedicated ourselves to examine the stability of the demand for money in Mexico through the period of financial liberalization. By combining two advanced time series econometric techniques, multivariate cointegration and structural break analysis, we were able to demonstrate that the Mexican demand for broad and narrow money were *de facto* not affected by the financial reform, and that a long run equilibrium relationship exists and was maintained. What makes us accept the neo-classic equation for money demand.

Although the financial reforms are very recent and a complete business cycle did not occur yet, Mexico's financial liberalization has, so far, been a success. Another distinguishing feature of Mexico's financial deregulation has been the speed at which the reforms were implemented. The financial reforms were also accompanied by several modifications in economic policy. These changes were implemented in many fronts and at the same time, what makes, in a way, difficult to distinguish their effects in the economy.

As the reforms started to bear fruits, Mexico's international credibility was regained and the economy recovered its confidence. These in turn allowed the reforms to go even faster. Today

Mexico has a trade agreement with the United States and Canada and has just joined the OECD. It no longer has a debt problem and its public finances are in order.

The cold shadows of the past are giving their place to the warm sunshine of the promising future. The future is promising indeed, and it seems that if the great leader of the Mexican revolution Emiliano Zapata, who once said

It is preferable, men from the south,
to die on your feet,
than to leave on your knees.
(in Parkes, 1961, p. 373)

was among us, he would be glad to see his country stepping up from the precarious status of "developing country."

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APPENDIX 1: MEXICO'S FINANCIAL LIBERALIZATION: A CHRONOLOGY³⁴

I. FINANCIAL AND MONETARY REFORMS:

1982 Nationalization of the private banks (September).

Liberalization of the sale of CETES (treasury bills with maturity date of mostly 28 to 90 days).

1983 Consolidation of the nationalized banks reducing their number from 60 to 29.

1985 A Banking law replaces temporarily the Nationalization law, allowing the government to sell up to 34% of shares of the nationalized banks to the private sector.

Number of banks is further reduced from 29 to 19.

1986 Creation of a Banking Restructuration Fund, the *Fondo de Apoyo Preventivo a las Instituciones de Banca Multiple (FONAPRE)*.

The government starts to issue and sell the *Pagaré de la Tesorería de la Federación (PAGAFES)*.

1987 Stock market crisis (October).

Fiscal reform on investment.

34% of the shares of 15 of the nationalized banks are sold to the private sector.

Government starts to issue and sell bonds with maturity of one to two years, the *Bonos de Desarrollo del Gobierno Federal (BONDES)*.

1988 Beginning of the financial liberalization; changes on credit contingencies on high priority sectors and changes in reserve requirements.

³⁴ Sources: Banco de México (1993), Exchange Arrangements and Exchange Restrictions: Annual Report, IMF, various issues, Griffith (1993), OCDE (1992), Kalter and Khor (1990), Coorey (1992) and Loser and Kalter, eds., (1992)

Beginning of interest rates deregulations (October/November).

1989 Controls on interest rates and maturities on all traditional bank instruments and deposits are eliminated (April).

Banks are authorized to pay interest on short-term deposit accounts.

The reserve requirements on bank deposits are replaced by a 30% liquidity ratio similar to that applicable to banker's acceptances³⁵. (At the time, banks were required to channel at least 50% of these deposits to the public sector, inclusive of reserve requirements).

Government paper held to satisfy the liquidity ratio earn market interest rates and are fully tradable.

Restrictions on bank lending to the private sector are removed.

Mandatory lending at below-market interest rates to the public sector by commercial banks is discontinued.

Banks are given a greater degree of managerial flexibility and the autonomy of bank boards is expanded.

The role of providing preferential credit is limited to the development banks and trust funds.

Reduction of restrictions of proprietorship of banks (August).

The *Nacional Financiera Sociedad Anónima (NAFINSA)* becomes the SME Bank.

Modification of 5 financial laws.

Government issues and sells the *Bonos Ajustables del Gobierno Federal (Ajustabonos)*, and the *Bonos de la Tesorería de la Federación (Tesorobonos)*.

1990 Separation of the *Comisión Nacional Bancaria (CNB)* and of the *Comisión Nacional de Seguros y Finanzas (CNSF)* (January).

Closing of the *Aseguradora Nacional Agropecuaria (ANAGSA)* (February); it is replaced by the *Agropecuaria Aseguradora Mexicana (ASMEX)*.

³⁵ Note here that according to OCDE (1992), this reform took place in April 1990, but for Coorey (1992) the same reform took place in April 1989.

Law on financial holdings.

Modification of the constitution authorizing the privatization of the banks. Up to 30% of a stock of a bank may be held by foreign investors with the exception of foreign governments and government owned entities. Corporate rights of foreigners would be similar tot those of national investors. Any one individual may own up to a maximum of 5% of the equity of a bank; this maximum may be increased to 10% with the prior authorization of the Government. Institutional investors may hold up to 15% of bank shares; financial holding companies are exempted from this maximum.

The banking law establishes a controlling mechanism through a new requirement reserve level (July).

Emission of regulation for the stock market.

Beginning of the program of merger/closing of the development banks.

Emission of directives concerning the dismantlement of the nationalized banks (September).

1991 Emission of prudential rules (classification/provision of loans) (March).

Emission of directives concerning banking capitalization (May).

Commercial Banks are no longer required to maintain a liquidity coefficient for their liabilities in pesos. A financial mechanism was put in place to oversee for a smooth transition, and thus to avoid market imbalances (September).

9 banks are sold to the private sector (June to November).

Deregulation of stocks market's commission (November).

Banks were authorized to pay interest at market rates on balances held in checking accounts.

1992 Banks were released from the obligation to buy ten-year BONDES (part of the financial mechanism put in place in September 1991) (April).

The Banco de México restricts commercial banks to accept foreign currency deposits to no more than 10% of their total deposits (April).

