ESSAYS ON CONSUMPTION, CREDIT, AND STABILIZATION

by

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ABSTRACT

This thesis is an empirical investigation of the role of financial markets in economic activity. Two issues are covered. The first two chapters examine the effects of changes in banking credit on consumption and aggregate demand. In the last chapter I investigate the effects of financial innovation on the demand for money.

Chapter two presents an empirical investigation on the role of banking credit in the post-stabilization consumption booms of Mexico, Chile, and Israel. Credit from the banking sector to the private sector expanded very rapidly following the stabilizations. I show that this increase in credit reduced the proportion of consumers that are liquidity constrained in the economy. This reduction in liquidity constraints can help to fuel the observed consumption booms. In addition, I show that the most important channels for the expansion in credit in Mexico are the rapid remonetization of the economy, the fall in the debt to GDP ratio held by banks, and the increase in foreign liabilities held by banks. For Chile, the most important channel is the remonetization of the economy, whereas in Israel it is the crowding in effect from the fall in the ratio of public debt to GDP held by banks. This dichotomy is mostly due to the very different nature of the financial systems in Mexico and Chile on the one hand, and Israel on the other.

Chapter three examines the validity of the credit hypothesis as an additional channel for the transmission of shocks to credit markets. The question of whether there exists a credit channel for the transmission of monetary policy has been one of the most important and controversial ones in macroeconomics. If this channel exists, then shocks to credit markets, particularly to bank loans, can have real effects. This paper presents new evidence on the credit hypothesis for the case of Mexico after 1984. We present a simple variant of the open economy IS-LM model which includes a credit channel. The model has the following empirical implications which are absent from models which do

not include a credit channel. We show that changes in the expectations of devaluation, the desired cash/deposit ratio, and measures of financial deregulation, will have real effects because they change the quantity of credit available in the economy. We explore these implications of the model with vector autoregression techniques and find that the evidence strongly supports the credit view. We find that shocks to the nominal interest rate and the level of credit can explain a substantial portion of the variance in economic activity. In addition, we find that the principal source of variations in credit is changes in the nominal interest rate.

Finally, Chapter four presents an empirical investigation of how financial innovation can affect the demand for real balances and its speed of adjustment. Traditional studies of money demand for both developed and underdeveloped countries have shown that there are periods of "missing money," that is, there is consistent overprediction of real balances. This paper uses cointegration techniques to study the effects of financial innovation on the demand for real balances in Bolivia, Israel, and Venezuela. The results show that financial innovation can account for the instability of money demand observed in these countries. In particular, I find that the long run demand for real balances shifted down. In addition, I show that the speed at which people adjust their demand for money when out of equilibrium increases following financial innovation.

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CHAPTER 1

INTRODUCTION

Throughout the 1980's changes in financial markets have been widespread, and increasingly the link between financial markets and growth is becoming apparent. This thesis is composed of three empirical essays on the role of financial markets in economic activity. There are two separate topics which are covered. Chapters two and three examine the effects of changes in banking credit on consumption and aggregate demand, while the final chapter looks at the effects of financial innovation on the demand for real balances.

The first essay investigates the role of credit in the consumption booms observed in Chile, Mexico, and Israel following the implementation of their stabilization programs. These consumptions booms are large; from the beginning of the program to the quarter when consumption peaked, total private consumption increased by 34% in Chile, 38% in Israel, and 25% in Mexico. Simultaneously, credit from the banking sector to the private sector increased very rapidly in all three countries.

In this essay, I examine two aspects of the role of credit in post-stabilization consumption booms. First, using a version of the permanent income hypothesis which allows for the presence of liquidity constraints I show that there is a large share of the population which is liquidity constrained prior to the stabilization, and that this share drops significantly after. This reduction in liquidity constraints

can help explain the consumption booms observed in Chile, Mexico, and Israel following the stabilization programs.

Second, I examine the three main channels for the expansion of banking sector credit after the stabilizations. These are, an increase in the volume of financial intermediation, a decrease in the ratio of public debt to GDP held by banks, and an increase in foreign borrowing. Prior to the stabilization, the combination of a small (and mostly) inefficient banking system and a high inflation environment was reflected in very low levels of credit to the private sector, particularly consumption credit. The drastic fall in the inflation rates after the stabilizations combined with progressive financial reforms worked to increase the resources available to the banking sector to finance private consumption. The results show that in Mexico, all three of the sources examined played and important role. For Chile, I find that only the remonetization of the economy matters; and for Israel only the crowding in effect from a fall in the ratio of public debt held by banks to GDP matters. These results highlight the difference in the financial markets of Mexico and Chile on the one hand, and Israel on the other. Israel's highly indexed and developed financial system mean that there was not a significant increase in the volume of financial intermediation after the stabilization since it was already fairly high. Consumers in Israel had access to

domestic indexed credit prior to the stabilization whereas in Mexico and Chile this was not the case.

The second essay examines the validity of the credit hypothesis as an additional channel for the transmission of shocks to credit markets. The question of whether there exists a credit channel for the transmission of monetary policy has been one of the most important and controversial ones in macroeconomics. This "credit hypothesis" focuses on financial market imperfections. Shocks to credit markets, particularly to bank loans, have real effects. This paper presents new evidence on the credit hypothesis for the case of Mexico after 1984.

In this essay, we examine whether the credit view is relevant for Mexico by evaluating whether different indicators of credit shocks have any predictive power for output and investment. We present a simple variant of the open economy textbook IS-LM model which allows us to examine different scenarios with respect to the effect of credit shocks on aggregate economic activity. The model contains three main empirical implications which are absent in an open economy IS-LM model without a credit channel. First, we show that changes in the expectations of devaluation have real effects because they change the quantity of loans in the economy. Second, changes in the desired cash/deposit ratio and/or the reserve requirement also have real effects when we include a credit channel. Finally, other measures of financial

deregulation that permit banks to have additional sources of financing will also have real effects.

We use the vector autoregression techniques to test the predictions of the model, and find that the credit view is quite important for Mexico. Our results show that both the volume of credit and the nominal interest rate contain significant predictive power for economic activity, while real money balances do not. In addition, we find that shocks to credit are mostly due to changes in the nominal interest rate.

The third essay examines a separate topic from the previous two essays. This essay presents an empirical investigation of how financial innovation can affect the demand for real balances and its speed of adjustment for the cases of Bolivia, Israel, and Venezuela. Traditional studies of money demand for both developed and underdeveloped countries have shown that there are periods of "missing money," that is, there is consistent overprediction of real balances. All three of the countries studied embarked on serious deregulation and expansion of their financial markets.

Using the new cointegration techniques developed, this paper shows that financial innovation can account for the instability of money demand observed in these countries. In particular, I find that the long run demand for money shifted down. More surprisingly however, I show that financial innovation can increase the speed of adjustment of money demand to its determinants.

CHAPTER 2

THE ROLE OF CREDIT IN POST-STABILIZATION CONSUMPTION BOOMS

I. INTRODUCTION

This paper presents empirical evidence on the relevance of credit and in particular, the role of financial markets in the reduction of liquidity constraints after stabilizations. This reduction in liquidity constraints can help explain the consumption booms observed in Chile, Mexico, and Israel following the stabilization programs.

Conventional wisdom maintains that disinflations can have austere consequences. Estimates for the "sacrifice ratio" in the U.S. lie between 3 to 18. (Sachs (1985)) 1/ This has usually been based on evidence from money-based stabilizations. Sargent(1982) challenges this view based on evidence from the disinflation programs of the early 1920's european hyperinflations. Recently, Kiguel and Liviatan (1992) have shown that the programs in Latin America and in Israel during the mid 1980's have actually been expansionary.

The expansionary initial phase is driven by a consumption, and sometimes, an investment boom. The characteristics of these stabilizations include a large initial devaluation and a subsequent fixing of the exchange rate. Since they use the exchange rate as the nominal anchor, they are usually called exchange rate based, ERB, stabilizations. From the beginning of the program to the quarter when consumption peaked, total

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1/ The sacrifice ratio is defined as the cumulative percent output loss per percentage point reduction in inflation.

consumption increased by 34% in Chile, 38% in Israel, and 25% in Mexico.1/ Private consumption in Mexico increased at an average real annual rate of 5.8% during 1989-92, at 4.3% in Chile between 1978 and 1982, and at 11 % in Israel between 1985 and 1987. Figures 1,2, and 3 show the increase in real per capita private consumption in each country.

FIGURE 1

1/ These figures do not change much if the quarter before the stabilization is taken as the starting point.

CHILE PRIVATE CONSUMPTION

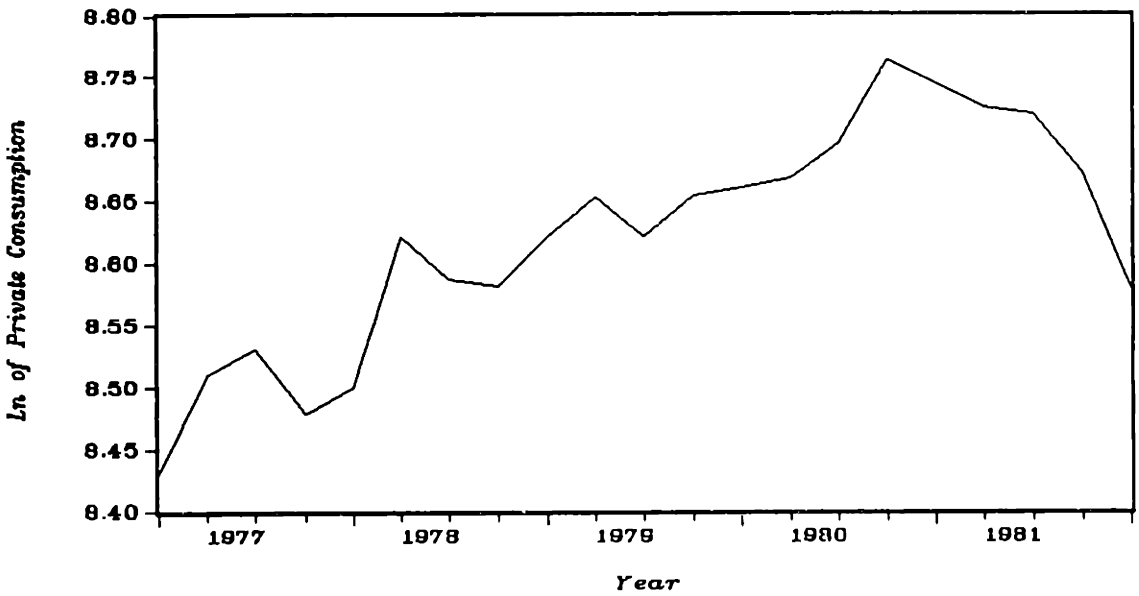

FIGURE 2

ISRAEL PRIVATE CONSUMPTION

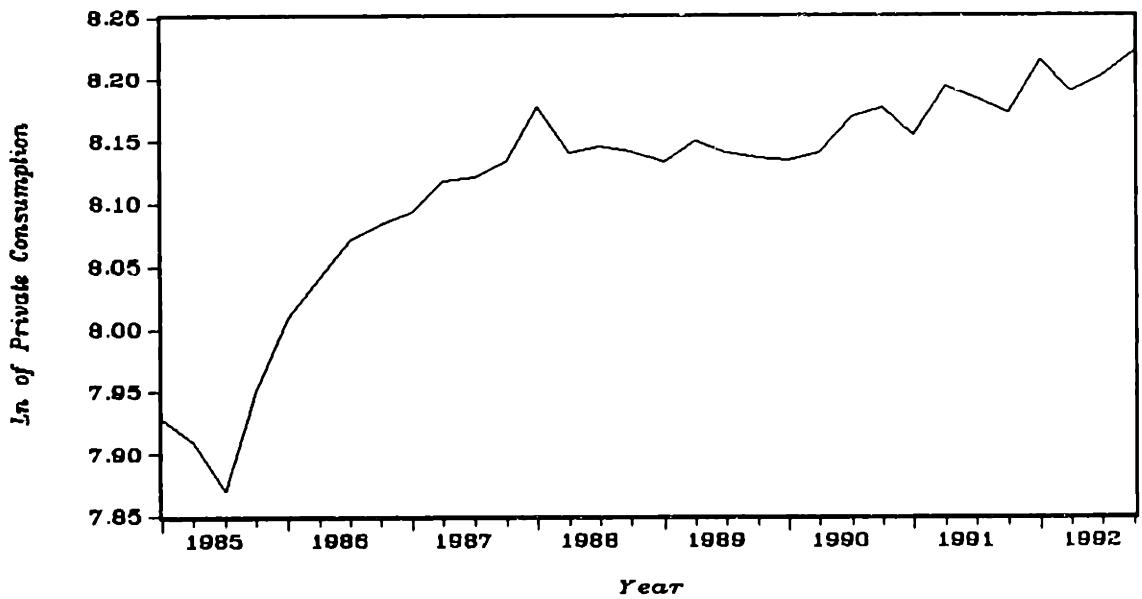

FIGURE 3

Consumption booms following a stabilization have also been observed in Denmark in 1982 and in Ireland in 1987 by Giavazzi and Pagano (1990). The Danish experience was driven by a consumption boom of 3.7% and an investment boom of 12.7% during 1983-1987. In Ireland, during 1987-1989, private consumption grew at an average rate of 3.6%, and investment at 6.7%.

Several explanations have been proposed in the literature for the mechanism through which stabilization policies could generate consumption booms. The most prominent of these is the idea introduced by Calvo (1986) that a lack of credibility in the program induces the public to increase current consumption relative to future consumption because today's effective price is lower than the post collapse price. Another idea is that the fall in the inflation rate at the beginning of the program generates a wealth effect because the value of government bonds (which are part of private wealth) increases. (Bruno (1992)). This increase in the value of private wealth increases expenditure and generates a consumption boom. The third explanation, which is the focus of this paper, relies on the idea that following a stabilization credit from the banking system to the private sector increases and this reduces liquidity constraints in the economy. A reduction in liquidity constraints can generate a consumption boom through a decline in excess savings or lumpy purchases of consumer durables. The effects of all three of

these explanations are more pronounced on consumer durables than on nondurables.

In this paper, I concentrate on two aspects of the role of credit in post-stabilization consumption booms. First, I show that there is a significant drop in the share of households that are liquidity constrained after the stabilization. Previous studies (Rossi(1988)) have shown that liquidity constraints are very important in explaining the excess sensitivity of consumption in LDC's. Deaton (1989) shows that consumers with binding borrowing constraints can have savings and asset accumulation in excess of what is optimal if those constraints were not binding. The results indicate that there was a sharp reduction in the share of liquidity constrained consumers in both Mexico and Chile, but the fall is not significant in Israel.

A fall in the proportion of consumers who are liquidity constrained can generate a consumption boom in two ways. One is through a reduction in the excess savings accumulated by these households. A second is through the increase in purchases of consumer durables. All the households that prior to the stabilization were liquidity constrained and could not buy the durables they wanted can do so when they are no longer constrained. This generates a bunching of purchases of consumer durables and a jump in total consumption expenditures.1/

1/ Hayashi (1982) makes a similar argument.

In the second part of the paper, I look at the three main exogenous channels through which banking sector credit can expand after the stabilizations and fuel the consumption booms by reducing liquidity constraints. Prior to the stabilizations, the combination of a small (and mostly) inefficient banking system and a high inflation environment was reflected in very low levels of credit to the private sector, particularly consumption credit. The drastic fall in the inflation rates after the stabilizations combined with progressive financial reforms worked to increase the resources available to the banking sector to finance private consumption. The ratio of banking credit to total private consumption went from 29.8 percent in 1978 to 98.4 percent in 1982 in Chile. In Mexico, the ratio of consumer credit to total private consumption went from 2.9 percent in 1987 to 10 percent in 1992, and in Israel the ratio of unlinked bank credit to total private consumption went from 15% in 1985 to 30% in 1988. 1/ De Long and Summers (1987) also credit the increased availability of consumer loans with the reduced variability of aggregate demand and the fall in liquidity constraints in the postwar U.S.

The results highlight the difference between the financial sectors in Mexico and Chile on the one hand, and Israel on the other. In Mexico all three channels for the increase in

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1/ In Israel, unlinked Bank credit is the source of most consumer loans.

credit are very important; that is the remonetization of the economy, the fall in the ratio of debt to GDP held by banks, and the increase in foreign liabilities held by banks. For Chile, the most important channel is the remonetization of the economy, while for Israel it is the fall in the public sector debt (held by banks) to GDP ratio. Israel's highly indexed financial sector and its high private savings ratio mean that there was not a significant increase in the volume of financial intermediation after the stabilization, while for Mexico and Chile this was a very important factor. In addition, both Mexico and Israel achieved a significant reduction in the ratio of public debt to GDP.

The rest of the paper is structured as follows. Section II relates the main features of the stabilization programs and the evolution of credit and consumption thereafter. Section III presents the permanent income hypothesis (PIH) and sets out an alternative allowing for liquidity constrained consumers. The empirical investigation is carried out in Section IV and Section V concludes.

II. A BRIEF HISTORY OF CHILE, MEXICO, AND ISRAEL

Before turning to the estimation results, we take a brief look at the history of the three stabilization episodes.

II. 1 CHILE

Following the coup of 1973, the government of Pinochet embarked on a program that would drastically change the Chilean economy. Between 1973 and 1975, the government started an aggressive program to correct the most important distortions of the previous regime. During this period, a gradual anti-inflationary policy was implemented without much success. In April of 1975, the first serious attempt to lower inflation was made by an orthodox program of tight money growth. By 1978, however, it had become clear that the program was not working and with inflation still running at 37% a year the government changed course and started targeting the exchange rate.

In 1979, the government introduced a new stabilization plan by fixing the exchange rate at 39 pesos per dollar. The program worked well for a while and inflation fell to 10% by 1981; however, the exchange rate became progressively overvalued. By late 1981 it became apparent that the Chilean "miracle" was coming to an end. The fourth quarter of 1981 was characterized by extraordinarily high real interest rates, a huge current account deficit, rising unemployment, and a fall in real GDP.(Dornbusch (1993)). The program collapsed in early 1982 and a severe financial crisis developed. During this time, real total private consumption in Chile grew at an average rate of 4.3% per year. As we will see later on, this

consumption boom was fueled by the increase in consumer credit which relaxed liquidity constraints in the economy.

In addition to the goals of trade liberalization and inflation reduction, the stabilization plan also included measures to liberalize financial markets and ease restrictions on credit. Edwards and Cox Edwards (1991) describe Chile's financial market during most of the 60's and 70's as a textbook case of financial repression. Credit markets were underdeveloped and highly distorted; the degree of financial intermediation was extremely low, real interest rates were negative, and reserve requirements were extremely high at 100% in 1973 and then 42% in 1979. Most importantly, credit was rationed and allocated using arbitrary and inefficient criteria. Table 1 shows the ratio of M2 to GDP, real interest rates, and credit to the private sector.

TABLE 1: CHILE: INDICATORS OF THE FINANCIAL SECTOR 1970-1981

YEAR	Real Credit to the Private Sector 1975=100	M2/GDP (%)	Real Interest Rate [a] % per year
1970	63.2	8.8	
1971	91.2	13.1	
1972	93.2	13.6	
1973	77.2	10.7	
1974	88.2	5.4	
1975	100.0	5.6	
1976	136.8	5.9	
1977	270.0	8.3	8.8
1978	444.3	10.4	18.9
1979	585.0	12.0	6.8
1980	817.2	13.2	5.9
1981	983.7	21.2	26.5

Source: Edwards and Cox Edwards (1991) and various issues of the Central Bank of Chile monthly bulletin. a) The ex-post real rates were constructed as $r=(1+i)/(1+\pi)-1$ where i is the annualized nominal rate on short term deposits, and π is the actual annualized rate of inflation.

The numbers show a very striking increase in the volume of financial intermediation, measured by the increase in M2/GDP ratio, after 1979. Prior to 1979, credit to the private sector was small but increasing due to a combination of the fall in the inflation rate and some reforms to the capital markets. However, between 1977 and 1981 the real volume of total credit to the private sector increased by 264%! Another indication of the decline in credit rationing can also be seen in the percentage fall in the spread between the deposit and the lending rate, and the increase in the

credit to consumption ratio shown in Table 2. This credit expansion led to a fall in liquidity constraints which helped to fuel the consumption boom during this period. Edwards and Cox Edwards (1991) point out that the rise in expenditure (consumption and to a lesser extent investment) was largely financed through higher credit from the banking sector.

TABLE 2: CHILE

YEAR	CREDIT/CONSUMPTION (%)	SPREAD % per year
1975	6.6	
1976	9.8	
1977	22.7	38.5
1978	29.8	17.3
1979	42.7	12.1
1980	59.6	5.5
1981	71.3	10.1
1982	100.7	4.6

Source is various issues of the Central Bank of Chile monthly bulletin. Credit/Consumption is the ratio of total real credit to the private sector to total real private consumption. Spread is the difference between the real short term lending and deposit rate.

II.2 MEXICO

Following the debt crisis of 1982, Mexico began a process of adjustment with the aims of reducing inflation, lowering the budget deficit, and liberalizing trade. In 1986, oil prices plummeted leaving Mexico with a new crisis. In response to this shock, there was a real depreciation of the peso which fueled inflation. By 1987, however, the acute

external sector crisis was amplified by the severe problem of inflation, which reached almost 160% in that year. On December 15 1987, the De La Madrid administration set in motion a stabilization package called the Economic Solidarity Pact (PSE) to reduce inflation and streamline the economy. The exchange rate was fixed and used as a nominal anchor for prices.

The pact managed to reduce inflation from 159% in 1987 to 51.6% in 1988 without a recession; today inflation is around 8%. In addition Mexico has been experiencing a consumption boom. Between 1989 and 1992, consumption expenditure has increased significantly and grew faster than output averaging about 5.8% per year. Table 3 shows some major economic indicators for Mexico.

TABLE 3: MEXICO: MACROECONOMIC INDICATORS
Real Rates of Growth unless otherwise stated.

YEAR	GDP	CONSUMER PRICES	CONS/GDP (%)	PRIVATE CONSUMPTION	PRIVATE INVESTMENT
1986	-3.8	105.7	63.2	-2.6	-11.1
1987	1.9	159.2	62.0	-0.01	6.4
1988	1.2	51.7	62.4	1.8	10.2
1989	3.3	19.7	64.4	6.8	7.5
1990	4.4	29.9	65.4	6.1	13.3
1991	3.6	18.8	66.1	4.6	12.7
1992	2.6	11.9	68.2	5.9	20.4

Source: The Mexican Economy 1993. Banco de Mexico.

This consumption boom has been fueled by the extraordinary increase in the volume of financial intermediation and real consumer credit which has significantly reduced the proportion of the population that is liquidity constrained.

Prior to 1988, the financial sector of Mexico was severely underdeveloped and repressed. Quantitative restrictions to credit were widespread, and interest rates were highly regulated. Between the 1950's and 1980's, control over credit was exercised through the quantitative controls on the intermediaries by the imposition of very high reserve requirements, selective credit quotas, and borrowing interest rates set by the Banco de Mexico-in many cases upon instructions from the ministry of Finance- and not by current market conditions. (Aspe (1993)).

Thorough financial reforms were implemented along with the new pact. Starting in the fall of 1988, interest rates were allowed to vary more due to market conditions, and "credit quotas" to high priority sectors were eliminated. By 1989, the selective credit mechanism was no longer in place, compulsory reserve requirements were removed, and new financial instruments were created. All these reforms were further strengthened by the full privatization of the banking system which began in May 1990 and was completed in 1992.

The combined effect of the exchange rate based stabilization and the financial reforms was to increase the amount of consumption credit to the private sector, through

the increase in the volume of financial intermediation. Tables 4 and 5 show the rapid increase in credit and the volume of financial intermediation (as measured by M2/GDP and M4/GDP).

TABLE 4: MEXICO: FINANCIAL INTERMEDIATION MEASURES

YEAR	M2/GDP (%)	M4/GDP (%)	Financing to Pvt. Sector (% of GDP)
1985	27.7	33.3	12
1986	32.2	41.2	11
1987	31.8	43.7	10
1988	22.4	34.4	10.5
1989	24.6	39.9	14.5
1990	26.6	43.2	18.0
1991	31.1	44.8	26.0
1992	31.9	45.8	33.0

TABLE 5: MEXICO CREDIT GIVEN TO INDIVIDUALS BY COMMERCIAL BANKS
Real Rate of Growth

	90-91	91-92
Total to firms and individuals	41.1	36.8
Total to individuals	59.0	55.9
Credit to Indiv. by Type		
Consumption	67.5	49.9
Credit Cards	51.6	30.1
Durable Goods	100.5	129.8
Housing	52.6	60.9

Note: Sources for both table 4 and 5 are the Annual Report of the Banco de Mexico 1992 and The Mexican Economy 1993 from the Banco de Mexico. Data for Table 5 does not include financing from non-banking financial intermediaries.

As these Tables clearly indicate, the growth in real credit has been spectacular, particularly credit for consumption, durable goods, and housing. Credit to private individuals more than doubled in 1991 and 1992. We will see in the next section how this increase in credit led to a fall in liquidity constraints which fueled the consumption boom.

II.3 ISRAEL

Following the stock market collapse of 1983, a balance of payments crisis developed in Israel. A maxi-devaluation led to a step increase in the inflation rate. After several tries with three "package deals" among the government, the major union organization (the Histadrut), and the association of private employees to lower inflation through wage and price freezes, the government introduced an exchange rate based stabilization program in July of 1985. The main objectives of the plan were to reduce inflation and improve the balance of payments.

The program that was announced was very tough: it planned to reduce the budget deficit by at least 5% of GNP. This was achieved mostly through sharp cuts in subsidies and higher taxes. The sheqel was initially devalued by 19% and then fixed at 1.5 sheqel per dollar for a time. Wages and prices were allowed a one-time adjustment and then frozen at levels

that caused a significant reduction in the real wage in the initial months of the program. (Bruno et al..(1991)).

The plan was extremely successful in reducing both inflation and the budget deficit. Inflation fell from 500% a year to approximately 16-20% per year over the next couple of years, and the government deficit fell from an average of 15% of GNP in the previous decade to being balanced and even a slight surplus in 1986. The success of the program was reflected in a rapid consumption boom. Between 1986 and 1987 total private consumption grew at an average annual rate of over 11%. This boom eventually deflated in late 1988 as a recession set in. Table 6 shows some main economic indicators for this period.

TABLE 6: ISRAEL MAIN ECONOMIC INDICATORS
Real Rate of Growth per year (%)

YEAR	GDP	Private Consumption	Gross Domestic Investment
81-85 avg	2.9	4.4	0.1
85	3.9	0.5	-10.6
86	3.6	14.2	10.4
87	5.2	8.5	2.9
88	1.6	3.8	-1.9
89	1.3	0.0	-2.7
90	5.4	5.3	22.6

Source: Bank of Israel Annual Report various issues.

The consumption boom was partly fueled by the increase in real credit from the banking sector to the private sector.

Between 1985 and 1990 the credit to consumption ratio doubled. See Table 7. However, unlike the Mexican or the Chilean case, Israel's financial system is highly indexed. A very large proportion of the financial system are liquid assets, mainly foreign currency denominated accounts, which are linked to the exchange rate or the CPI. In addition, about half of the credit given to the private sector by banks is indexed credit. The indexation of the financial system acts to protect depositors from inflation and devaluation risk. This means that Israeli's were able to obtain credit prior to the stabilization as well as after it.

TABLE 7 ISRAEL: INDICATORS OF THE FINANCIAL SECTOR

YEAR	Credit/ Consumption (%)	M3/GNP (%)	Real credit to the Private Sector[b] Growth Rate	Real Interest Rate[a] % per year
85	15.2	32.2	0	26.4
86	22.8	31.1	48.3	17.5
87	25.2	31.2	62.2	26.2
88	30.3	29.0	32.1	18.9
89	32.5	27.3	17.8	10.0
90	34.09	26.5	26.3	4.4

Source: Various issues of the Annual Report of the Bank of Israel.
(a)On unlinked free credit.
(b)From Commercial Banks

One of the main regulations introduced with the stabilization program prohibited any new (foreign currency indexed) resident deposits with maturities of less than a year (PATAM). The disinflation along with the new regulation on

foreign currency deposits was reflected as an increase in the relative demand for unindexed short-term assets, whose share in total private assets quadrupled during the period 1984-1987. See Table 8. This reshuffling of the public's asset portfolio from foreign currency deposits (included in M3) to short term sheqel deposits (which are in M2) meant that in Israel there was not a marked increase in the volume of financial intermediation like in Mexico or Chile. Table 7 shows that the ratio of M3 to GNP remained relatively constant throughout the period.

TABLE 8 ISRAEL: ASSETS OF THE PRIVATE SECTOR
Percent of Total Assets

YEAR	INDEXED		UNINDEXED
	Savings & Long Term Deposits	Resident Deposits[a]	Demand Deposits[b]
85	36.7	32.1	22.4
86	37.5	26.5	28.7
87	38.9	24.5	28.5
88	59.9	27.0	31.5
89	46.2	22.4	31.1

Note: Source is the Annual Report of the Bank of Israel, various issues
(a) includes Patams and other resident deposits
(b) Includes currency in circulation

As we see, Israel is a case which is different from the other two countries. First, the consumption boom was only short lived (between 1986 and 1987) after which a recession ensued. See Table 6. Second, the role of credit in this

expansion is not as marked in the data since due to the indexed nature of the financial system Israelis were able to keep their money at home and therefore were able to get loans prior to the stabilization. Finally, the process of liberalizing the financial sector began very late and did not bear on the supply of consumer credit. The first minor changes were not done until 1987 and more was done in 1990. These effects will become evident in the empirical results presented below.

Next, we set up the model of the PIH with an allowance for liquidity constrained consumers to see if the share of consumers which are liquidity constrained falls in these countries following the stabilizations.

III. THE PERMANENT INCOME HYPOTHESIS AND LIQUIDITY CONSTRAINTS

In this section we present the permanent income hypothesis (PIH) when we allow for the presence of liquidity constraints. This model will allow me to test whether liquidity constraints actually fall after the stabilizations.

III.1. THE THEORY

Following Hall(1978), the PIH can be modeled from the decisions of a representative consumer. The basic set of assumptions are that consumers i) can freely borrow and lend

at the same rate of interest ii) have rational expectations iii) have identical-time separable preferences with either a quadratic or logarithmic instantaneous utility function and iv) cannot die in debt. The representative consumer maximizes

$$V(A_t) = E_t \sum_{t=1}^{T} (1+\delta)^{-t} U(C_t) \qquad U' > 0 \quad U'' < 0$$

$$s.t.\ (1) \quad A_{t+1} = (1+r)(A_t + w_t - C_t) \qquad for\ t = 1,\ldots,T-1$$

$$(2) \quad A_T \geq 0 \qquad (1)$$

where T is the length of time a person lives, C is consumption, δ is the subjective rate of discount, w_t is labor income, A_t are asset holdings, r is the constant rate of return on assets, and E_t is the expectation conditional on the information available at time t.

The first order condition necessary for an optimum is

$$E_t U'(C_{t+1}) = \left(\frac{1+\delta}{1+r}\right) U'(C_t) \qquad (2)$$

This is the Euler equation which is usually tested in consumption models; it says that marginal utility today is the best forecast of marginal utility tomorrow up to a constant multiple.

If we assume $r=\delta$ and that $U(C_t)$ is quadratic,1/ then marginal utility is linear and we can use the random walk result for consumption which states that $E_t(C_{t+1})=C_t$. This says that consumption today is the optimal forecast of consumption tomorrow, which implies

$$\Delta C_t = \epsilon_t \qquad (3)$$

where ϵ_t is a rational forecast error and represents the news in permanent income. So, the change in consumption is not forecastable; that is no information in t-1 or before can help in predicting future consumption growth.

In empirical tests of the PIH, however, Flavin (1981) and Hayashi (1982) have found that certain variables (e.g current disposable income, stock prices etc..) have enough predictive power to reject the random walk hypothesis. 2/ This excess sensitivity of consumption to anticipated changes in income suggests an alternative hypothesis.

Following Campbell and Mankiw (1989), I nest the PIH in a more general model which allows for some liquidity constrained consumers. In this model, there is some fraction λ of income which accrues to individuals who consume their

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1/ For example, the typical quadratic utility function is $U(C_t)= -(\alpha - C_t)^2$. The results hold if $U(C_t)$ is close to quadratic or the change in marginal utility from one period to the next is small.

2/ For other studies were excess sensitivity has been found see Hansen and Singleton (1982).

current income (i.e. they are liquidity constrained), while the remainder (1-λ) accrues to individuals who consume their permanent income.

Total income then, is the sum of the two groups' respective income; that is $Y_t = Y_{1t} + Y_{2t}$. Where Y_{1t} is the income of the liquidity constrained consumers, and Y_{2t} is the income of the group which behaves according to the PIH. Since the first group receives λ of total income, $Y_{1t}=\lambda Y_t$ and $Y_{2t}=(1-\lambda)Y_t$. Per capita consumption in the first group is then $C_{1t} = Y_{1t} = \lambda Y_t$, implying that

$$\Delta C_{1t} = \Delta Y_{1t} = \lambda \Delta Y_t \qquad (4)$$

$$\Delta C_{2t} = (1 - \lambda) \epsilon_t$$

Using equation (4) the change in total per capita consumption can be written as

$$\Delta C_t = \Delta C_{1t} + \Delta C_{2t} = \lambda \Delta Y_t + (1-\lambda)\epsilon_t \qquad (5)$$

Under this alternative hypothesis, the change in consumption is a weighted average of the change in current income and the unforecastable innovation in permanent income. Equation (5) reduces to the Hall(1978) PIH when λ=0.

III.2 CONSUMPTION AND THE REAL INTEREST RATE

The "random walk" hypothesis for consumption depends on the assumption that the real interest rate is constant. However, the countries in our sample all experienced large changes in the real interest rate. If we ignore this effect, variation of the real interest rate can make consumption appear excessively sensitive to income even though individuals intertemporally optimize without any borrowing constraints.1/

The generalization of the consumer's Euler equation to allow for changes in the real interest rate (in log linear form) is 2/

$$\Delta C_t = \mu + \lambda \Delta Y_t + \theta r_t + \epsilon_t \qquad (6)$$

where r_t is the real interest rate contemporaneous with ΔC_t, and ϵ_t may be correlated with r_t, but is uncorrelated with lagged variables. The coefficient $\theta=(1-\lambda)\sigma$ where σ is the intertemporal elasticity of substitution. Equation (6) tells

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1/ See Christiano (1987) on this point.

2/ See, for example, Hansen and Singleton(1982), and Hall(1988). Note that in the process of log-linearizing the first-order condition, the variance of consumption growth has been included in the constant term. Hence, heteroskedasticity is one possible reason for rejection of the model; see Barsky(1985) for a preliminary exploration of this issue.

us that high ex ante real interest rates should be associated with rapid growth of consumption.