The compulsory liquidity coefficient for deposits in foreign currency, which went from 0 to 50% according to the maturity of deposits, was replaced by a 15% requirement (April).

A new "deposit account of monthly savings" was introduced. Its objective is to constitute 12, 24 and 36 months deposits for small savers. Interest rates are linked to those of CETES (August).

The Banco de México allowed banks to accept deposits in foreign currency in two new tranches: a first tranche of up to 4% of the deposits in pesos and in foreign currency taken by commercial banks in the 3 month period immediately preceding the month in question, to be used exclusively for granting export credits and/or for sales of domestic capital goods. A second tranche, of up to 6% of deposits taken in the 3 months immediately preceding October 1992. This limit will be in place until February 1996, and then will gradually decrease until it is cancelled in February 1998 (November).

Bank's net capital requirements are raised from 7% to 8%.

- 1993** The Banco de México established a system to determine interbank interest rates in the domestic market. With the introduction of a new reference interest rate, *TIP (Tasa interbancaria promedio)*, the domestic financial market draws closer to major international markets. The new interbank rate is similar to LIBOR, since both are determined by credit operations between banks at a given moment; therefore, they reflect current market conditions (January).

The Executive submitted to Congress a Constitutional amendment proposing central bank independence, (with the objective of preserving the purchasing power of the currency). The proposal would ensure the central bank's independence in two ways: Firstly, by giving the Banco de México complete freedom to manage its own credit. Secondly, by providing the central bank with administrative autonomy (May).

Several changes are proposed to the General Law on Auxiliary Credit Organizations and Activities. Their objective is to stimulate the growth of these intermediaries by deregulating their activities. Other reforms were in the following laws: General Law on Insurance Institutions, Stock Market Law, Federal Law on Bonding Institutions, Credit Institutions Law and the Law Regulating Financial Groups (May).

Reform to the legal framework concerning Treasury Bills aimed at allowing CETES to be issued with maturities beyond one-year at interest rates to be agreed (May).

II. FOREIGN EXCHANGE REFORMS:

- 1982** Withdrawal of the Mexican Central Bank of the foreign exchange market; depreciation of the peso (February).

Daily depreciation of the peso, 4 cents per day (March-August); Introduction of a double exchange rate system and forced conversion of the "Mex-dollars" (August); creation by decree of the dual exchange rate system (December).

Total control on foreign exchange (September).

1983 Central Bank of Mexico starts a mechanism for the settlement of private debt due to foreigners. Creation of a fiduciary fund to cover foreign exchange risk (FICORCA), this fund was to manage the settlement mechanism (February).

1984 The daily peso depreciation is augmented to 17 cents a day (December).

1985 The daily peso depreciation is augmented to 21 cents a day (May).

Devaluation of the controlled exchange rate of 20% and the announcement of a managed float system to be implemented from August on.

1987 Withdrawal of the Mexican Central Bank from the foreign exchange markets; the free floating exchange rate depreciates by 32.8%.

End of the intervention of the Central bank on the free market (November).

Devaluation of the controlled exchange rate by 21.8% (December).

1988 Fixed exchange rate is introduced in March.

1989 Modification of the rules concerning the foreign exchange rate, to a daily depreciation of the peso in regard to the USA dollar in a fixed amount previously announced of 1 peso (January).

1990 The daily depreciation of the peso is reduced to 80 cents (May), and then to 40 cents (November).

1991 The Controlled Exchange Rate Market was eliminated. A band within which the market rate would fluctuate was defined, and the daily depreciation of the peso is reduced to 20 cents (November).

1992 The responsibility for administering the Trust Fund for the Coverage of Exchange Risks (FICORCA) was transferred to the Trust Fund for the Administration of External Financing (FAFEXT) (May).

FICORCA was abolished on March 1994.

The government announced that a new currency, the new Mexican peso, would be introduced on January 1st, 1993. One new peso would be equivalent to 1,000 of the former Mexican pesos (June).

The daily depreciation of the selling intervention point was increased from MEX\$0.20 to MEX\$0.40 per US\$1.00 (October).

III. INTERNATIONAL DEBT REFORMS:

- 1982** Mexico declares a moratorium of 90 days on the payment of the principal of its public external debt. Beginning of the renegotiation of the due payments from August 1982 to December 1984 (August).

Signature of the rescheduling of 98% of the past due external public debt from August 1982 to December 1984.

- 1986** Establishment of an agreement with the international commercial banks for the rescheduling the debt and for a reduction of the cost of the debt and the obtaining of "fresh money."

Beginning of the swaps to finance foreign investment (May).

Rescheduling with the Paris Club of the payments due from September 1986 and May 1988.

- 1987** Signature of the agreements concluded in 1986 with the international commercial banks (March).

Suspension of the swaps program (November).

- 1988** Renegotiation of the public external debt (December).

- 1989** Accord with the Paris Club to restructure the payments of interest and principal, in order to reduce capital out-flows (May).

Mexico returns to voluntary international capital market financing through the placement of *Bancomext* bonds. These unenhanced bonds had a maturity of two and a half years and paved the way back into international financing for the Mexican government and for private companies.

Announcement of an accord with the commercial international banks on the rescheduling of the international debt, accord which includes a program of swaps and a partial cancellation of the debt (July).

1990 Signature of the accord with the international commercial banks for the reduction of the external public debt (February).

IV. FOREIGN DIRECT INVESTMENT REFORMS:

1984 Emission of liberal directives on the interpretation of the law of 1973 on foreign investment. The national commission on foreign investment announces the sectors into which majority foreign participation will be allowed (foreign participation was up to then limited to 49% of the capital). Simplification of the procedures (February).

1986 Reduction of the restrictions on investment in the petrochemical sector. Introduction of the "neutral capital" concept.

1988 New simplification on the funding and procedure of foreign investment.

1989 Important liberalization of the law of 1973: the activities in the petrochemical, banking, and insurance sectors are partially opened to foreign investment (May).

Liberalization of foreign ownership of up to 100% on companies having a maximum value of US\$ 100 million. Also allows foreigners to invest in the Mexican Stock Exchange on specially designed fiduciary funds (May).

The Bank of Mexico authorized Brokerage firms to provide services of custodianship and management of Federal Treasury bills (CETES) for nonresident investors.

1992 New Federal Antitrust law.

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V. FINANCIAL SERVICES UNDER THE NORTH AMERICAN FREE TRADE AGREEMENT³⁶

1991 Canada, the United States and Mexico agreed to negotiate a free trade agreement (February).

Formal negotiations of the North American Free Trade Agreement (NAFTA) began in June of 1991 and was concluded after 14 months of intense negotiations.

1992 A final agreement is reached on August 12, 1992.

Some of NAFTA's goals are:

- * The elimination of barriers to trade
- * The promotion of conditions of fair competition
- * An increase of investment opportunities
- * The establishment of effective dispute resolution procedures.

In addition to the gradual elimination of tariffs, duties and other barriers to trade in goods, NAFTA incorporates agreements on trade in services, financial services, investment, intellectual property and dispute resolution.

1994 The NAFTA became effective on January 1st, 1994.

A. Brief summary of NAFTA's main provisions regarding financial services³⁷:

Each Nafta country must grant "national treatment" and "most-favoured-nation" treatment to participants from other NAFTA countries. Market access is limited to individuals or companies that already engage in their country of origin in financial services. It may also be limited to subsidiaries rather than direct branches.

Mexico is allowed to impose on US and Canadian participants individual and aggregate market share limits. These will be stated as a proportion of the total capital in each sector and

³⁶ A detailed investigation of NAFTA's influence on Mexico's financial services is beyond the scope of this paper. However, the interested reader is referred to Musalem, Vittas and Demirgüç-Kunt (1993) and Banco de México (1993).

³⁷ Source: quoted from Musalem, Vittas and Demirgüç-Kunt 1993, pp. 54-55.

will be phased out by the year 2000. The whole issue will, however, be revisited if US and Canadian participants acquire a combined market share in excess of 25%.

In **banking**, the aggregate limit will rise from 8% in 1994 to 15% by 1999. The single-institution limit will be 1.5% throughout the transition period. Both during and after the transition period, acquisitions of Mexican banks will be subject to an individual, per institution limit of 4%.

In the **securities** industry, the aggregate limit will increase from 10% in 1994 to 20% by 1999. The single-institution limit will be 4% throughout the transition period. Within two years of entry into force, Mexico will decide whether to authorize new types of limited-scope securities firms that would be subject to lower capital requirements.

In the **insurance** sector, the aggregate limit will rise from 6% in 1994 to 12% by 1999. The single-institution market limit will remain 1.5% throughout the transition period. US and Canadian insurance companies that enter joint ventures with Mexican firms will be permitted to expand their equity participation on an accelerated schedule, reaching 51% in 1998 and 100% in 2000. Moreover, these investments will not be subject to either individual or aggregate limits.

The provision of cross-border financial services includes both the concept of the "mobility of provider" and the concept of "mobility of consumer". Each NAFTA country must permit its citizens and residents to purchase financial services from providers located in other NAFTA countries. Except for insurance companies, Mexico may require that a Mexican subsidiary must be wholly owned by the US or Canadian parent institution. Mexico may also deny access to Canadian or US banks or securities firms that are affiliated with industrial or commercial corporations.

These are various provisions for the creation of limited-scope financial institutions that would be subject to less onerous capital requirements and less restrictive market share limits.

Warehousing, bonding, foreign exchange and mutual fund management will not be subject to market share limitations.

The right to provide new financial services and to transfer information for data processing is also covered in the proposed agreement. No requirement to employ nationals in key positions will be allowed.

Finally, the proposed NAFTA does not constrain the right of each country to impose regulatory or restrictive measures for prudential reasons, in pursuit of monetary, credit or exchange rate policies, for balance of payments reasons or for taxation and social security purposes.

APPENDIX 2: MEXICO'S FINANCIAL SYSTEM³⁸

I. THE STRUCTURE OF THE FINANCIAL SYSTEM

Institutional financial intermediation in Mexico is carried out by:

- a) The banking system
- b) Auxiliary Credit Organizations and activities
- c) Stock brokerage firms
- d) Insurance companies and
- e) Bonding institutions.

Many of the institutions above are currently engaged in a process of formation of financial groups³⁹, that will increase the efficiency and productivity of financial activities in Mexico by offering several financial services in a single location. Each group must include at least three financial institutions. Two different kinds of groups can be formed: in the first case the group is headed by a holding company, and in the second case by a bank or brokerage firm. The creation of a financial group requires the prior authorization of the Secretariat of Finance and Public Credit. According to the legislation in place, two or more intermediaries of the same kind cannot

³⁸ Source: quoted from Banco de México (1993), pp. 113-117, unless otherwise indicated.

³⁹ This was made possible by the Act Regulating Financial Groups introduced in 1990 (Coorey, 1992).

form part of a group, except for investment societies and insurance companies, provided that they cover different risks [13]⁴⁰. As of mid-May 1993, twenty-six financial groups were registered.

The regulatory authorities for the financial system are the Secretariat of Finance and Public Credit, which determines the rules for a part of the transactions made by banks and non-bank financial intermediaries; the Banco de México, which regulates the operation of the banking system and the transactions (mostly credit) of other financial institutions; and the National Banking Commission, the National Securities Commission and the National Insurance and Bonding Commission, which oversee compliance with the regulatory framework and monitor activities of intermediaries under their supervision, and that also have certain powers to establish policies and regulate transactions.