IV. LIQUIDITY CONSTRAINTS, CREDIT EXPANSIONS, AND STABILIZATIONS

In this section, we use the framework developed in the previous section to investigate the effects of credit expansions after stabilizations on liquidity constraints. First, I look at whether there was a reduction in liquidity constraints after the stabilizations, then I examine if there is a positive correlation between increases in credit to the private sector and private consumption. Finally, I look at the channels through which credit expansions occurred in Mexico, Israel, and Chile.

IV.1 STABILIZATIONS AND LIQUIDITY CONSTRAINTS

Using the model set up in section III, we estimate λ directly and test the hypothesis that $\lambda=0$ against the alternative that consumers are liquidity constrained ($1<\lambda<0$). This direct estimation of λ has the advantage of providing a useful measure of the economic importance of deviations from the theory. For example, if the estimate of λ is close to zero then one can say that the PIH is approximately true even if λ is statistically significant.

Since the error term may be correlated with ΔY_t, we use instrumental variables, because least squares estimation of equation (6) can produce inconsistent estimates. Any lagged stationary variables are potentially valid instruments since they are orthogonal to ϵ_t. The instruments used were selected because they help predict income growth. The instruments I used are a combination of the following; lags two through four of each of the following variables, ΔC_t, ΔY_t, and the following per capita variables real exports, real government expenditure, real government consumption, real investment, real M1, the terms of trade and a trend.3/

I estimated equation (6) for Mexico, Chile, and Israel under the null hypothesis that λ remained constant during the entire sample period. The alternative hypothesis is that λ fell after the stabilization program. The model is a log-linear approximation to the true model in levels and differences since aggregate time series on consumption and income seem to be closer to log-linear than linear. That is, the mean change and the innovation variance both grow with the level of the series.4/

Due to the fact that consumption and income are measured as quarterly averages rather than points in time, then measured consumption is the time average of a random walk if

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3/ Several combinations of these instruments were tried for each country, the results did not vary much from the ones reported here.

4/ See Campbell and Deaton (1989) on this.

the permanent income hypothesis holds in continuous time. Therefore, the change in consumption will have a first-order serial correlation of 0.25, which could lead us to reject the model even if it is true. To eliminate this problem, the instruments I used are lagged more than one period, so there is at least a two-period time gap between the instruments and the variables in equation (6). The time average of a continuous time random walk is uncorrelated with all variables lagged more than one period, so by using twice-lagged instruments we obtain a test of the model that is valid for time-averaged data.5/

To estimate the model I used data from various sources including the IFS and data provided by the Central Banks of Mexico, Chile, and Israel.6/ The data used are as follows: Y_t is per capita real GDP, C_t is total real private consumption per capita and r_t is the real interest rate which was constructed from the nominal ex post deposit rate for Mexico and Chile, and from the lending rate in Israel.7/

There are two data issues to deal with here. The first, is that for the countries studied here, relatively long time

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5/ See Working (1960) on this.

6/ I would like to thank Gil Bufman, Leonardo Leiderman, Rafi Melnick, Carmen Reinhart, Rodrigo Vergara, and Martin Werner for providing me the data used in this paper. For Israel and Mexico C and Y are seasonally adjusted.

7/ The ex-post real interest rate was calculated as $r=[(1+i)/(1+\pi)]-1$. Where i is the annualized deposit or lending rate, and π is the annualized quarterly inflation rate.

series of quarterly consumption data are only available for total private spending which includes durables.8/ If we assume exponential depreciation, however, durability should merely lead to the change in consumer spending being a first-order moving average process rather than white noise.9/ Since I am using twice-lagged instruments, the inclusion of spending on durables does not change the implication of the permanent income hypothesis that forecastable changes in income should not lead to forecastable changes in consumption. Second, I use GDP as a proxy for disposable personal income. This is not a perfect proxy but it should still provide a valid test of the null hypothesis that the permanent income theory is correct.

The final equation estimated for each country consisted of:

$$\Delta C_t = \mu_0 + \lambda_0 \Delta Y_t + \theta_0 r_t + \mu_1 D_t + \lambda_1 DY_t + \theta_1 Dr_t + \epsilon_t \qquad (7)$$

where D_t is a dummy variable equal to 0 prior to the stabilization and 1 afterwards, $DY_t = \Delta Y_t * D_t$, and $Dr_t = r * D_t$.

8/ Hayashi(1982) makes the point that a measure of consumption which includes expenditures on durables is a more relevant measure of consumption for liquidity constrained consumers since they must use their saved income to purchase durables.

9/ See Mankiw (1981) on this.

The dummy variables are defined as follows.

1) Mexico D = 0 1980.1-1987.4

1 1988.1-1992.4

2) Chile D = 0 1975.1-1978.4

1 1979.1-1983.1

3) Israel D = 0 1980.1-1985.4

1 1986.1-1992.4

Table 9 shows the results.

TABLE 9: $\Delta C_t = \mu_0 + \lambda_0 \Delta Y_t + \theta_0 r_t + \mu_1 D_t + \lambda_1 DY_t + \theta_1 Dr_t + \epsilon_t$

TSLS Estimates	MEXICO	CHILE	ISRAEL
	1980.1-1992.4	1975.1-1983.1	1980.1-1992.4
1. μ_0	0.0039 (.99)	-0.001 (-0.02)	0.004 (.45)
2. λ_0	0.931 (4.6)[a]	0.863 (1.72)[c]	0.88 (2.19)[b]
3. θ_0	0.042 (1.8)[c]	-0.03 (-0.24)	0.003 (.31)
4. μ_1	0.005 (.97)	-0.043 (-0.7)	-0.003 (-.21)
5. λ_1	-0.783 (-2.63)[a]	-0.70 (-1.00)	-0.88 (-1.49)[d]
6. θ_1	-0.086 (-2.56)[a]	-0.25 (-0.92)	0.04 (1.04)
7. N	47	32	48
8. ΔY_t R^2	.09	.49	.0002
9. Δr_t R^2	.79	.93	.51
F-Statistic	6.94	1.00	2.21
Critical F (10%)	2.84	2.88	2.84

Note: t-statistics are presented in parentheses. (a) indicates significant at the 1% level, (b) at the 5% level, and (c) at the 10% level (d) at the 15% level. The F-Statistics were calculated using the corrected method suggested by Wooldridge (1991). Different combinations of the instruments gave very similar results.

The estimates for the proportion of the population that is liquidity constrained clearly show a decrease after the stabilizations. For Mexico, the estimate is 0.93 before the stabilization and 0.15 after, with the drop significant at the 1% level. For Chile, the estimate is 0.86 before, and 0.16 after. Finally, for Israel the estimate is 0.88 before and 0.0 after at the 15% level. An F-test shows that the change in λ for Mexico is significant at the 5% level, for Chile is significant at the 25% level, and for Israel it is significant at the 15% level. Even though for both Chile and Israel the drop in λ is not significant at normal levels, this is partly due to the small number of data points before the stabilization and in the case of Chile after the stabilization as well. For Chile, when the sample is extended to 1989 the magnitude of the coefficients do not change but the drop in λ becomes significant at the 5% level. Rows 8 and 9 present the first stage adjusted R^2, which are high relative to those found by Campbell and Mankiw (1989), indicating that the instruments used have significant power in predicting income growth and the interest rate. This implies that we can reject the permanent income hypothesis and the hypothesis that λ remained constant throughout the sample with a fair bit of confidence.

The results of Table 9 show that liquidity constraints fell drastically after the stabilizations, in the next section

we determine that this was brought about by an increase in credit from the banking sector.

IV.2 CONSUMPTION AND CREDIT

If in fact the expansion of credit reduces liquidity constraints and can therefore be used as an explanation for the consumption booms we observe, then the model presented in section III is an approximation. In particular, in a complete model of consumption with borrowing constraints the fraction of consumers exhibiting excess sensitivity (λ) will depend on a variety of factors such as wealth, income, individual characteristics, and more importantly, on how well credit markets function. Table 10 presents the sample correlations between total per capita private consumption and credit to the private sector from the banking system. This correlation gives us an index by which to measure how consumption and credit move together. The correlation between the two series is strongest for Mexico, but for all three countries it is fairly strong.

TABLE 10: CONSUMPTION AND CREDIT

Country	Correlation
Mexico	0.93
Chile	0.60
Israel	0.85

Note: For Israel, credit is unlinked bank credit to the nonfinancial private sector, for Mexico it is consumption credit to the private sector, and for Chile it is total claims on the private sector from commercial banks and other banking institutions.

In order to get a better sense of how consumption and credit are related, we present a scatterplot of per capita consumption and per capita credit for each country. Figures 4,5,and 6 show that in all cases consumption and credit are positively related and a regression line of consumption on a constant and credit shows that this relationship fits quite well.

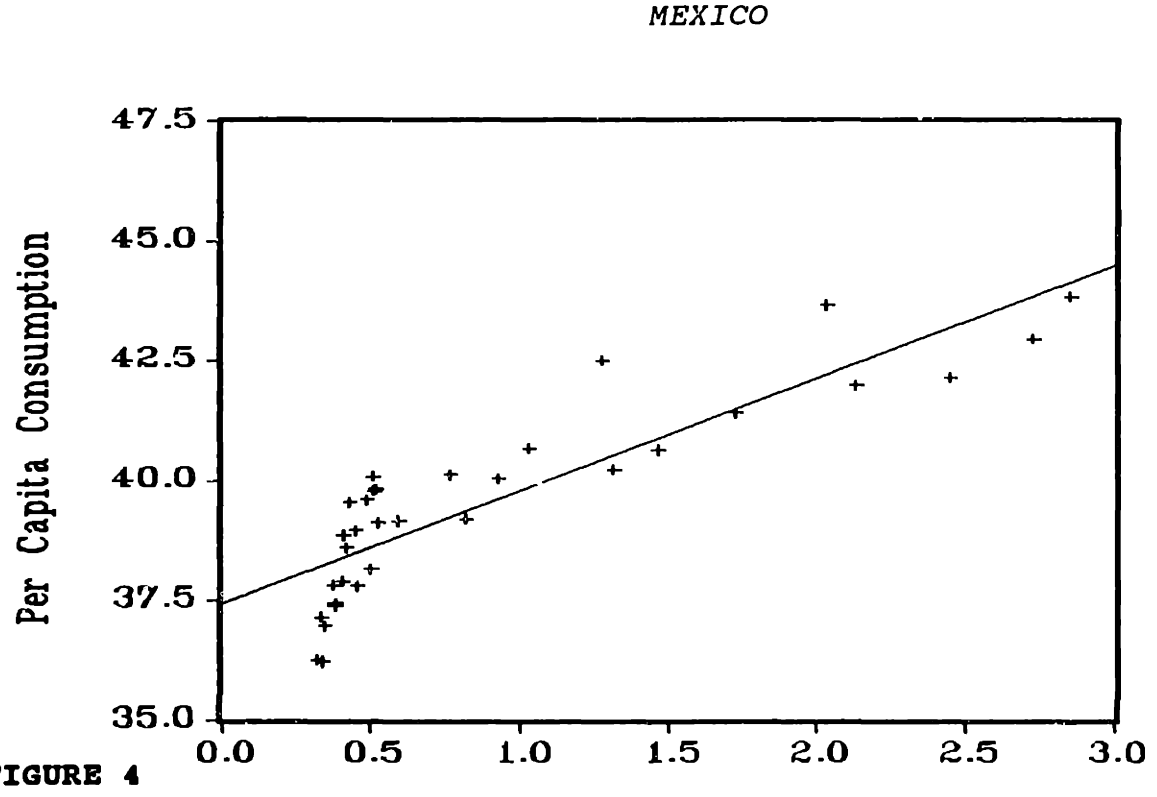

FIGURE 4

CHILE

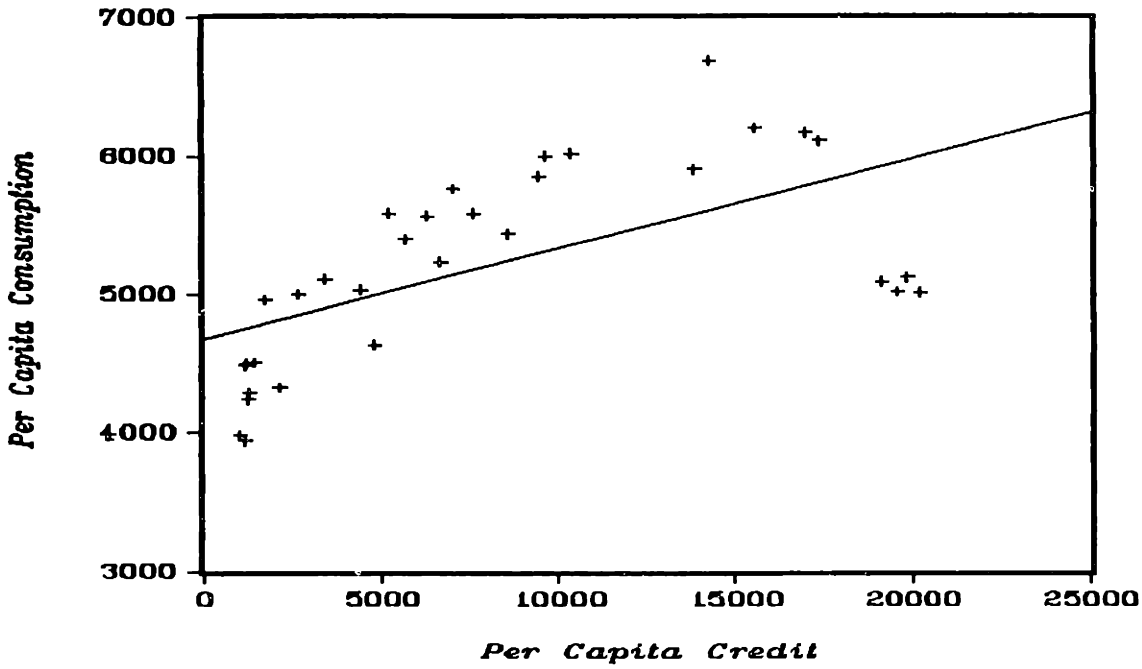

FIGURE 5

ISRAEL

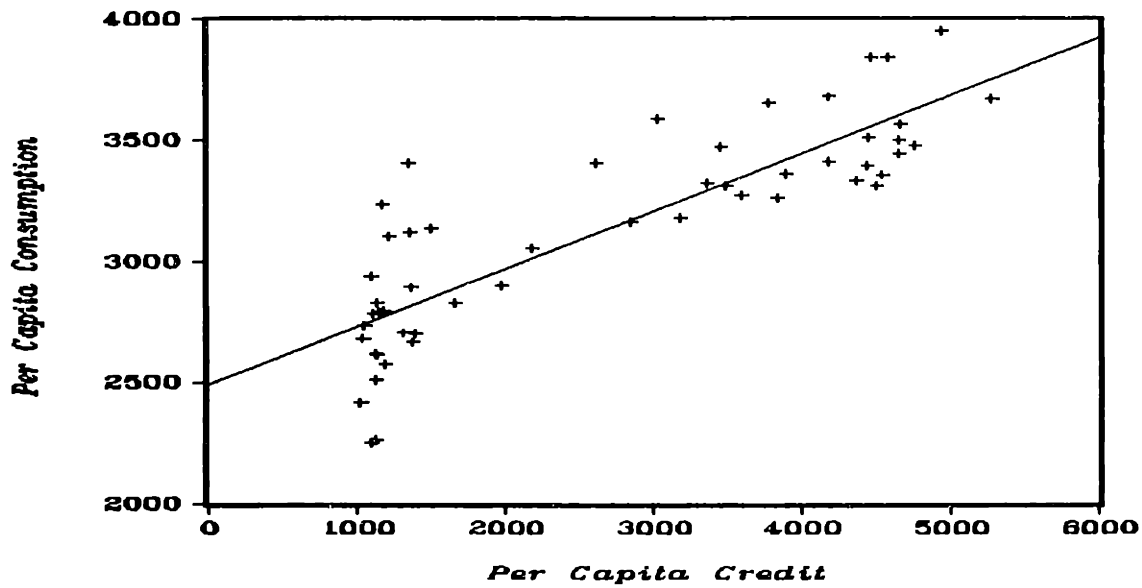

FIGURE 6

These correlations suggest that credit might be an important determinant of consumption if it works to reduce the share of households that are liquidity constrained in the economy.10/ The reduction in liquidity constraints can generate the consumption booms we observe because it allows consumers who desire to consume more, but could not due to borrowing constraints, to increase their consumption and to reduce their excess savings; or by allowing them to purchase the durables they have been waiting to buy.

IV.3 SOURCES OF CREDIT EXPANSIONS AFTER STABILIZATIONS

The evidence presented in the previous section, shows that increases in credit after stabilizations play an important role in reducing credit constraints after these plans were enacted. In this section, I look at the exogenous sources of these credit expansions.

There are three possible channels through which credit can increase after a stabilization. These channels are evident when looking at the following accounting identity from a bank balance sheet.

10/ If we assume that credit is exogenous, we can write $\lambda_t=\beta-\gamma cred_t$ and plugging this into equation (6) we get $\Delta C_t=\mu+\beta\Delta Y_t-\gamma\Delta Y_t*cred_t+\theta r_t+\epsilon_t$. This was estimated for all the three countries, and in each case γ was negative and highly significant. The estimates were γ_{mexico}= -1.04, γ_{chile}= -1.4E-05, and γ_{israel}= -9.3E-05, indicating that an increase in credit reduces liquidity constraints.

$$PrivateSectorLoans = Deposits - Reserves - GovernmentLoans \quad (8)$$

First, an increase in deposits given the level of public debt held by banks (and the level of reserves) increases the supply of loans to the private sector. The increase in deposits can come from the repatriation of capital held abroad as inflation stabilizes at lower levels and is reflected in the rapid remonetization of the economy as measured by an increase in M2/GDP. The second channel through which credit availability can increase after a stabilization is through a decline in the level of public debt held by banks at any given level of the ratio of M2 to GDP. Resources from the financial sector which were previously being used to finance the government can now be used to finance the private sector. This crowding in effect of a lower level of public debt occurs independently of the increase in the volume of financial intermediation.