The Mexican banking system is made up of:

- a) the Banco de México,
- b) credit institutions,
- c) public trust funds, and
- d) the National Savings Trust (Patronato del Ahorro Nacional).

a) The Banco de México, in addition to regulating credit operations, is also responsible for controlling the issue and circulation of money, and credit and exchange transactions. It is the lender of last resort in the credit system, the government's banker, and its financial agent and adviser [14]⁴¹.

⁴⁰ [13] This restriction will be eliminated if the bills submitted by the Executive to Congress on May 20, 1993 are approved (...).

⁴¹ [14] ..., on May 17th, 1993 a Constitutional amendment was sent to Congress that proposes the independence of the central bank.

b) Credit institutions are divided into multiple service banks and development banks. At present, there are 19 [15]⁴² multiple service banks in operation. During the first months of 1993, applications were presented for the establishment of several banks. It is expected that some of these will be authorized shortly. Development banks belong to the government, and offer second tier services to specific sectors of the economy that are considered priority for the country's development. Development banks are Nacional Financiera (NAFIN), the Banco Nacional de Comercio Exterior (BANCOMEXT), the Banco Nacional de Comercio Interior (BNCI), the Banco de Obras y Servicios Públicos (BANOBRAS), Financiera Nacional Azucarera (FINASA), and the Sistema Banrural (Banco Nacional de Crédito Rural and 13 regional banks).

c) Development Trust Funds extend loans to determined sectors of the domestic economy. The main trusts are FIRA (agriculture, poultry, fishery), FOVI (low income housing), FIDEC (commercialization and distribution) and FONATUR (tourism). CECOBAN, the financial system's clearing house, is a trust fund that complements the activities of the central bank.

d) The National Savings Trust fosters domestic savings by issuing national savings stamps and bonds, and by creating term deposits for the smallest savers who have limited access to other institutions [16]⁴³. It occasionally lends to development banks and development trust funds.

⁴² [15] Excluding the Mexico branch of Citybank, N.A.

⁴³ [17] In August 1992 a new "deposit account of monthly savings" was introduced. Its objective is to constitute 12, 24 and 36 months deposits for small savers. Interest rates are linked to those of CETES.

The Banking Fund for the Protection of Savings⁴⁴ (FOBAPROA) is a deposit insurance mechanism against any financial problems that might arise in multiple service banks. A similar insurance scheme exists for the Mexican Stock Exchange and brokerage houses.

With respect to auxiliary credit organizations and activities, by mid-May 1993 there were 31 public warehouses registered, 230 credit unions, 63 leasing companies, 2 authorized and some 300 requests for the establishment of savings and loan societies, 65 finance factoring companies, and some 56 exchange houses.

The financial system has 43 insurance companies and 18 bonding institutions registered. Companies operating on the stock market include the Bolsa Mexicana de Valores (Mexican Stock Exchange), the Securities Deposit Institution (INDEVAL), brokerage houses, stock-market specialists, investment societies, and investment society operating companies.

According to Elizondo Almaguer (1994), from 1989 to June 1994, the Mexican authorities have authorized more than 300 new financial institutions (99 finance factoring companies, 43 leasing companies and 165 exchange houses), 15 limited-scope financial societies, 17 savings and loan societies and 150 credit unions. Furthermore, he expects to see in the few years to come, 41 new financial institutions in operation in Mexico. Of these there are 20 foreign financial institutions; 14 banks, who were authorized in the past 2 years; and 7 banks, who are waiting for a positive answer.

⁴⁴ According to Coorey (1992, p. 46), the legislation enacted in 1990 extended the role of the FOBAPROA. "In addition to its traditional preventive role, it would provide 'express and direct protection to depositors' (Bank of Mexico (1991), p. 89)." "All banks contribute a premium to this fund; although there is no formal deposit insurance in Mexico, this fund provides some safety net in emergencies" (Coorey, 1992, p. 46).

Aspe (1994) summarizes the financial status by saying that the number of banks in operation in Mexico went from 19 in 1988, to 30 in 1993 and in 1994 it is expected to be at 55 (by year end). Furthermore, he gives the following table on Other Financial Institutions in operation:

Table A.1: Other Financial Institutions

	Authorized 1989-1993	In Operation
Brokerage Houses	3	26
Insurance Companies	4	44
Leasing Companies	43	62
Finance Factoring Cos.	82	61*
Exchange Houses	164	373
Total	296	566

(*) The reduction is explained by 21 cancellations and 17 mergers.
source: Aspe (1994).

II. MAIN FINANCIAL INSTRUMENTS

A. Bank Instruments

CHECKING ACCOUNTS can be either interest-bearing or not.

TIME DEPOSITS, also known as non-negotiable certificates of deposit, have a monthly yield, and are available for one, three and six month terms.

PROMISSORY NOTES are issued for 1, 3 and 6 months, with a fixed rate of interest that is paid at maturity. They can be traded in the stock market.

Banks also issue "*BANK BONDS*", which are long-term credit instruments sold by auction initially to brokerage houses or to banking institutions.

B. Private Sector Financial Instruments

BANKERS ACCEPTANCES are bills of exchange issued by companies for a term of under one year. They are accepted by the credit institution that provided financing, which in turn sells them to investors with its guarantee. "They have a face value of 100.00 Mexican new pesos and are placed at a discount with the maturity specified by the issuer" (Mexican Investment Board, 1993, p. 13).

COMMERCIAL PAPER WITH BANK GUARANTEE, a highly marketable security for which each issuer is free to decide the term according to his needs. "Maturity varies from 15 to 360 days and these instruments are generally placed under par value. Firms sometimes issue dollar-indexed commercial paper if their activities generate a considerable inflow of dollars" (Mexican Investment Board, 1993, p. 13).