Each of these channels in and of themselves, can explain the increase in availability of credit to consumption following a stabilization. This implies that any (or both) of these reasons could be the key to explaining the decline in liquidity constraints that occurs after stabilizations. In effect, the level of credit in the economy is negatively related to the level of public debt held by the banking sector (scaled by GDP), and positively related to the degree of

remonetization, measured by M2/GDP. With these effects in mind, we specify the share of the population that is liquidity constrained endogenously.

$$\lambda_t = \beta + \gamma \left(\frac{M2}{GDP}\right)_t + \delta \left(\frac{B}{GDP}\right)_t \qquad (9)$$

where M2/GDP is the ratio of M2 to GDP and B/GDP is the ratio of the real stock of internal public debt held by banks to GDP.11/ We expect γ to be negative and δ to be positive. Equation (9) says that as the economy gets remonetized credit increases so liquidity constraints decrease, and that as the level of debt increases the amount of credit decreases so λ increases. Substituting equation (9) into (6) we get

$$\Delta C_t = \mu + \beta \Delta Y_t + \gamma M2Y_t + \delta BY_t + \theta r_t + \epsilon_t \qquad (10)$$

where $M2Y_t$= M2/GDP * ΔY_t and BY_t= B/GDP * ΔY_t. I estimated equation (14) for Mexico Chile, and Israel. 12/ The results are shown in Table 11. For Mexico and Chile, it is clear that the remonetization of the economy after the

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11/ B is the sum of the IFS lines 52an, 52b,and 52c for Mexico, the sum of 22a-c,42a-c,and 42ap for Chile, and it is line 22a for Israel. The results are approximately the same when the budget deficit was used instead of the stock of public debt.

12/ The method of estimation is always TSLS with the same set of instruments as before.

stabilization was a key element in the credit expansion (and therefore in the reduction in liquidity constraints) that ensued. As expected, we see that the estimate of γ is negative and significant at the 10% level. On the other hand, this is not the case for Israel. This is not surprising, since as we mentioned before, the financial system of Israel is very different from that of either Mexico or Chile.

Its highly indexed system acts to protect depositors from inflation and devaluation risk; therefore the level of banking resources available to the private sector did not change much from before the stabilization to after it. The steadying of the exchange rate and consequent sharp drop in devaluation expectations, the drop in inflation, and the rise in real interest rates on local currency accounts led to a drastic change in financial asset holdings, notably a shift from PATAM and other resident deposits to short-term sheqel deposits. In Israel, people kept the money at home but they kept it in accounts linked to the dollar, when the stabilization lowered inflation, people switched from dollars to domestic currency but the amount of resources in the banking system did not change much. This is reaffirmed by the evolution of the volume of financial intermediation as measured by M3/GNP shown in Table 7.

TABLE 11: $\Delta C_t = \mu + \beta \Delta Y_t + \gamma M2Y_t + \delta BY_t + \theta r_t + \epsilon_t$

TSLS Estimates	MEXICO		CHILE		ISRAEL	
	1983.1	1992.4	1975.1	1989.4	1980.1	1992.4
μ	0.003	(1.0)	-0.007	(-.34)	0.009	(1.40)
β	0.61	(2.06)[b]	2.80	(2.49)[a]	0.17	(.23)
γ	-3.06	(-1.73)[c]	-2.24	(-1.63)[c]	-0.92	(-.57)
δ	2.33	(1.98)[b]	0.89	(.10)	0.36	(1.35)[d]
θ	0.02	(.65)	-0.05	(-.64)	-0.008	(-.75)
N	40		60		48	

Note: The sample period for Mexico begins in 1984.1 since data on the public stock of debt are not available earlier. t-statistics are presented in parentheses. (a)indicates significant at the 1% level, (b) indicates significant at the 5% level, and (c) at the 10% level, and (d) at the 15% level.

Looking at the results for the estimate of δ we see that it is positive (as expected) in all cases, but it is only significant in Mexico and Israel. This implies that for Mexico the channels through which credit expansions occurred were both a remonetization of the economy and the fall in public debt held by the banking sector.

The crowding in effects from a fall in public debt held by the banking system are also quite important in Israel. This is logical since one of the principal objectives of the stabilization plan was to drastically reduce the deficit to GDP ratio. Even though this was the case in Chile as well,

the data for Chile are very bad and some of the missing years were interpolated from the existing series. 13/

In addition to the two channels through which credit expansions can take place already mentioned, there is a third factor. Banks can issue liabilities abroad and use these resources to increase the amount of loans to the private sector. In order to take this effect into account we respecified λ as

$$\lambda_t = \beta + \gamma \left(\frac{M2}{GDP}\right)_t + \delta \left(\frac{B}{GDP}\right)_t + \rho \left(\frac{FL}{GDP}\right) \qquad (11)$$

where FL are the real short-term foreign liabilities of the banking sector. Substituting equation (11) into equation (6) we get

$$\Delta C_t = \mu + \beta \Delta Y_t + \gamma M2Y_t + \delta BY_t + \rho FLY_t + \theta r_t + \epsilon_t \qquad (12)$$

where FLY_t= FL/GDP * ΔY_t. We expect γ and ρ to be negative and δ to be positive. The results are presented in Table 12.

13/ I tried a non-linear specification for λ in order to ensure that it is always between 0 and 1 since the linear specification has the problem that λ can become negative as M2/GDP gets large, or larger than one as B/GDP gets too large. I specified λ as $\lambda=\gamma[1/\exp^{(M2/GDP)}]-\delta[1/\exp^{(B/GDP)}]$ and estimated $\Delta C_t=\mu+\gamma\Delta Y_t*[1/\exp^{(M2/GDP)}]-\delta\Delta Y_t*[1/\exp^{(B/GDP)}]+\theta r_t+\epsilon_t$. The results are the same for each country.

TABLE 12: $\Delta C_t = \mu + \beta \Delta Y_t + \gamma M2Y_t + \delta BY_t + \rho FLY_t + \theta r_t + \epsilon_t$

TSLS Estimate	MEXICO	CHILE	ISRAEL
	1984.1 1992.4	1975.1 1992.4	1981.3 1992.4
μ	0.004 (1.36)	-0.004 (-.16)	0.006 (.63)
β	1.26 (2.79)[a]	2.4 (1.78)[c]	4.35 (1.0)
γ	-2.02 (-1.37)	-3.54 (-1.61)[c]	-5.24 (-.89)
δ	1.57 (1.40)[d]	2.54 (.25)	1.81 (1.34)[d]
ρ	-59.1 (-1.78)[c]	6.48 (.82)	-4.17 (-1.24)
θ	0.002 (.40)	-0.08 (-.82)	0.004 (.28)
N	36	60	46

Note: The sample period for Mexico begins in 1984.1 since data on the public stock of debt are not available earlier. t-statistics are presented in parentheses. (a)indicates significant at the 1% level, (b) indicates significant at the 5% level, and (c) at the 10% level, and (d) at the 15% level.

The results show that only for Mexico does the increase in foreign liabilities by the banking sector make a difference in the increase in credit and consumption. It also makes the remonetization not as important (γ is significant at the 20% level). For Chile and Israel this channel does not seem to matter and as before the relevant channels are the remonetization and the fall in the public debt held by banks respectively.

V. CONCLUSIONS

In looking at the role of credit in the post-stabilization consumption booms of Mexico, Chile, and Israel, we find that

the expansions in banking credit after the stabilizations are indeed an important determinant of consumption. The paper shows that there is strong evidence against the PIH and that liquidity constraints were quite important in these countries prior to the stabilization. In addition, we see that the share of households that are liquidity constrained falls sharply after the stabilizations. This effect is strongest in the case of Mexico. The decline in liquidity constraints can generate a decline in excess savings and/or a lumping of expenditures on consumer durables which can help explain the consumption booms that we observe.

In looking at the sources of credit in these economies, I find that for the case of Mexico, all three of the sources examined played an important role. Credit expanded through the rapid increase in the volume of financial intermediation, through the decrease in the ratio of debt to GDP held by banks, and through the increase in foreign borrowing by banks. For Chile, I find that only the remonetization of the economy matters; and for Israel only the crowding in effect matters. These results highlight the difference in the financial markets of Mexico and Chile on the one hand, and Israel on the other. Israel's highly indexed and developed financial system mean that there was not a significant increase in the volume of financial intermediation after the stabilization since it was already fairly high. Consumers in Israel had access to domestic indexed credit prior to the stabilization whereas in

Mexico and Chile this was not the case. This means that the impact of the increase in credit in Mexico and Chile is much larger than in Israel.

These results suggest that the role of the financial system in the economy is quite important when monitoring the progress of an economy after a stabilization. A country considering an exchange rate based stabilization should keep its financial system tightly monitored and regulated if it wants to avoid the ups and downs of the potential consumption booms.

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CHAPTER 3

CREDIT AND ECONOMIC ACTIVITY IN MEXICO

joint with Alejandro M. Werner

I. INTRODUCTION

The question of whether there exists a credit channel for the transmission of monetary policy has been one of the most important and controversial ones in macroeconomics. This "credit hypothesis" focuses on financial market imperfections. Shocks to credit markets , particularly to bank loans, have real effects. This paper presents new evidence on the credit hypothesis for the case of Mexico after 1984.

The theoretical underpinnings of the credit hypothesis contain two basic assumptions. The first is that loans are imperfect substitutes for other non-bank assets such as commercial paper for firms in the economy. The second is that there exist shocks (for example monetary policy ones) which affect the cost and availability of funds to banks.

The first of these assumptions, imperfect substitutability, arises due to imperfect information in credit markets. Banks give credit to agents who, due to high screening and monitoring costs, cannot easily obtain funds in the open market. The result is that if banks become unable or unwilling (if banks simply cut back on credit) to extend credit, there will be a fall in spending by customers who depend on it and therefore so will aggregate demand.
Together the assumptions mentioned imply that "credit shocks" will have real effects on economic activity. We examine whether the credit view is relevant for Mexico by evaluating

whether different indicators of credit shocks have any predictive power for output and investment. We begin by presenting a simple variant of the open economy textbook IS-LM model in Section II.[1] This model allows us to examine different scenarios with respect to the effect of credit shocks on aggregate economic activity. Specifically, we see that shocks to the nominal interest rate, keeping the real rate constant, have real effects. In addition, we look at the effect of financial deregulation on credit and aggregate demand. In Section III we test the predictions of the model with the vector autoregression methodology. First, we show that shocks to the nominal interest rate or credit to the private sector explain between 16 and 30 percent of the variance of economic activity. Second, our evidence supports the contention that the principal source of variations in credit is changes in the nominal interest rate. The conclusions are presented in Section IV.

II. THE MODEL

This section extends the credit channel model of Bernanke and Blinder (1988) to an open economy with predetermined exchange rates. We model a financially backward economy where there are three assets: money, bonds, and loans. Unlike the

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[1] The closed economy version is in Bernanke and Blinder (1988).

typical IS-LM model, we abandon the perfect substitutability assumption between bonds and "loans"; we also discuss the effects of credit rationing. In this economy, there are two types of firms, those who are able to finance their needs issuing bonds and shares in the open market, and an important fraction of firms who borrow from the banking system. For the latter type of firms, we assume that their demand for credit is a function of their desired investment which depends on the interest rate on loans and the level of activity (y). If ρ is the interest rate on loans, the demand for credit is:

$$\underset{(-)\ (+)}{L(\rho - \dot{e}, y)} \qquad (1)$$

Assuming purchasing power parity (PPP) means that expected inflation (π) is equal to the expectations of devaluation, $\dot{e}$; therefore ρ-$\dot{e}$ is the real interest rate on loans faced by these firms.

Loan supply will be determined by the balance sheets of banks. Banks finance themselves from deposits, and total deposits in the banking sector are:

$$\frac{D}{P} = m\frac{M}{P}(i, y) \qquad (2)$$

where m is the ratio of deposits to money which we assume is constant, i is the nominal interest rate in pesos, and M/P is real money balances. Assuming perfect capital mobility implies that uncovered interest parity (UIP) will hold so that, $i=i^{*}+\dot{e}$, where i^{*} is the foreign interest rate on bonds, for example the U.S. T-bill rate.

The quantity of loans in the economy will be supply determined, and the interest on loans will be determined in the credit market. Equilibrium in the loan market implies:

$$L(\rho-\dot{e},y)=m\frac{M}{P}(i,y)(1-\tau) \qquad (3)$$

where τ is the required reserve ratio. From equation (3) we can solve for the equilibrium level of $\rho-\dot{e}$. As we stated before, the quantity of loans is supplied determined. Therefore, total loans will be a function of i, y, and $m(1-\tau)$.[2]

$$\underset{(-)}{C}(\underset{(-)}{i},\underset{(+)}{y},\underset{(+)}{m(1-\tau)}) \qquad (4)$$

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[2] If there is credit rationing equilibrium in the credit market will be characterized by an excess demand for loans and a rate on loans of $\rho-\dot{e}$, which is lower than the one that makes equation (3) hold with equality. In this case, when the supply of loans changes then the loan rate, ρ, will remain constant, and $C(.)=m(1-\tau)M/P$.

Given that in this economy investment is done by two types of firms, those that react to the interest rate on bonds (i) and other firms whose investment depends on the amount of loans; these two variables will affect aggregate demand.[3] The analog to the IS curve will be:

$$y = Y(i - \dot{e}, C(i,y), G) \tag{5}$$

where G includes all the other sources of demand such as government expenditure, the real exchange rate, etc... The effect of a change in the nominal interest rate on output will be:

$$\frac{dy}{di} = \underset{(-)}{y_i} + \underset{(+)}{y_C}\underset{(-)}{\frac{dC}{di}} < 0 \tag{6}$$

An open economy with a predetermined exchange rate will have an LM curve which is completely elastic at the nominal interest rate $i = i^{*} + \dot{e}$. Figure 1 shows the equilibrium in the goods and money markets.

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[3] The quantity of loans is preferred to the real interest rate on loans because as discussed previously in footnote 2, if there is credit rationing in the economy the real rate on loans might not change and all the action will be captured by the quantity of loans.

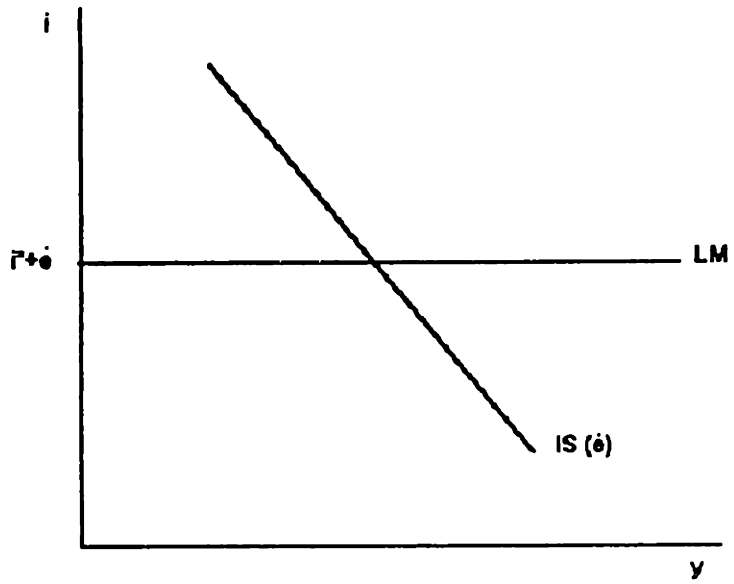

FIGURE 1

II.1: COMPARATIVE STATICS

In this section, we use the model presented above to study two types of shocks which have been particularly important in Mexico. First, we look at the effect on aggregate demand of a fall in the expectations of devaluation. This could be due to a variety of reasons, but a particularly interesting one is due to the implementation of an exchange rate based stabilization plan such as the one which was introduced in Mexico in December 1987. Second, we look at the effect of an

increase in the deposit to money ratio due to financial deregulation.

A fall in the expectations of devaluation will, given i^*, translate one for one into a fall in the nominal interest rate i. This means that the LM curve will shift by the amount $\Delta\dot{e}$. The IS curve, however, will shift downwards and to the left by less than $\Delta\dot{e}$. To see this we totally differentiate equation (5) which is the IS curve.

$$dy = Y_i(di - d\dot{e}) + Y_C(C_i di + C_y dy) \qquad (7)$$

setting dy=0 and solving for di, we get

$$di = [\frac{Y_i}{Y_i + Y_C C_i}]\, d\dot{e} \qquad (8)$$

Equation (8) shows that keeping output constant, the change in the nominal interest rate needed to equilibrate the goods market is smaller that the change in the expected devaluation (since $Y_i/Y_i+Y_CC_i < 1$). Since the LM curve will shift down by more than the IS curve, output will actually increase, as Figure 2 shows.

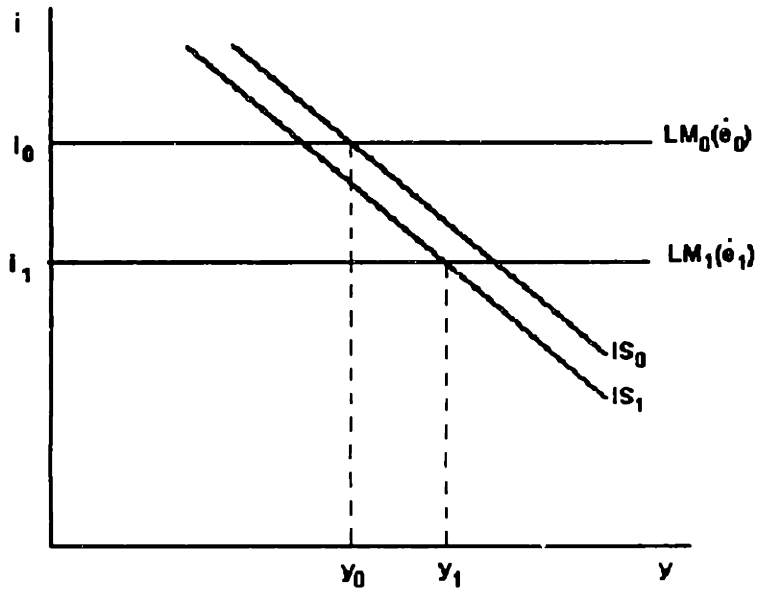

FIGURE 2

where $i_0=i^*+\dot{e}_0$ and $i_1=i^*+\dot{e}_1$ and $\dot{e}_1<\dot{e}_0$. This outcome differs from the one which would result in a model without a credit channel. In an economy where all firms can borrow at i, $Y_C=0$, so di=dė and output will not change! We think this model helps to clarify the difference of opinion between those who claim that the reduction in nominal interest rates is expansicnary, and those who think that given that this reduction in the nominal interest rate is driven by a fall in the expectations of devaluation, it should not have any <u>real</u> effects aside from the increase in the real quantity of money.

Finally, we look at the effect of a different type of shock, one brought on by financial deregulation. This type of shock is particularly relevant for the case of Mexico where starting in 1988, a series of steps where taken to deregulate financial markets and to privatize the banking system. Financial deregulation would lead to an increase in m, the ratio of deposits to money, that individuals want to hold. From equation (3), we see that when $m(1-\tau)$ increases, then for any nominal interest rate i, the quantity of loans will rise. This will shift the IS curve to the right as in Figure 3. Given a horizontal LM curve at $i=i^{*}+\dot{e}$ this shift in the IS curve will imply an expansion in output.[4]

[4] If the shock was due to a decline in the reserve coefficient τ, the results are exactly the same.

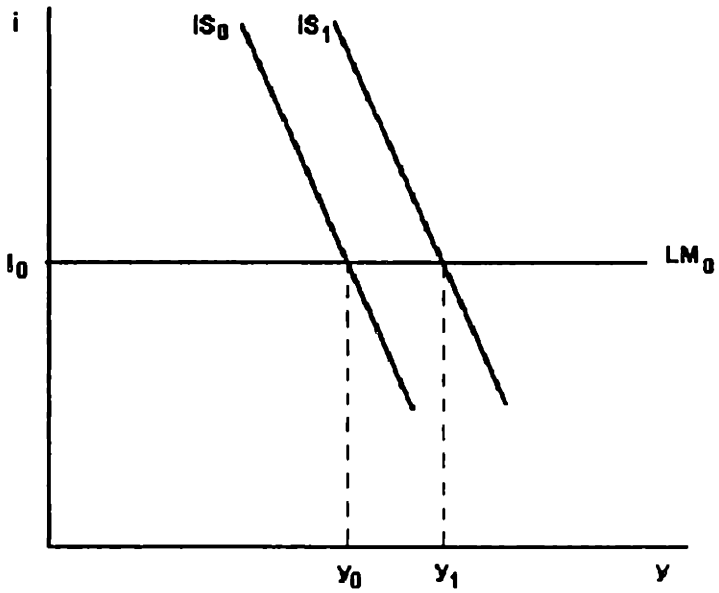

FIGURE 3

In summary, this model presents the following empirical implications which are absent in an open economy IS-LM model without a credit channel.

i) Changes in the expectations of a devaluation have real effects because they change the quantity of loans in the economy. If there is credit rationing the interest rate on loans might not change.

ii) Changes in the desired cash/deposit ratio and/or the reserve requirement also have real effects when we include a credit channel.

iii) Other measures of financial deregulation that permit banks to have additional sources of financing will also have real effects.

III. EMPIRICAL RESULTS

The model developed in the previous section highlights some interesting results. In this section, we evaluate the empirical evidence for the credit hypothesis in Mexico from 1984 to 1993. Previous studies for the U.S. economy, particularly by King (1985) find that the evidence runs contrary to the credit view. He uses standard VAR techniques to show that credit, which he measures as commercial and industrial loans by commercial banks, has little predictive power for GNP.

Although this evidence seemed particularly damaging, Bernanke(1986) and Bernanke and Blinder (1989) show that using a structural VAR improves the importance of credit significantly.

Our approach is to test our model's predictions by a standard VAR analysis to show that the credit view is quite important for Mexico. In order to determine whether each of our "credit" measures is an important predictor of economic activity, we ran a series of VARs with four variables. Each VAR contains one measure of economic activity (industrial production or investment), the real exchange rate, the real

interest rate, and one of the "credit" measures (the nominal interest rate, the real volume of credit to the private sector, or real balances). Our results show that both the volume of credit and the nominal interest rate contain predictive power for economic activity while real money balances do not.

This result poses the question of whether all the shocks to credit are due to changes (contemporaneous and past) in the nominal interest rate, or whether they are exogenous. To answer this question we estimated a set of VARs that include both the nominal interest rate and the volume of credit together. Our results indicate that shocks to credit are mostly due to changes in the nominal interest rate.

III.1 REDUCED FORM EVIDENCE

The model of Section II, shows us that changes in the expectations of devaluation and financial regulation can affect aggregate demand through a credit channel. It is well known that monetary aggregates aid in the prediction of the future behaviour of output. Our first step in examining the credit view for the case of Mexico is to see whether credit is also a good reduced form predictor for economic activity.

We use as our measure of credit, total loans to the non-financial private sector given by commercial and development

banks. In addition, the model suggests that there are two variables which affect aggregate demand through their effect on the quantity of credit in the economy. These are changes in the nominal interest rate, which are negatively related to the quantity of credit, and changes in real money balances which are positively related. We use two separate measures of economic activity. One is an index of industrial production, and the other is an index of gross fixed investment. The data are monthly from 1984:01 to 1993:06. All the variables are seasonally adjusted and in logs with the exception of the interest rates. The following is a list of all the variables used. [5]

1) CETE is the nominal interest rate
2) CRED is the real quantity of credit. (see text)
3) M1 is real money balances
4) CPP is the real interest rate
5) RER is the real exchange rate
6) IP is an index of real industrial production
7) INV is an index of real gross fixed investment.

We ran a series of Granger Causality tests to see whether our "credit" variables (i.e. CETE, CRED, and M1) contain information about the behaviour of our economic activity

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[5] CETE is the rate on 30 day Mexican Treasure Bills in pesos. CPP is the average cost of funds + 5% - π_t. CRED is as described in the text. All the data are from the Banco de Mexico.

measures (i.e. IP and INV). Table 1 contains marginal significance levels for the test that 12 lags of CETE, CRED, or M1 significantly aid prediction of the output measure after controlling for a constant and 12 lagged values of the output variable itself. Each row of the table represents an equation that forecasts some measure of economic activity by 12 lags of itself, 12 lags of the real interest rate (CPP), 12 lags of the real exchange rate (RER), and 12 lags of each of the "credit" variables in turn.[6]

TABLE 1: GRANGER-CAUSALITY TESTS

Economic Activity Measure	CPP	RER	CETE	CRED	M1
IP	.52	.002	.23	---	---
IP	.31	.02	---	.06	---
IP	.44	.12	---	---	.85
INV	.09	.003	.04	---	---
INV	.16	.03	---	.07	---
INV	.43	.10	---	---	.73

[6] This lag length was chosen by running F-tests for omitted lags with 6, 7, and 8 lags.

Each entry in the table shows the marginal significance levels for the hypothesis that all lags of the column variable can be excluded from the equation predicting a real variable. Therefore, a small value indicates that the column variable is important for predicting the row variable. The results of Table 1 show that credit "Granger causes" both industrial production and investment at the .10 level. The nominal interest rate is more important in the prediction of investment, where it is significant at the .05 level, but it is not significant for industrial production. It is interesting to note that the real exchange rate is very important for both output and investment, especially since this is a variable which experienced wide swings during this time period in Mexico.

Credit is always a superior predictor than the real interest rate, which is usually insignificant.[7] This shows quite clearly that there is an additional channel for the transmission of monetary policy.[8]

Granger-Causality tests are not necessarily the best way to assess "predictive power," since the right hand variables are not orthogonal. To address this issue, we estimate some vector autoregressions (VARs) with orthogonalized residuals in

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[7] The one exception is for investment when the nominal interest rate is used.

[8] The results do not vary much if the data is in log levels or log differences, or for non-seasonally adjusted data.

order to capture the joint time series behavior of these series. The percentage of the variance of the forecasted variable attributable to alternative right-hand side variables at different horizons gives a better way of measuring predictive power. Each VAR contains one of the measures of economic activity (IP or INV), one of the "credit" variables (CETE, CRED, or M1), and both the real exchange rate and the real interest rate. Each equation was estimated using a constant and 12 lags of each variable.

We estimated the VARs using a standard approach, that is one that uses the Cholesky decomposition to orthogonalize the residuals.[9] The variance decomposition results for each four variable VAR are presented in Table 2. Each entry in the table is the percentage of the variance of the row variable attributable to each of the column variables at a 12, 24, and 36 month horizon. The results presented are for the ordering listed in the table, however, the results for two other orderings (Y-CPP-X-RER, and Y-X-CPP-RER) were almost identical.[10] This suggests that for most variables the information contained in the policy variable is nearly orthogonal to the information in the other forecasting variables. We believe this model to be the correct structural

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[9] A VAR with a structural model for the residuals gives almost identical results, therefore they are not included here.

[10] Y refers to either IP or INV, and X refers to CETE, CRED, or M1.

one for the innovations. This is because in a small open economy with perfect capital mobility, the domestic real interest rate differs from the foreign interest rate by the expected real appreciation (see Dornbusch (1983)). Therefore, in our model the real exchange rate should be before the real interest rate in the ordering. Finally, we handicap the predictive power of our "credit" variables by placing them last in the ordering.

TABLE 2: 4 VARIABLE VAR VARIANCE DECOMPOSITIONS OF ECONOMIC ACTIVITY

Economic Activity Measure (Y) [a]	IP OR INV	RER	CPP	CETE	CRED	M1
1.IP/12	59.3	5.12	12.7	22.8	---	---
2.IP/24	51.5	5.85	21.0	21.7	---	---
3.IP/36	53.9	7.10	19.3	19.7	---	---
4.INV/12	55.5	5.24	21.9	17.4	---	---
5.INV/24	28.3	7.85	47.2	16.7	---	---
6.INV/36	27.6	11.7	44.2	16.5	---	---
7.IP/12	67.0	9.95	6.19	---	16.9	---
8.IP/24	61.0	9.38	9.45	---	20.2	---
9.IP/36	62.3	9.56	9.48	---	18.6	---
10.INV/12	60.5	10.4	2.69	---	26.4	---
11.INV/24	50.1	12.4	7.37	---	30.1	---
12.INV/36	51.9	13.3	7.31	---	27.5	---
13.IP/12	73.1	14.7	6.57	---	---	5.6
14.IP/24	75.4	12.4	7.21	---	---	5.0
15.IP/36	77.4	10.2	6.81	---	---	5.6
16.INV/12	66.9	15.9	15.8	---	---	1.4
17.INV/24	64.4	11.3	22.5	---	---	1.8
18.INV/36	65.0	8.51	24.6	---	---	1.9

a: The numbers following the / refer to the horizon (i.e. 12 is 12 months ahead). Entries show the percentage of forecast variance of (Y) at different horizons attributable to innovations in column variables. Ordering is as shown.

The results in Table 2 are quite favorable to the credit hypothesis. Rows 1-6 show that innovations to the nominal interest rate explain a substantial fraction of the variations

in industrial production (almost 23%), and a bit less but still important fraction of the variations in investment. Rows 7-12 show that credit explains a large percentage of the investment (30%) and industrial production (20%) variations. On the other hand, M1 does not explain much of the variation in either industrial production or investment.

It is interesting to note, that just as with the Granger Causality tests before, the real exchange rate always explains a substantial portion of the variations in both output and investment. The real interest rate, contrary to the Granger Causality test results now plays a significant role in explaining the variations in both output and investment.

The following set of figures show the dynamic response of all the variables in the VAR to a unit shock in the estimated equations associated with the credit variables (CETE,CRED,and M1) in Table 2.[11] In the impulse response functions shown in Figures 4A and 4B, positive shocks to the nominal interest rate (i) are seen to have a large negative effect on output, particularly during the first year, and reach a trough in the ninth month. As expected, a shock to the nominal interest rate (due to an increase in the expectations of devaluation) will decrease the amount of credit in the economy, and

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[11] The impulse response functions for Investment are identical throughout, therefore we present the graphs for industrial production only. The contemporaneous month is number 1.

therefore should reduce output. As aggregate demand falls, the prices of nontradeables decrease and this will create a real depreciation. This is evident in Figure 4B. It is interesting to note that a shock to the nominal interest rate has an immediate effect on the real interest rate which dies out very quickly.

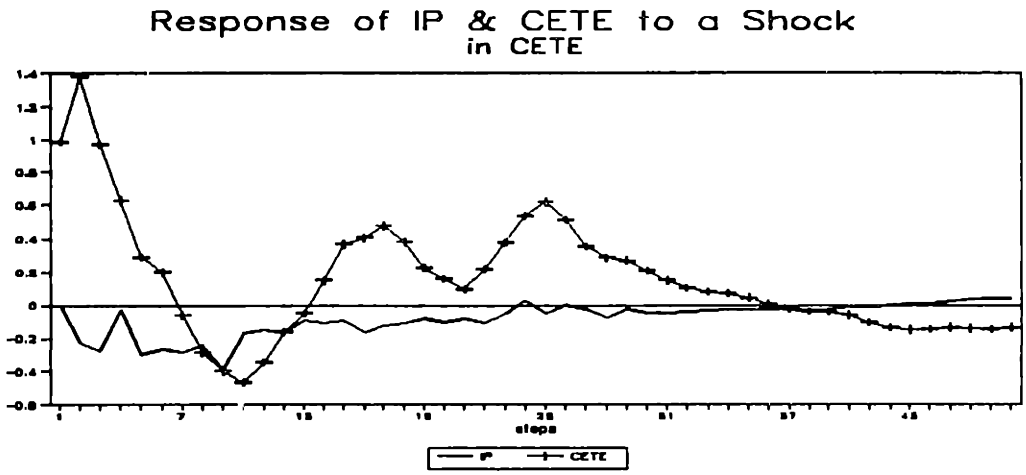

FIGURE 4A

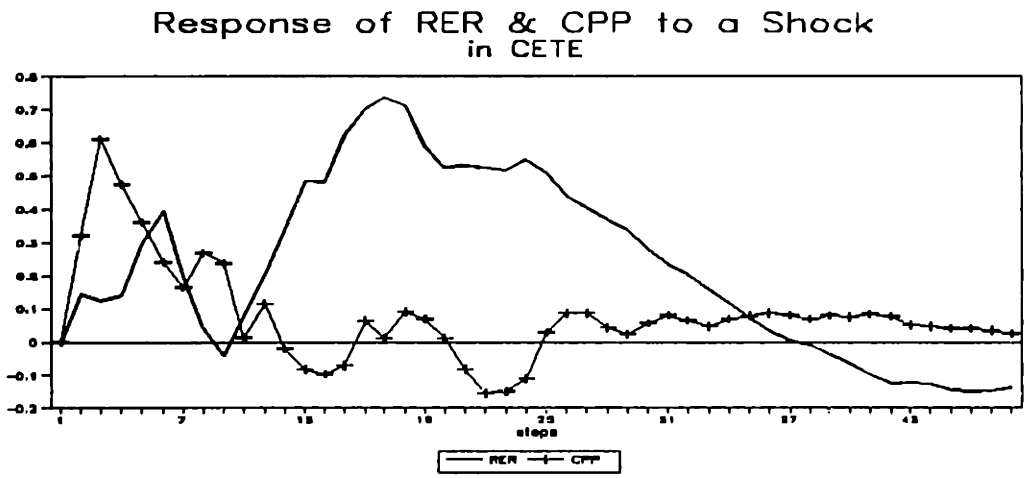

FIGURE 4B

Figures 5A and 5B show the impulse response functions for a shock to credit. Credit has a strong initial impact on industrial production and the effect is still present after 4 years. Once again, a shock to credit affects the real exchange rate in the anticipated manner showing a large initial appreciation (since the prices of nontradeables will increase in this case) for approximately one year and then a gradual depreciation as Figure 5B shows.