SHARES of debt and variable income investment societies, whose yield calculated on a daily basis according to the value of the investment society's portfolio.

"*OBLIGACIONES QUIROGRAFARIAS*" are unsecured debts with a maturity of up to three years; and "*OBLIGACIONES HIPOTECARIAS*" are debts secured by real estate.

BONOS DE PRENDA (Collateral Bonds) are commodities-backed bonds issued by firms. They have a yield equal to Treasury Bills (CETES) plus a premium. A quantity of the commodities, valued at 40% in excess of the bonds's value, are

deposited in warehouses, and a negotiable deposit certificate is issued. Face value is usually 100.00 Mexican new pesos. The bonds are placed under par value and they have a maturity of no more than 30 days (Mexican Investment Board, 1993, p. 13).

CEPLATAS are silver certificates issued by a trust and backed by 100 troy ounces of silver. The initial maturity term is 30 years subject to review.

CENTENARIOS are Mexican Independence Centennial commemorative fifty-peso gold coins weighting one troy ounce whose intrinsic value is related to world fluctuations in the price of gold. *Centenarios* and troy ounces of silver can also be purchased in the securities market. The silver troy ounces are coins minted by the Federal Government (Mexican Investment Board, 1993, p. 14).

C. Government Financial Instruments

CETES (Certificados de la Tesorería), or treasury bills are debt instruments issued by the Federal Government to finance Government spending and regulate the money supply. CETES are the most important money market instrument. They fulfil the function of implementing government monetary policy, and represent the majority of the money market's total instruments [they are briskly traded in the secondary market], the 28-day rate is the benchmark for interest rates in Mexico. CETES, backed by the Federal Government, are auctioned weekly by the Banco de México. They have a par value of 10.00 Mexican new pesos and the different

issues mature at 28, 91, 180 and 360 days (Mexican Investment Board, 1993, p. 15).

BONDES (Bonos de Desarrollo del Gobierno Federal), or Federal Government Development Bonds, with either one or two year maturity [17]⁴⁵. They earn interest every 28 days on their face value, the rate being linked to the higher of the yield on 28 day CETES, or the interest rates on a sample of bank promissory notes.

TESOROBONOS (Bonos de la Tesorería de la Federación), or Federal Treasury Bonds, have a yield pegged to the exchange rate. They are considered to be hedging instruments, because the investor is protected against any move in the exchange rate. "Tesorobonos auctions are held according to government financing needs and may not be placed weekly. They have a denomination of US\$100.00 or multiples thereof. They are usually placed under par value when maturity is less than 6 months and otherwise they pay periodic interests" (Mexican Investment Board, 1993, p. 14).

AJUSTABONOS (Bonos Ajustables del Gobierno Federal), whose value is indexed to the National Consumer Price Index. Currently, these are available with three or five year maturities. They yield a fixed "real" rate of interest established at the time of sale, payable every 91 days, based on the adjusted value of the instrument on the date interest is paid.

PAGARÉ PEMEX, Pemex Promissory Notes are short-term notes issued by Pemex (Petróleos Mexicanos), the state oil company. They have a face value of 100.00

⁴⁵ [17] There are also 10 year BONDES, issued in September 1991 to avoid an undesirable impact on the financial markets of the elimination of the liquidity coefficient to which banks were subject. These are held by banks and can only be traded with other commercial banks and the Banco de México (for further information see Section 6, [Chapter III, Banco de México, 1993]).

Mexican new pesos and a term of maturity of one year. Interest is paid on monthly coupons based on yields of CETES and Bank Promissory Notes, whichever the higher (Mexican Investment Board, 1993, p. 15).

APPENDIX 3: DATA SOURCES AND DEFINITIONS

Except for interest rates, all series are transformed to their natural logarithms, so to benefit from the near equivalence between differences in logarithms and percentage rates of growth in absolute levels.

$$\mathbf{M1 = \ln(M1/CPI), M2 = \ln(M2/CPI), Y = \ln(Y/CPI), P = \ln(CPI), NRa, NRo, BRo.}$$

I. MONETARY AGGREGATES

Narrow Money (M1): Currency held by the public plus demand deposits (checking accounts).

Broad Money (M2): Narrow money plus time and savings deposits (quasi-money)

Data for both narrow and quasi-money are in quarters and were taken from lines 27334 and 27335, respectively, of the IMF's International Financial Statistics CD-Rom database. Data for narrow and broad money are in millions of New Pesos.

I. INCOME AND PRICES

Income was proxied by nominal GDP.

Data were taken from line 27399B of the IMF's International Financial Statistics CD-Rom database. As the IFS CD-Rom only has GDP per year, quarterly data for nominal GDP were calculated from annual observations according to the pattern of quarterly movements in industrial production plus oil production (lines 27366, and 27366AA respectively). Nominal GDP data are

in millions of New Pesos. Industrial production and oil production data are index numbers (1985 = 100) of period averages.

Prices were proxied by consumer prices.

Data were taken from line 27364, of the IMF's International Financial Statistics CD-Rom database. Consumer prices data are index numbers (1985 = 100) of period averages.

III. INTEREST RATES

A. Rate of return on money (R_o):

- * *For Narrow money*: $NR_o = \text{zero}$, as narrow money is assumed to be non-interest bearing, (to avoid multicollinearity between interest rates, only one rate is used to calculate the opportunity cost of narrow money, R_a).
- * *For Broad money*: BR_o was approximated by the deposit rate multiplied by the share of quasi-money in broad money.

B. Interest rates on alternative assets (R_a):

- * *For Narrow money*: NR_a was proxied by deposit rates.
- * *For Broad money*: BR_a was proxied by the treasury bill rate minus the deposit rate weighted by the share of quasi-money in broad money.

Data for Deposit Rates were taken from line 27360L, and data for the Treasury Bill Rates were taken from line 27360C, of the IMF's International Financial Statistics CD-Rom database. Interest rates data are in percent per annum, reflecting the average for the quarter.