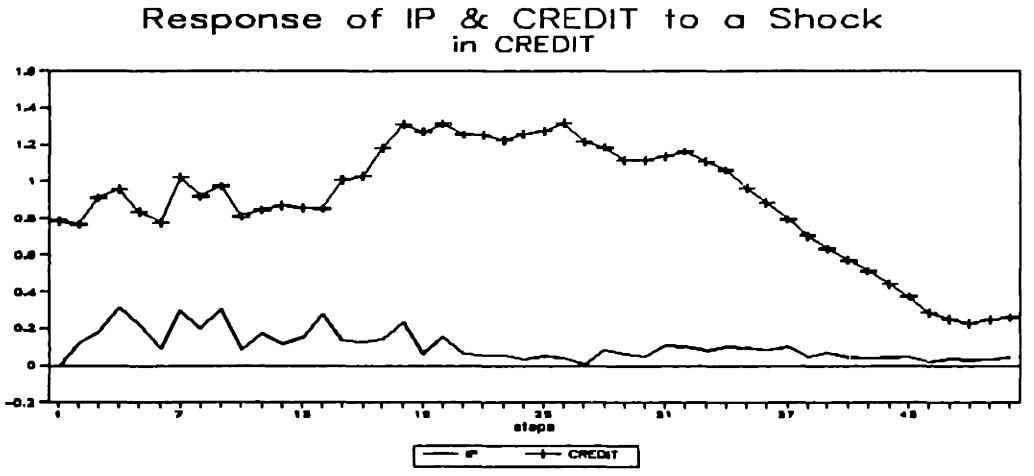

FIGURE 5A

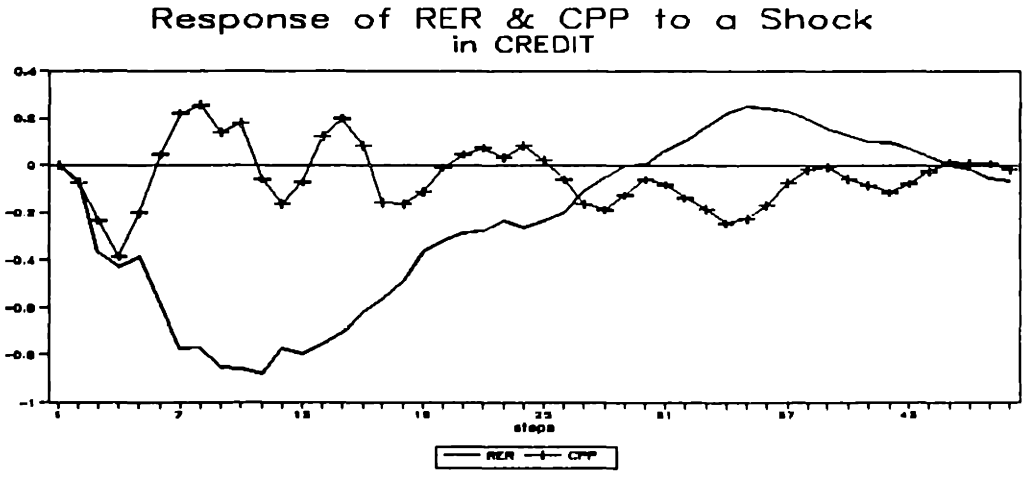

FIGURE 5B

Figures 6A and 6B show a similar pattern for a shock to M1. A shock to M1 (which increases credit) has a small positive effect on output. However, a shock to M1 seems to have the opposite effect on the real exchange rate; here it depreciates when it should (according to the model presented in section II) appreciate.

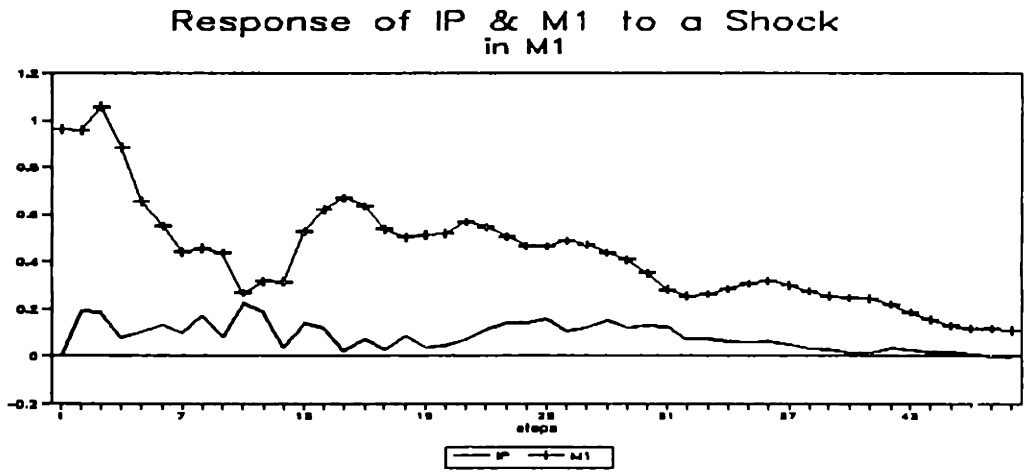

FIGURE 6A

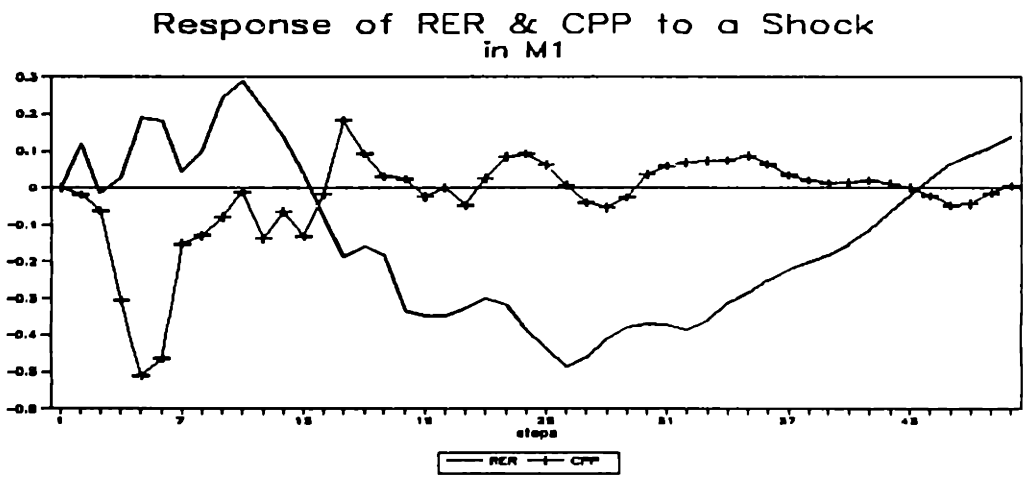

FIGURE 6B

In general, we find that credit and the nominal interest rate can explain between 16 and 30 percent of the forecast variance of output or investment. In particular, we show that credit and the nominal interest rate always dominate M1. Although this is particularly encouraging because the results do not depend on the ordering, it does not tell us whether the principal source of the shocks to credit are exogenous or induced by changes in the nominal interest rate. To determine this we estimated a new set of VARs which include both the nominal interest rate and credit. [12]

Table 3 shows the variance decompositions for both the VAR with industrial production and the one with investment. The results show that once we account for nominal interest rate innovations, exogenous shocks to credit are not very important for predicting the variation in either output or investment. These results are invariant to placing credit before the nominal interest rate in the ordering.

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[12] Granger Causality tests which include these two variables show that credit and the real exchange rate "Granger cause" output at the 6% level. On the other hand, only the real exchange rate is significant for investment (at the 3% level). The strong multicolinearity between credit and the nominal interest rate may explain the insignificance of the latter.

TABLE 3:5 VARIABLE VAR VARIANCE DECOMPOSITIONS OF ECONOMIC ACTIVITY

Economic Activity Measure (Y) [a]	IP OR INV	RER	CPP	CETE	CRED
1.IP/12	57.5	7.70	11.2	18.8	4.76
2.IP/24	52.4	6.36	12.6	22.6	6.05
3.IP/36	51.6	6.30	10.9	25.6	5.57
4. INV/12	53.5	5.57	22.2	16.2	2.49
5. INV/24	30.5	6.69	33.1	26.1	3.62
6. INV/36	24.8	10.7	28.0	31.1	5.45

a: The numbers following the / refer to the horizon as in Table 2. Entries show the percentage of forecast variance of (Y) at different horizons attributable to innovations in column variables. Order is as shown.

Figures 7A and 7B show the dynamic response of all the variables to a unit shock in the nominal interest rate. [13] Figure 7A shows that a positive shock to the nominal interest rate has a negative effect on credit (except for the contemporary period) which increases over time. This response is the one we would expect because banks cannot reduce their stock of credit instantaneously. As Bernanke and Blinder (1989) put it: "Loans are quasi-contractual commitments whose stock is difficult to change quickly." In addition, a shock to the nominal interest rate generates a permanent reduction in output after the fourth month. Figure 7B shows that the real exchange rate depreciates quite sharply following the nominal interest rate shock. The real interest rate does not

[13] The impulse response functions for Investment are exactly the same.

follow any clear pattern, it increases initially and then levels out.

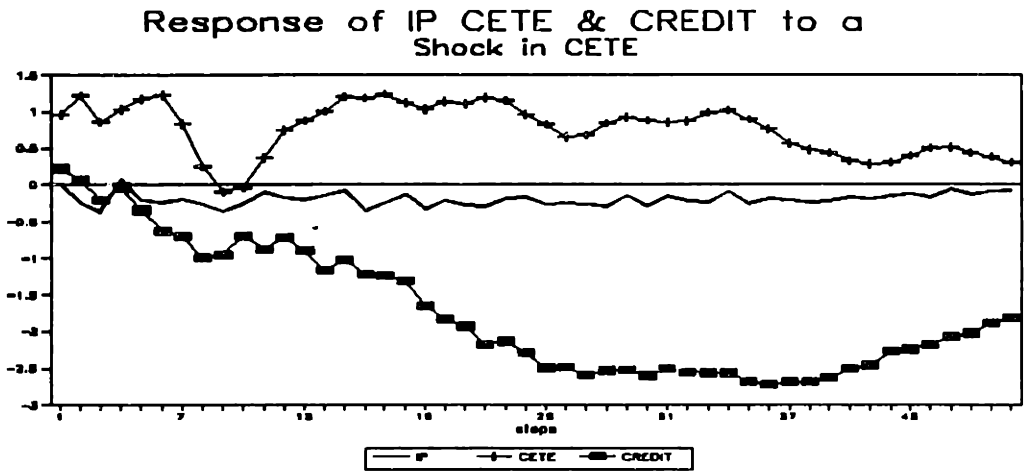

FIGURE 7A

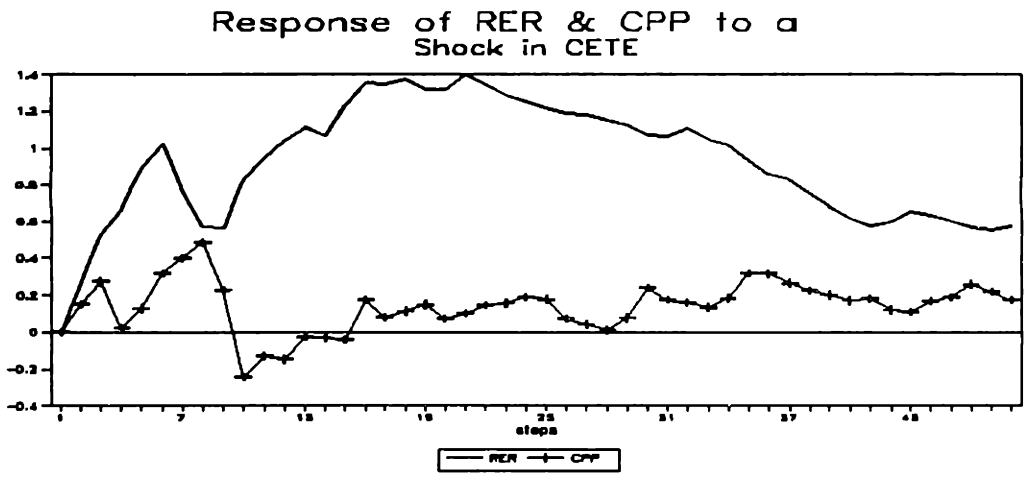

FIGURE 7B

This analysis leads to two important conclusions. First, we find that the credit hypothesis is very important for the case of Mexico. The impact on aggregate demand of credit and

nominal interest rate shocks is of the same magnitude, and sometimes larger, than that of the real interest rate or the real exchange rate. Second, we find that shocks to the nominal interest rate are the principal source of fluctuations in credit as opposed to exogenous shocks to credit . This is in accordance with the fact that financial intermediation increased greatly when nominal interest rates dropped from an average of 96% in 1987 to 15.6% in 1992 (for a description of the Mexican experience see Dornbusch and Werner (1994)).

These empirical results support the conclusions drawn from the model we presented in Section I of the paper. The credit channel is an important one for Mexico. In particular, increases in the quantity of loans in the economy, whether directly or caused by a fall in the expectations of devaluation, have a positive effect on real economic activity.

IV. CONCLUSIONS

Although there have been some theoretical models which include a credit channel for the transmission of monetary policy, the empirical evidence has been mixed. In this paper we first developed a variant of the open economy IS-LM model in which shocks to credit markets have effects on real output. We then tested the model's implications empirically for the Mexican economy during 1984 to 1993.

The model we present has the following empirical implications which are absent from the standard open economy IS-LM model. The first is that changes in the expectations of devaluations (which translate one for one to changes in the nominal interest rate), have real effects because they change the quantity of credit available in the economy. Secondly, changes in the desired cash/deposit ratio or the reserve requirement will also have real effects. Finally, we find that other measures of financial deregulation which allow banks to have additional sources of financing will also have real effects. These implications are particularly interesting for Mexico where an exchange rate based stabilization plan lowered expectations of devaluation, and financial deregulation has been progressive.

The empirical evidence strongly supports the credit view. We find that the impact on aggregate demand of credit and nominal interest rate shocks is of the same magnitude, and sometimes larger, than that of the real exchange rate and the real interest rate. In addition, the results show that changes in the nominal interest rate are the principal source of changes in credit.

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CHAPTER 4

FINANCIAL INNOVATION AND THE SPEED OF ADJUSTMENT OF MONEY DEMAND: EVIDENCE FROM BOLIVIA, ISRAEL, AND VENEZUELA

I. INTRODUCTION

Empirical studies of the demand for money have flourished in recent years. The reason for this large volume of literature can be explained by the importance of money demand in monetary policy. The income and interest elasticities of money demand are at the core of the most basic macroeconomic models such as the IS-LM, where the effectiveness of monetary policy (that is, its ability to affect the real side of the economy) depends on the elasticity of money demand. It is very important therefore, to find consistent estimates of these elasticities.

Following the seminal papers by Goldfeld (1973,1976) a large number of papers for both developed and less developed countries have shown that there have been periods of "missing money" that is, there is consistent overprediction of real balances. This has led to the conclusion that the money demand function is basically unstable.

Two principal explanations have been used to account for this instability of money demand. One is financial innovation and the other is currency substitution. Throughout the 1980's changes in financial markets have been very widespread, and have been particularly important in Bolivia, Israel, and Venezuela. All three of these countries suffered high inflations during the 1980's; two of them, Bolivia and Israel, were actually hyperinflations. In the mid to late 1980's

Bolivia, Israel, and Venezuela embarked on stabilization programs designed to halt inflation.

The purpose of this study is to show that financial innovation leads to a faster speed of adjustment of money demand to its determinants, as well as to the instability of the observed demand for real balances. This is an aspect of the money demand literature which has hardly been explored, in particular in terms of the new cointegration methods. For Israel, Melnick (1991) shows that ignoring financial innovation is the principal cause for the lack of stability in the money demand equation. I will show that the long run demand for real balances not only shifted down, but that in the short run the effect of financial innovation has been to increase the speed with which people adjust their actual money holdings to their desired money holdings.

Recent developments in econometric theory by Engle and Granger (1987) have shown that the traditional method of partial adjustment to estimate the demand for money will lead to misspecification and incorrect conclusions. Typically, the fact that the variables used in the estimation are non stationary is ignored. Ignoring the stochastic properties of real money balances, the transactions variable, and the opportunity cost variable can lead to OLS regression results which are statistically invalid. For this reason, I will use the cointegration approach to estimate the demand for money for Bolivia, Israel, and Venezuela.

The remainder of the paper is structured as follows. Section II presents the model which provides the theoretical foundations for the empirical section. I use the Miller-Orr (1966) model of money demand and show that a decline in the transactions cost (which is a proxy for financial innovation), leads to a faster adjustment of money demand to its determinants. Section III provides a brief description of the events in Bolivia, Israel, and Venezuela. Section IV presents the cointegration methodology. In Section V I estimate the long run demand for money in all three countries using the cointegration methods of the previous section. In this section I also test for the stability of the demand for real balances and allow for both a one time shift and a change in the slope. In Section VI the short run demand for money is estimated as an error correction model and the change in the speed of adjustment is demonstrated. Section VII concludes.

II. THE MODEL

The long run money demand function is represented in terms of the Miller-Orr (1966) model. The model is a transactions demand for money where the decision maker can hold two types of assets, 1) money which does not earn any interest and 2) a "bond" or other earning asset which pays interest at a rate i per dollar per day. In what follows I will use the inflation rate, π_t , as the relevant opportunity cost, since in all the

three countries in the study interest rates were fixed for a large part of the sample.

The firm faces a stochastic cash flow that can be characterized by a sequence of t independent Bernoulli trials per day. In each trial cash balances can go up by x with probability p or can go down by x with probability q=1-p; where x is the "step size." Transfers of funds between the two assets can be made instantly at cost b. This is a cost which is incurred per transaction and is independent of the size of the transaction. A reduction in b decreases the cost of transactions and therefore, I will associate it with financial innovation as in previous studies. Finally, the minimum level of money holdings is normalized to zero.

The time path of cash holdings will evolve as in Figure 1, where h is the maximum holdings of cash that the individual will ever have, and z is the level to which balances are restored after a transfer. The optimal desired level of cash holdings can be derived by minimizing the total expected daily cost of this Ss policy given the two parameters h and z.[1]

The solution to this problem is an optimal level of cash holdings given by

$$m_t^* = \frac{h^* + z^*}{3} = \frac{4}{3}\left[\frac{3b}{4\pi}\, x^2 t\right]^{1/3} \qquad (1)$$

[1]See Miller and Orr (1966) pages 420-423 for the methodology and derivation of equations (1) and (2).

where

$$z^{\bullet} = \left[\frac{3\ b\ x^2\ t}{4\ \pi}\right]^{1/3} \quad , \quad h^{\bullet} = 3z^{\bullet} \qquad (2)$$

and where $m_t^{\bullet}$ denotes the optimal desired stock of real money balances and π_t is the inflation rate which is a proxy for the opportunity cost. Equation (2) gives the optimal upper bound as a function of the optimal return point. With this equation for the optimal level of cash balances in mind, we now proceed to determine the effects of financial innovation on both the speed of adjustment and the level of optimal money holdings.

In this context, financial innovation is proxied as a decline in the transactions costs, b. A lower transactions cost implies a lower real cost of transforming financial assets into money. Holding all else constant, this implies that financial innovation induces a reduction in the desired quantity of real money balances that are held. One can actually think of b as also including effects associated with the introduction of more instruments at the time of the financial liberalization which can be used to avoid holding more cash balances.

Equation (2) shows that a reduction in b will decrease $h^{\bullet}$ and $z^{\bullet}$, narrowing the band of inaction of Figure 1; while equation (1) shows that $m^{\bullet}$ also declines. The idea is that when transactions costs decline, an individual will wait less time to adjust their money balances when they are out of

equilibrium. Therefore, as agents adjust sooner than before, the speed of adjustment of desired money holdings in the economy as a whole increases.

Next, we take a brief look at the financial liberalization episodes that took place in each country.

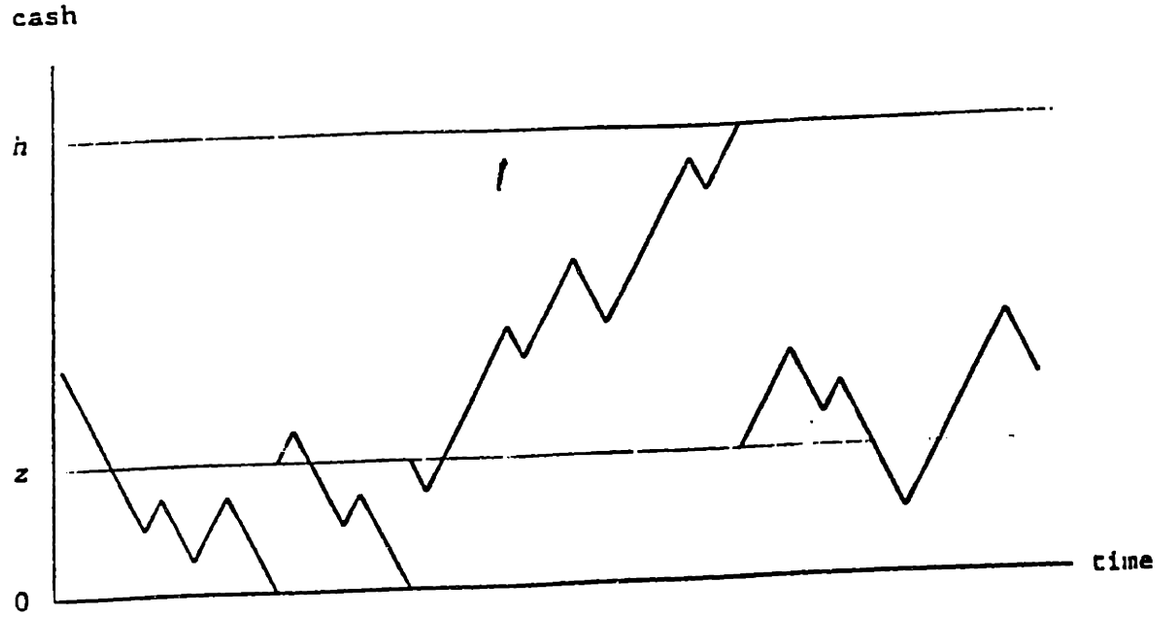

FIGURE 1

III. A LOOK AT BOLIVIA, ISRAEL, AND VENEZUELA.

III.1 BOLIVIA

During 1984-1985, Bolivia experienced the highest inflation rate of Latin America and one of the highest in world history. Using Cagan's (1959) definition of a hyperinflation, that is 50% a month or higher, Sachs (1986) places Bolivia's hyperinflation as the seventh highest of the twentieth century. During approximately the year and a half which the hyperinflation lasted, the average monthly inflation rate reached 46%. In response to this, the Bolivian government introduced a stabilization program in late August of 1985. The hyperinflation quickly subsided and over the past few years has remained both low and fairly stable. This program was introduced in conjunction with an extensive liberalization of all markets, and financial markets in particular.

Morales (1988) describes the vast financial liberalization which was introduced in Bolivia. All interest rate ceilings were eliminated and capital market restrictions were also eliminated. Banks were allowed to operate in international trade and capital account transactions without restrictions. In addition, depositors were allowed to open dollar and dollar indexed accounts and banks could make loans in dollars or indexed to the dollar as well as any local currency loan they

deemed valuable. These dollar accounts have lower reserve requirements than other accounts.

The effect of this financial liberalization was to expand the definition of M2, of which the deposits in dollars were the principal component. Short term dollar deposits and those indexed to the dollar increased dramatically, from less than $28 million in September of 1985 to $270 million in March of 1987. The large shift in people's portfolios was mostly due to the very high interest rates that were observed during this time, not only in pesos, but in dollars as well. Interest rates reached 32% in September 1985 and remained high for some time. Table 1 shows that dollar deposits reached about 78% of total commercial bank deposits in 1989, up from less than 30% prior to the deregulation. Even after the hyperinflation ended, the demand for real balances never returned to its previous level (see Figure 2), which is further evidence for the hypothesis that financial innovation caused the decline in real balances.

TABLE 1. BOLIVIA: Dollarized Deposits and Interest Rates

	1986	1987	1988	1989
1.Dollarized Deposits (% of total commercial bank dep.)	45.5	67.5	73.4	78.0
2. Interest Rates annual nominal rate for dollarized dep.	14.3	15.6	15.5	14.7

Source: Morales (1991)

BOLIVIA: INFLATION AND REAL M1

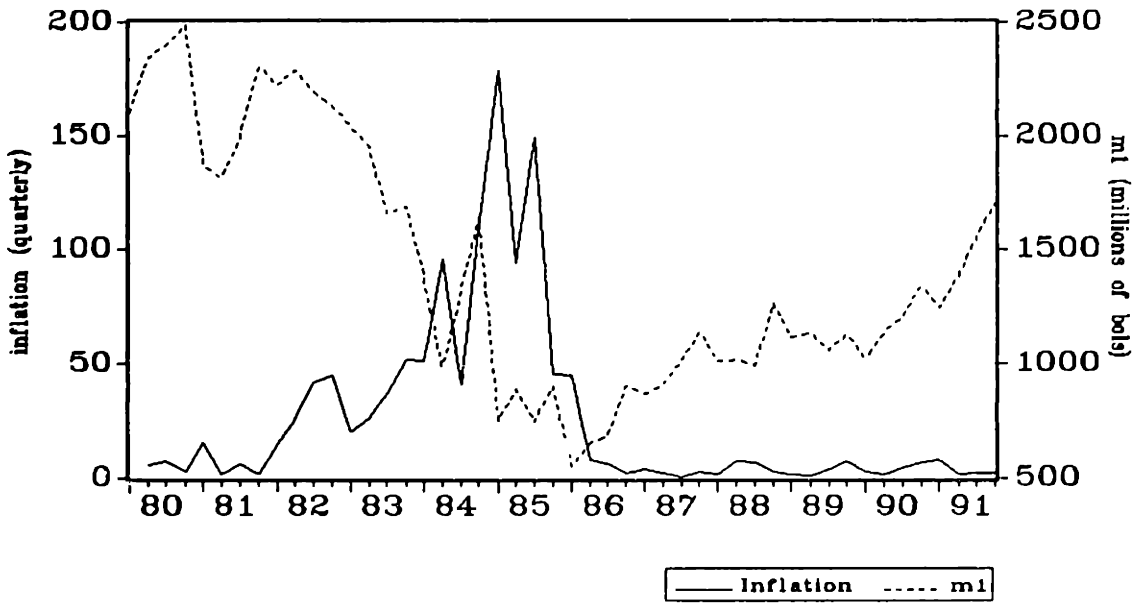

FIGURE 2A

BOLIVIA: REAL M1 TO GDP RATIO

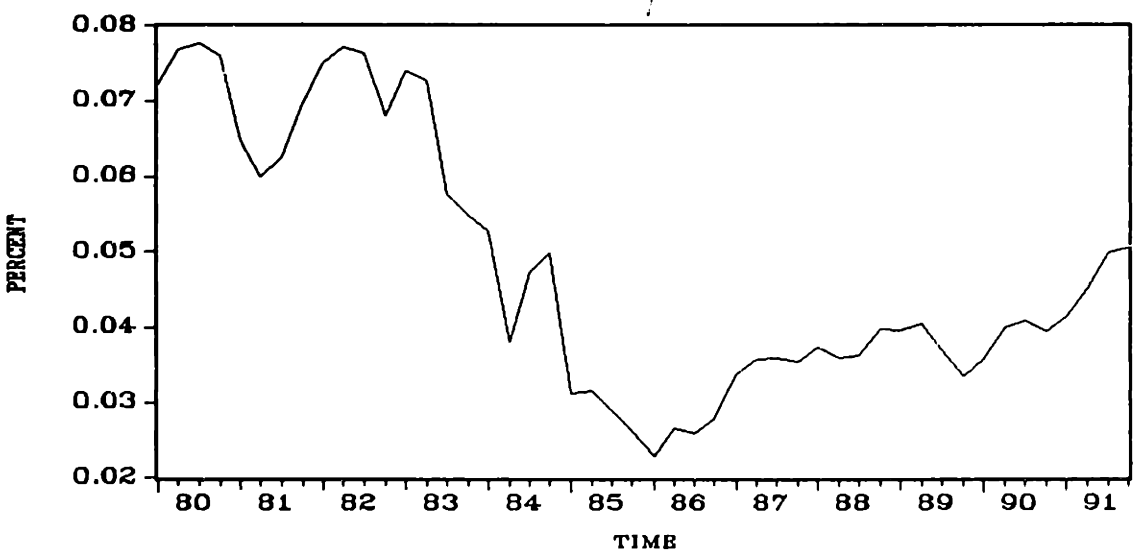

FIGURE 2B

III.2 ISRAEL

In July of 1985, Israel introduced a stabilization program which was extremely successful in ending the hyperinflation. Unlike the Bolivian case, Israel did not immediately adopt all capital market reforms. The drop in real balances experienced by Israel occurred in the beginning of 1987 in conjunction with the adoption of several large and important financial market reforms.[2]

Previous studies of money demand in Israel (see for example Melnick (1991) and Ben-Bassat and Marom (1988)) have found a shift in the demand for real balances after the 1976 financial liberalization, however, most studies have not looked at the period after 1983. Figure 3 shows that real balances in the late 1980's were lower than in the early 1970's, even though inflation was down to the same levels and GDP was higher.

During the last quarter of 1986, Israel began a process of financial liberalization. The liberalization has taken the form of a unification and a reduction of mandatory liquidity ratios. Most importantly, in April of 1987 non financial firms were given full freedom to issue bonds. In addition, limitations on foreign-exchange linked credit were relaxed.

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[2]In mid 1985, there was a change in the regulations designed to actually increase money demand, however, it was not successful as can be seen in Figure 3 and documented in Ben-Bassat (1988).

In essence, the government's role in financial markets was severely reduced (Ben-Bassat 1988). This led to a narrowing of interest rate gaps in the capital market and a decrease in the average rate on government bonds. Since the deregulation and the stabilization program, new financial instruments have been a big part of Israel's money market, which have led to the decline in desired money holdings.

ISRAEL: INFLATION AND REAL BALANCES

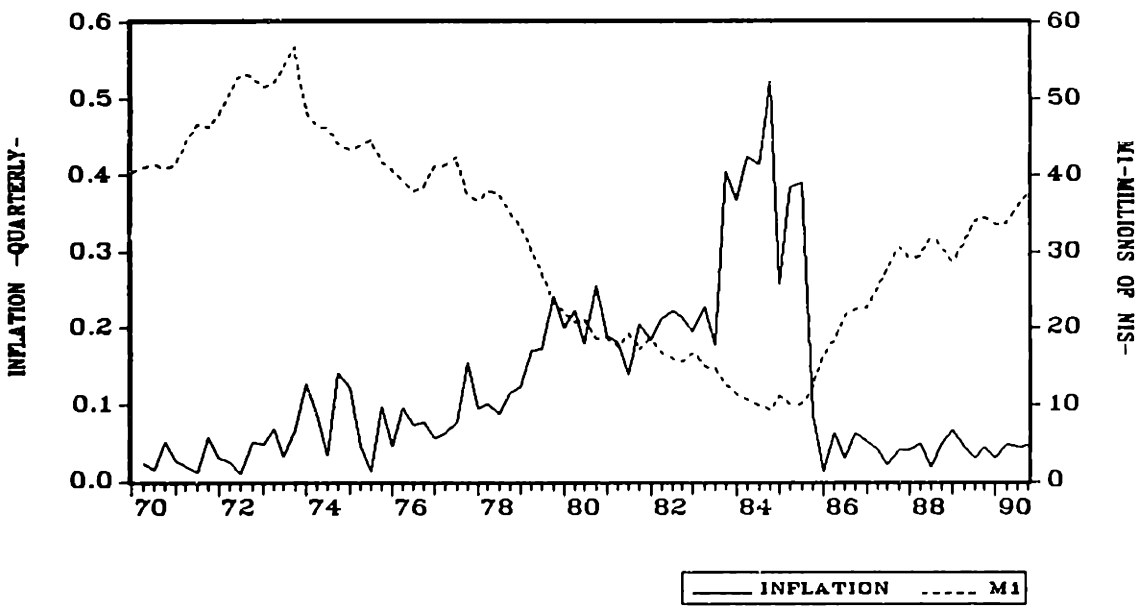

FIGURE 3A

ISRAEL: REAL M1 TO GDP RATIO

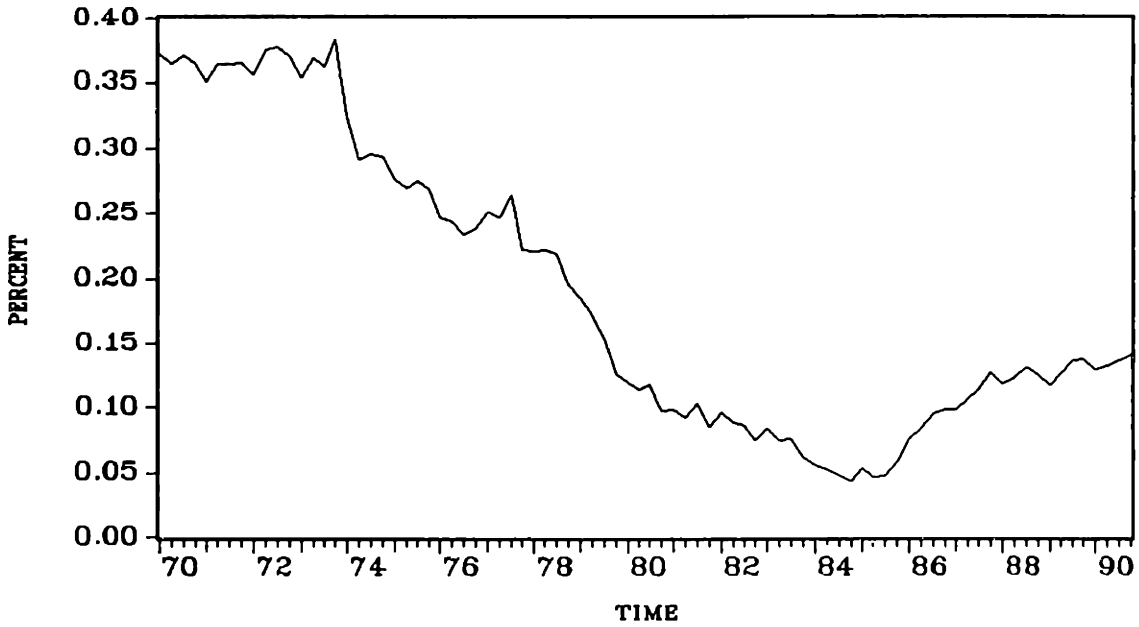

FIGURE 3B

III.3 VENEZUELA

In 1989 Venezuela experienced a sharp drop in real money balances that cannot be accounted for with the traditional set of explanatory variables. Figure 4 shows real money balances and inflation during this period. The drop in money demand coincides with the beginning of a financial liberalization package introduced in 1989 along with the stabilization program which floated the exchange rate and removed all capital restrictions and access to the foreign exchange market.