Note that because the Treasury Bill Rates are reported only from 1978:1, we are constrained to work with data starting on this date.

Note: Data for the Deposit Rate for the second quarter of 1983 was missing from the IMF's International Financial Statistics CD-Rom database; for what it was taken from the IMF's International Financial Statistics book for December 1985.

Data for the Treasury Bill Rate for the third quarter of 1986 was missing from the IMF's International Financial Statistics CD-Rom database, for what it was taken from the IMF's International Financial Statistics book for December 1988.

**APPENDIX 4: NOTES ON THE
SIMULATION OF TRACE STATISTICS'
CRITICAL VALUES IN THE PRESENCE OF
A BROKEN TREND**

As explained by Johansen and Nielson (1993, p. 3), "... the asymptotic distribution of the likelihood ratio test for the cointegration rank is not χ^2 , but generalised Dickey-Fuller distributed, with a structure depending on the problem." Their statistical software DisCo, was created to calculate asymptotic critical values for the cointegration rank test.

In our analysis, we are confronted with the presence of structural breaks in the trend function of the data. These breaks were found after the series were tested for unit roots, allowing for the possibility of a one time structural change. According to the results that we have obtained after using Perron's Innovation Outlier Model 2 and Additive Outlier Model 2 (Perron, 1993b), IOM2ALPH.SRC and AOM2ALPH.SRC in Perron's statistical procedures for testing for unit roots allowing for a structural break at an unknown time, in RATS Version 4.0, we have found that there are 4 series with breaks (see figure 10). After analysis of the breaks and of the fit of the changing trend, we have decided to work with the breaks occurring on the fourth quarter of 1987, in BRo and NRa. The break means that a change in the intercept and in the slope of the trend function occurred simultaneously, which is equal to having a change in level followed by a different growth path (Perron, 1993b).

In Perron's AO and IO Models 2, the change in slope, DT_{it}^* , and the change in intercept, DU_{it} , (see equations 9 and 11) take the values: $DU_{it} = 1$, $DT_{it}^* = t - T_b$ if $t > T_b$ and 0 otherwise.

These values have then to be incorporated into the simulation to find the asymptotic critical values of the trace statistics, as intervention dummies.

In Johansen and Nielson's Disco software, the system is constructed for the VAR model analyzed by likelihood inference, as the one we are using in this study (equation 3). They assume that the drift term γ_t is decomposed as

$$\gamma_t = \sum_{j=1}^n \gamma_j k_j(t) \quad t = 1, \dots, T$$

where the drift functions $k_j(t)$ are some deterministic functions of t , chosen such that the matrix

$$\begin{bmatrix} k_1(1) & \dots & k_1(T) \\ \vdots & & \vdots \\ k_n(1) & \dots & k_n(T) \end{bmatrix}$$

is of full rank.

Johansen and Nielson (1993) show that the asymptotic analysis has to distinguish the drift parameters into unrestricted and into α_L restricted ones. For such they introduce the notation $H_{m,n}(r)$, such that the model has $m+n-m=n$ drift functions. "The m first of these correspond to unrestricted parameters, while the other $n-m$ of these has α_L -restricted parameters" (p. 5). In our case we have $m = 1$ and $n = 1$, specifically we have one unrestricted parameter composed of a constant, a time trend and two intervention dummies DU_t and DT_t^* that account for the break.

The asymptotic analysis follows from the stochastic matrix:

$$-2\log Q(H(r) | H(p)) \Rightarrow tr \left\{ \int_0^1 (dB)' F' \left[\int_0^1 FF' du \right]^{-1} \int_0^1 F (dB)' \right\} \quad (A.1)$$

where B is a $p-r$ dimensional Brownian motion and F depends on the tested hypothesis, which, in our case is:

$$H_{1,0}(r): \gamma_t = \alpha + \beta t + \Theta DU_t + \delta DT_t^*$$

Thus F is equal to:

$$(G_1(u), B_2(u), \dots, B_{p,r}(u))' \text{ corrected for } (g_i(u)).$$

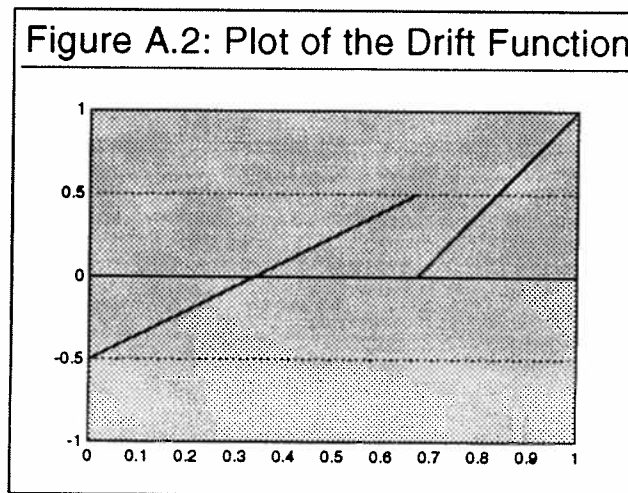
Albeit it is not our interest to go in deep detail on the asymptotic analysis, the interested reader is referred to Johansen and Juselius (1990) and Johansen and Nielson (1993) for specifics on the asymptotic distribution statistical analysis.

"The asymptotic analysis of the likelihood ratio test is performed by the theory of weak convergence on the space $D[0,1]$. So the process is considered on the interval $[0,1]$ instead of $\{0,1, \dots, T\}$ by the operation on $t \in [0,1]$ which finds the integer part of tT " (Johansen and Nielsen, 1993, p. 3). Therefore, in our case the simulations were performed with one drift function with unrestricted parameter ($\gamma_t = \alpha + \beta t + \Theta DU_t + \delta DT_t^*$).

As the break date was estimated to be in the third quarter of 1987, $DU_t = 1$ and $DT_t^* = t - T_b$ at $T_b + 1$, or 67%, our drift was determined as follows:

$$\begin{aligned} (0.00, -0.50) &\rightarrow (0.67, 0.50) \\ (0.67, 0.00) &\rightarrow (1.00, 1.00) \end{aligned}$$

Or graphically:



I. Simulation Principles:

The asymptotic distribution of the test statistic $(-2\log Q(H_{m,n-m}(r) | H_{m,n-m}(p)))$ has a limit distribution that depends only on the parameters $\alpha, \beta, \beta_1, \dots, \beta_m$ through the rank of the dimensions p and r , and only through the difference $(p-r)$, Johansen (1991). So the same limit distribution would be obtained by the $(p-r)$ dimensional model:

$$H_{m,n-m}(p-r): \Delta Y_t = \Pi Y_{t-1} + \sum_{i=1}^m e_i k_i(t) + \sum_{i=m+1}^n \Pi k_i(t) + \varepsilon_t$$

and test the hypothesis: $H_{m,n-m}(0): \Pi = 0.$

Here e_1, \dots, e_p are the columns of the unit matrix. This model corresponds to restrict the parameters of the drift functions k_{m+1}, \dots, k_n to be in the α -space and the parameters of k_1, \dots, k_m to be unrestricted.

Under the null hypothesis the process Y_t fulfils the equation:

$$\Delta Y_t = \begin{bmatrix} \varepsilon_1(t) + k_1(t) \\ \vdots \\ \varepsilon_m(t) + k_m(t) \\ \varepsilon_{m+1}(t) \\ \vdots \\ \varepsilon_{p-r}(t) \end{bmatrix}$$

The process Y_t is simulated by generating data from this equation. Together with the drift functions with α -restricted parameters the vector process:

$$Y_t^* = \begin{bmatrix} \sum_{i=1}^t \Delta Y_i \\ k_{m+1}(t) \\ \vdots \\ k_m(t) \end{bmatrix}$$

is obtained. The vectors ΔY_t and Y_t^* are then regressed on the variables k_1, \dots, k_m which is done by some orthogonal projection with matrix representation P . This gives the residuals:

$$R_0(t) = P\Delta Y_t = \varepsilon_t \quad \text{and} \quad R_1(t) = PY_t^*$$

From this the matrices $TS_{01} = \sum_{t=1}^T R_0(t)R_1'(t)$ and $TS_{11} = \sum_{t=1}^T R_1(t)R_1'(t)$ are calculated. Further the trace distribution ([A.2]) is asymptotically equivalent to and therefore calculated by:

$$tr \{S_{01} (S_{11}/T)^{-1} S_{10}\} = tr \{ \Sigma R_0 R_0' (\Sigma R_1 R_1')^{-1} \Sigma R_1 R_0' \}.$$

(Johansen and Nielsen, 1993, p.12).

To calculate the trace statistic critical values, the Brownian motion is approximated by a random walk with $T = 400$ steps. The process was repeated 5,000 times and results are tabulated in table A.2.

Table A.2: Distribution of the Critical Values for the Trace Statistics Test

Distribution of the Trace of the Stochastic Matrix

$$\left\{ \int_0^1 (\text{dB}) F' \left[\int_0^1 FF' du \right]^{-1} \int_0^1 F(\text{dB})' \right\}$$

Where B is a p - r dimensional Brownian motion and F depends on the structure of the hypothesis which is

tested, which is:

$$H_{1,0}(r): \gamma_t = \alpha + \beta t + \Theta DU_t + \delta DT_t;$$

Thus F is equal to:

$$(G_1(u), B_2(u), \dots, B_{p-r}(u))' \text{ corrected for } (g_1(u)).$$

Dim (1)	50%	80%	85%	90%	92.5%	95%	97.5%	99%	Mean	Variance
1.	0.473	1.669	2.122	2.752	3.219	3.953	5.169	6.436	1.021	2.099
2.	4.984	8.468	9.340	10.738	11.607	12.834	14.743	16.992	5.681	13.729
3.	14.463	19.440	20.744	22.447	23.451	25.040	27.356	30.806	15.149	29.712
4.	28.071	34.498	36.430	38.469	39.820	41.824	44.976	47.876	28.786	52.492

(1) Dimension $p - r$, i.e. the number of non-stationary components under the hypothesis.

Simulations were performed using the simulation program DisCo Version 1.0 by Nielson (1993), Johansen and Nielson (1993). Simulations were executed using a discretisation of the Brownian Motion equal to 400 and the process was simulated 5,000 times.

APPENDIX 5: RESULTS OF THE MULTIVARIATE COINTEGRATION ANALYSIS

Analysis done with the RATS Version 4.0 Procedure *JOHANSEN.SRC*. Program written by J. Johansen, K. Juselius and H. Hansen, and converted into a procedure by Thomas Doan, Var Econometrics, July 1990.

PROGRAM RESULTS

This are results from a cointegration analysis using

MI*
Y*
NRA*

Statistics for the error-processes

Autocorrelations in the error-process

Lag	1	2	3	4	5	6	7	8
	0.036	-0.092	-0.039	0.123	0.165	-0.008	-0.108	-0.075
	0.171	0.144	0.085	0.198	0.026	0.102	0.043	0.009
	0.102	0.037	0.162	-0.032	0.011	-0.065	-0.049	0.034
mean	var	skewness	kurtosis	normality	B.P-Q(12)			
0.00000	0.00440	0.69109	0.51029	5.06530	5.72670*			
0.00000	0.00390	0.36587	1.76352	8.50605	7.18416*			
0.00000	79.52049	1.46282	6.84378	129.25908	6.88185*			

The critical values for the Box-Pierce Q statistic are those of the Chi-Squared distribution. For 12 degrees of freedom, the critical value at the 5% level is 21.03 (Greene, 1990). The asterisk, therefore denotes the acceptance of the null hypothesis of no autocorrelation.

Partial autocorrelations in the cointegration-relations

Lag	1	2	3	4	5
	-0.028	-0.148	-0.152	0.534	-0.544
	0.356	-0.035	0.009	0.321	-0.309
	0.104	-0.231	0.083	0.729	-0.436

eigenvalues, lambda-max- and tracetest

0.38922	0.19179	0.11959
27.60893	11.92451	7.13261
7.13261	19.05712	46.66605

Eigenvectors

-10.178	7.873	-2.161
12.677	-4.239	16.145
0.112	0.090	0.003

beta

1.000	-1.857	-834.059
-1.246	1.000	6230.399
-0.011	-0.021	1.000

alpha

-0.259	0.104	0.000
0.240	0.029	0.000
20.350	15.011	0.004

pi

-0.432	0.265	0.001
0.227	-0.582	-0.003
-11.000	15.595	-0.540

sigma

0.00432	0.00121	0.16885
0.00121	0.00383	-0.05125
0.16885	-0.05125	78.10048

corr(eps)

1.00000	0.29659	0.29067
0.29659	1.00000	-0.09375
0.29067	-0.09375	1.00000

gamma

-0.144	0.029	-0.302
0.237	0.153	0.188
-48.492	0.833	-5.253

fi and Ao

-0.036	0.098	0.067	0.002	0.000	0.000
0.003	-0.386	-0.309	-0.252		
-0.795	-0.975	-1.076	-0.003	-0.003	-0.002
0.008	0.094	0.036	0.015		
-36.999	-20.609	-12.072	-0.487	-0.536	-0.491
0.235	7.839	-4.209	2.167		

The unit-matrix (control)

1.00000		
0.00000	1.00000	
0.00000	0.00000	1.00000

End of session

This are results from a cointegration analysis using

M2*

Y*

BRa*

BRo*

Statistics for the error-processes

Autocorrelations in the error-process

Lag	1	2	3	4	5	6	7	8
	0.087	0.226	0.030	-0.191	-0.022	-0.141	-0.296	-0.121
	0.075	0.080	0.030	0.073	-0.119	0.028	-0.072	0.080
	0.094	-0.162	-0.034	0.078	0.117	0.045	-0.069	-0.061
	0.152	0.184	0.106	-0.202	0.129	-0.106	-0.175	0.019

mean	var	skewness	kurtosis	normality	B.P-Q(12)
0.00000	0.00694	0.28784	0.96005	2.92391	16.30935*
0.00000	0.00281	0.17636	0.31430	0.52080	5.52521*
0.00000	1.20741	-0.25460	2.04941	10.40521	8.37269*
0.00000	29.18521	0.71114	3.67950	36.31037	15.02150*

The critical values for the Box-Pierce Q statistic are those of the Chi-Squared distribution. For 12 degrees of freedom, the critical value at the 5% level is 21.03 (Greene, 1990). The asterisk, therefore denotes the acceptance of the null hypothesis of no autocorrelation.

Partial autocorrelations in the cointegration-relations

Lag	1	2	3	4	5
	0.372	-0.135	-0.288	-0.073	-0.333
	0.189	-0.247	-0.187	0.295	-0.290
	-0.041	-0.369	-0.175	0.546	-0.488
	0.300	-0.132	0.202	0.635	-0.441

eigenvalues, lambda-max- and tracetest

0.69011	0.27738	0.15745	0.10275
65.60568	18.19276	9.59397	6.07172
6.07172	15.66569	33.85845	99.46413

Eigenvectors

-0.976	11.585	12.032	-0.944
1.650	-10.728	-22.439	-11.876
-1.116	0.866	-0.047	0.195
0.116	0.002	-0.205	0.019

beta

1.000	-1.080	-257.611	-48.930
-1.690	1.000	480.437	-615.419
1.143	-0.081	1.000	10.107
-0.118	0.000	4.396	1.000

alpha

0.039	0.253	0.001	0.000
0.024	-0.088	-0.001	0.000
-0.420	6.132	-0.010	0.000
5.304	21.070	0.037	-0.009

pi

-0.468	0.373	0.029	-0.001
0.267	-0.575	0.037	-0.005
-4.429	2.022	-0.986	0.004
-26.418	35.485	4.301	-0.480

sigma

0.00682	0.00066	0.00589	0.21541
0.00066	0.00276	-0.00201	-0.09017
0.00589	-0.00201	1.18585	0.98124
0.21541	-0.09017	0.98124	28.66405

corr(eps)

1.00000	0.15291	0.06553	0.48728
0.15291	1.00000	-0.03514	-0.32051
0.06553	-0.03514	1.00000	0.16830
0.48728	-0.32051	0.16830	1.00000

gamma

0.046	-0.550	-0.610	-0.153
0.320	0.183	0.275	-0.865
-4.327	-4.459	0.015	-0.861
-26.926	-20.285	-25.837	-17.028

fi and Ao

0.216	0.030	0.020	0.013	0.001	-0.003
0.004	0.001	0.007	-0.171	0.014	-0.156
-0.959	-1.067	0.024	0.025	0.029	-0.006
-0.006	-0.004	0.005	0.100	0.062	-0.001
0.042	5.675	-0.492	-0.692	-0.799	-0.018
0.014	0.021	0.030	0.674	1.663	0.703
1.777	-4.213	1.885	1.568	1.916	-0.651
-0.451	-0.186	0.128	-1.861	-1.487	-1.973

The unit-matrix (control)

1.00000
0.00000 1.00000
0.00000 0.00000 1.00000
0.00000 0.00000 0.00000 1.00000

End of session