VENEZUELA: INFLATION AND REAL M1

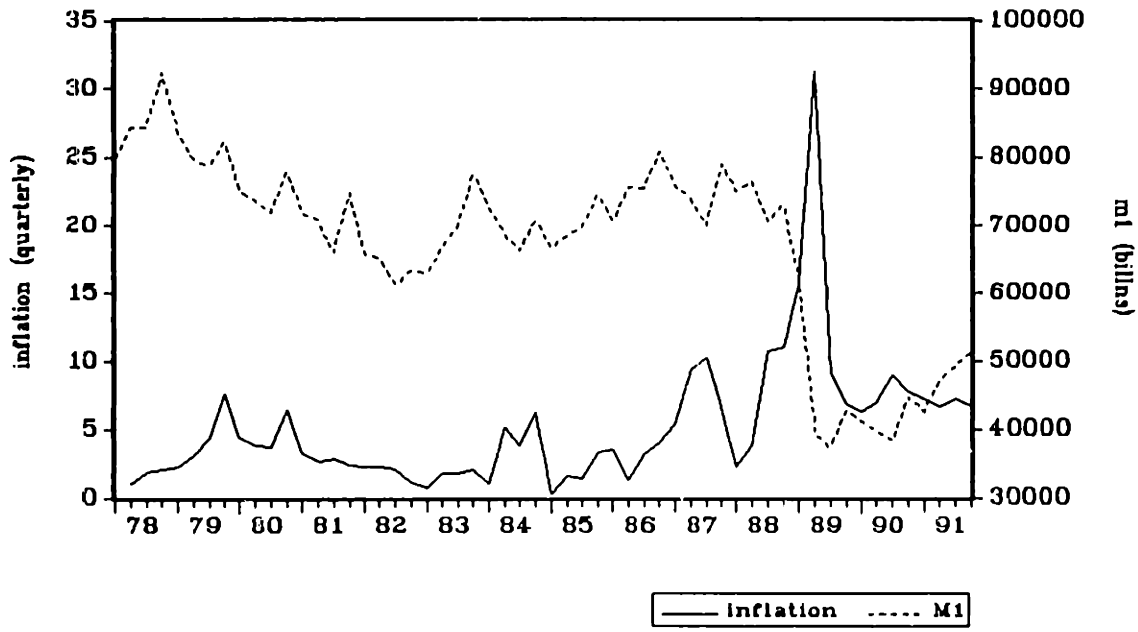

FIGURE 4A

VENEZUELA: REAL M1 TO GDP RATIO

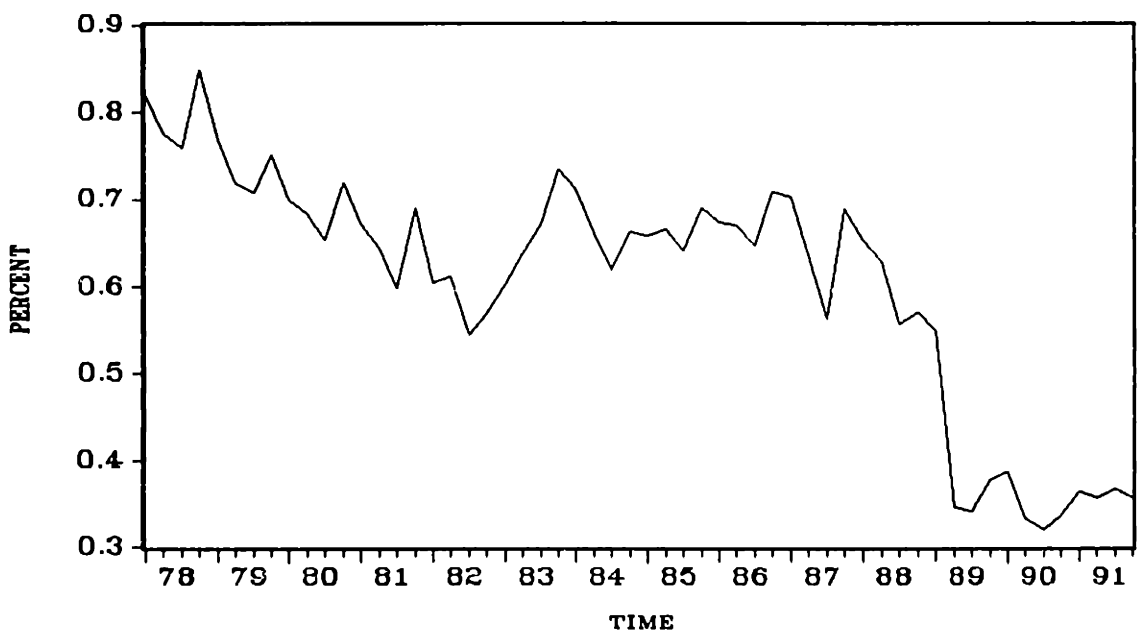

FIGURE 4B

Restrictions on nominal interest rates were lifted, new types of financial instruments such as savings and time deposit accounts, and new Central Bank bonds called "Bonos Zero Coupon" (or zero-coupon bonds) were introduced. The latter accounted for 55.7%, in 1990, of total flows in the gross flow of transactions in the stock market. In addition, the reserve requirements for demand deposits were unified and the role of the Central Bank as a lender of last resort was firmly established.

These reforms led to nominal interest rates of around 30% and to a strong recomposition of portfolios by agents in favor of highly liquid assets with very high returns, such as time deposits and savings certificates. In 1990 alone, time deposits and savings accounts increased at a real rate of approximately 119%. (See the Country Profile for Venezuela) This feature of the financial market reforms is not exclusive to Venezuela. All three countries introduced a wide range of new instruments with which people could save on money holdings. These new instruments create irreversible effects on the demand for money (Piterman (1988)). This is one of the channels through which financial innovation has permanent effects on money demand.

Having looked at the financial innovation episodes in the three countries, I now turn to the estimation of the long run and short run money demand for each country. In the next

section, I briefly discuss the cointegration approach to be used in the estimations.

IV. THE COINTEGRATION APPROACH

Traditional estimations of money demand have a partial adjustment specification which is estimated by OLS such as:

$$\ln m_t = \alpha_0 + \alpha_1 \ln y_t + \alpha_2 \ln \pi_t + \alpha_3 \ln m_{t-1} + \epsilon_t \qquad (3)$$

Conventional OLS analysis assumes that the error is not serially correlated and is not correlated with the regressors. More importantly, it assumes that all the regressors are either deterministic random variables or stationary. These assumptions give consistent OLS estimates and allow the use of t-statistics to determine the significance of different coefficients.

A problem arises, however, when the regressors are generated by a nonstationary process. In this case, the OLS estimates of equation (3) will not be consistent and regression results will be spurious. This implies that the distribution for the t and F statistics will diverge as the sample size increases giving incorrect critical values (Phillips (1986)). In order to estimate the long and short run demand for money correctly and be able to draw inferences on the elasticities, we must use the cointegration approach.

The cointegration approach deals with the case in which a linear combination of nonstationary variables is stationary. In general, a series X is integrated of order d if after differencing d times it is stationary ($X \sim I(d)$). Throughout the paper I will refer to series which are I(1) or difference stationary (d=1); that is after differencing once they are I(0). Let X_t be a vector of independent variables including a constant

$$z_t = y_t - \beta' X_t \qquad t=1,2,3... \tag{4}$$

then, if β is the vector which will make z_t stationary we say that X_t and Y_t are cointegrated with cointegration vector β (which need not be unique if X_t is multivariate). This cointegrating relation ($Y_t = \beta' X_t$) is interpreted as the long run relationship between Y and X, and z_t is known as the "equilibrium error", since it measures the degree to which the system is out of equilibrium.

Since the error is stationary, the relation between X and Y will return to the mean even though each series individually will move without that tendency. Allowance is made for the possibility of serially correlated but temporary divergences from this relationship. If X and Y are cointegrated, then OLS is the appropriate method to estimate the long run relationship among them, and the coefficient estimates will be consistent (Stock 1987). However, the test statistics will be

meaningless. The long run money demand function can then be estimated by OLS if it is a cointegrating relationship.

The cointegration approach can also be used to estimate the short run demand for money. The representation theorem by Engle and Granger (1987) indicates that series which are cointegrated can be represented by an error correction model (ECM). This ECM representation corresponds to the short run relationship among these variables consistent with the long run cointegrating equation. The ECM representation is as follows:

$$\Delta y_t = a + b_j \sum_{j=1}^{k} \Delta y_{t-j} + c_j \sum_{j=0}^{k} \Delta X_{t-j} - d z_{t-1} + \epsilon_t \qquad (5)$$

where z_{t-1} is the "equilibrium error" from the cointegration equation. Since all the variables in the ECM are I(0), OLS estimation provides consistent estimates and good test statistics. In equation (5) agents marginally adjust y_t in response to lagged changes in itself and the X_t variables as well as disequilibria from the long run cointegrating equation (4). In this ECM framework, the matrix d can be interpreted as a measure of the speed with which the system corrects last period's equilibrium error. For this reason, it is usually called the adjustment matrix.

V. THE LONG RUN DEMAND FOR MONEY

The data for all the countries are quarterly from different sources. For Bolivia, the data are from 1980:1 to 1991:4 from UDAPE. The data for Israel are from the Bank of Israel from 1970:1 to 1990:4. The data for Venezuela runs from 1978:1 to 1991:4 and come from various IFS issues.[3]

V.1 TESTING FOR UNIT ROOTS

Prior to estimating the long run demand for real balances, each of the variables must be submitted to a unit root test since cointegration methods require that all the variables be I(1). To test the null hypothesis that each variable is nonstationary I ran both Dickey Fuller (DF) and augmented Dickey Fuller (ADF) tests on each of the following series: m is the log of real M1 (deflated by the CPI), y is the log of real GDP, and π is the log of the inflation rate.[4] The general form of the test for any variable X is:

$$\Delta X_t = c + (\rho - 1) X_{t-1} + \sum_{j=1}^{k} \lambda_j \Delta X_{t-j} + \beta t + \eta_t \qquad (6)$$

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[3]The data for Israel were provided by Rafi Melnick from the Bank of Israel, and for Bolivia by UDAPE (Unidad de Analisis de Politicas Economicas) in La Paz.

[4]For Venezuela, y is the log of real non oil GDP. All the series are seasonally adjusted except the inflation rate.

The DF test omits the summation and both of the tests are run with and without a trend. The number of lags, k, is four (4) which is common for quarterly data. To reject the null we require ρ to be significantly negative. Tables 2A to 2C show the results of the tests for the three countries.

TABLE 2A: BOLIVIA-UNIT ROOT TESTS 1980:1-1991:4

Variable	DF(t)	ADF(t)	DF(nt)	ADF(nt)
levels				
y	-3.24	- .63	-3.25	-.957
π	-2.80	-2.25	-2.59	-1.90
m	-1.09	- .88	-1.75	-1.53
1st.difference				
Δy	---	---	-12.85	-2.50
$\Delta\pi$	---	---	-10.55	-3.25
ΔM	---	---	- 7.71	-2.18
Critical Values 5%	-3.50	-3.50	-2.9	-2.9

TABLE 2B: ISRAEL-UNIT ROOT TESTS 1970:1-1990:4

Variable	DF(t)	ADF(t)	DF(nt)	ADF(nt)
levels				
y	-4.53	-4.66	-1.40	-1.97
π	-2.68	-2.49	-2.75	-2.58
m	.06	-1.51	- .86	-1.74
1st.difference				
Δy	---	---	-13.19	-3.37
$\Delta\pi$	---	---	-12.33	-4.10
ΔM	---	---	- 6.30	-2.58
Critical Values 5%	-3.50	-3.50	-2.9	-2.9

TABLE 2C: VENEZUELA-UNIT ROOT TESTS 1978:1-1991:4

Variable	DF(t)	ADF(t)	DF(nt)	ADF(nt)
levels				
y	-2.86	-3.09	-.763	- .39
π	-4.20	-2.54	-3.64	-1.96
m	-1.61	-1.94	-1.00	-1.09
1st.difference				
Δy	---	---	-11.83	-3.19
$\Delta\pi$	---	---	- 9.1	-5.13
ΔM	---	---	- 5.27	-3.02
Critical Values 5%	-3.50	-3.50	-2.9	-2.9

The evidence from these tests shows that we cannot reject the null hypothesis of a unit root in the levels of y, π, and m. There are a few exceptions for each country but by far the results using the ADF test show that these variables are I(1). For the first differences, all the tests reject the null at the 5% level. The exceptions in each of the cases almost always involves the DF test which is the least powerful of the two tests. Under this criterion, and taking into account the low power of these tests, I conclude that these series are nonstationary. Since the regressors of the money demand function are generated by an I(1) process, applying OLS analysis to it will lead to misleading results. The correct way to estimate the money demand function is to use the cointegration approach.

V.2 COINTEGRATION TESTS

The evidence above shows that these variables are not stationary, therefore to run OLS on a typical partial adjustment specification would not yield the appropriate coefficient estimates. To estimate a long run money demand

for Bolivia, Israel, and Venezuela the following cointegration equation was estimated by OLS for each country.

$$m_t = \beta_0 + \beta_1 y_t + \beta_2 \pi_t + \mu_t \qquad \beta_1 > 0, \beta_2 < 0 \qquad (7)$$

To test for cointegration (i.e. to test for the existence of a long run equilibrium relationship), I ran ADF and DF tests on μ_t (the "equilibrium error") to see if it was stationary. Line 1 of Tables 3A to 3C shows the results. The evidence for all three countries fails to reject the null hypothesis of no cointegration (i.e. that μ_t is I(1)) for all the tests. This means that equation (7) is not a stable long run money demand function for any of the three countries studied.

This result can be interpreted in terms of the model presented in Section II. If equation (1) represents the correct long run money demand function, lack of cointegration may be due to the fact that we are ignoring the role of the transactions cost variable, b. Previous papers on the demand for real balances have shown that the lack of stability can be due to "financial innovation." Where this is defined as technological, legal and institutional changes which allow people to economize on their money holdings (see Laban (1991), de Gregorio et al..(1992) and Roley (1985)). In particular, Melnick (1991) shows that for Israel, ignoring a proxy for financial services leads to the misspecification of the long run money demand function and the lack of stability. I will show that the lack of stability, as is evidenced by the lack of cointegration, of the long run money demand function in all three of these countries is due to the exclusion of a proxy for financial innovation.

If financial innovation is a relevant variable in the demand for money function, excluding it will prevent the rejection of the null hypothesis of no cointegration. Therefore, we can again have spurious regression results in equation (7).

Previously, financial innovation has been modeled as a fall in transactions costs represented by an intercept dummy (Laban 1991) or a time varying intercept (Arrau and de Gregorio 1991). In this model, I allow financial innovation to affect, *a priori*, the slope as well as the intercept of the money demand function. The effects of financial innovation are captured by a set of three dummy variables:
i) DX which is 0 prior to year X:1 and 1 thereafter
ii) DXY which is 0 prior to year X:1 and equal to y thereafter and iii) DXI which is 0 prior to year X:1 and equal to π thereafter. Where X is the year in each country sample where financial innovation occurs. In Bolivia X is 1986, in Israel it is 1987, and in Venezuela it is 1989. The modified long run money demand equation becomes:

$$m_t = \gamma_0 + \gamma_1 Y_t + \gamma_2 \pi_t + \gamma_3 DX + \gamma_4 DXY + \gamma_5 DXI + \omega_t \qquad (8)$$

The estimated equations for each of the countries are as follows:

Bolivia

$$m_t = 17.93 - 1.46 y_t - 2.93 \pi_t - 43.89 D87_t + 4.37 D87Y_t + 2.4 D87I_t \quad (9)$$

$$T=83 \qquad \bar{R}^2 = .81 \qquad DW = 1.5$$

Israel

$$m_t = 9.97 + .11 y_t + .04 \pi_t - 8.13 D89 + .66 D89Y_t + .26 D89I_t \quad (10)$$

$$T=55 \qquad \bar{R}^2 = .82 \qquad DW = 1.1$$

Venezuela

$$m_t = -4.54 + 1.18 y_t - .55 \pi_t - 22.7 D86_t + 2.14 D86Y_t - .42 D86I_t \quad (11)$$

$$T=47 \qquad \bar{R}^2 = .78 \qquad DW = 1.5$$

The standard errors are not reported since they have degenerate distributions. As is evident, the long run elasticities of real money balances with respect to income have the right sign, but they tend to be a bit high when compared with other estimates, except for Israel. The long run elasticities of money demand with respect to income are 2.91 for Bolivia, 0.77 for Israel, and 3.32 for Venezuela. The long run semielasticities of inflation have the right sign

for both Bolivia and Venezuela, but not for Israel. These semielasticities all fall between -0.5 and -1, which is not unusual for less developed countries. The long run inflation elasticities are -0.5 for Bolivia, 0.30 for Israel, and -0.97 for Venezuela. These coefficient estimates will be consistent as long as the regressors are not cointegrated separately and the dummies are included. (See Tables 3A-3C, line 3). The R^2 are also very high and the DW statistics are fairly close to 2, indicating no serious problems with serial correlation.[5]

Line 2 of Tables 3A to 3C shows the results of the unit root tests on the equilibrium errors (ω's) of equations (9)-(11). It is clear that the dummy variables matter. For all three countries I can now reject the null hypothesis of no cointegration, which indicates that these equations provide a reasonable estimate of the long run demand for money in these countries. The evidence tends to support a downward shift, as well as a change in the slope of the long run equilibrium money demand function at the time when financial innovation occurred in these countries. All of the DX dummies come out negative and large.

Having estimated a stable long run demand for money, after taking into account financial innovation, I now estimate the short run demand for money and show how financial innovation can lead to a faster speed of adjustment of real balances to changes in its determinants.

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[5]The only exception is the regression for Israel that has a DW statistic of 1.1.

TABLE 3A: COINTEGRATION TESTS: BOLIVIA

	DF(t)	ADF(t)	DF(nt)	ADF(nt)
1. Equation (8)	-2.5	-2.3	-2.1	-1.7
2. Equation (9)	-5.0	-2.3	-5.1	-2.3
3. Cointegration btn. y and π	-3.0	-1.7	-3.1	-1.9
Critical Values 5%	-3.5	-3.5	-2.9	-2.9

note: Four lags used for ADF

TABLE 3B: COINTEGRATION TESTS: ISRAEL

	DF(t)	ADF(t)	DF(nt)	ADF(nt)
1. Equation (8)	-3.8	-2.6	-3.7	-2.6
2. Equation (10)	-4.4	-3.5	-4.1	-2.8
3. Cointegration btn. y and π	-3.4	-2.5	-1.2	-.75
Critical Values 5%	-3.5	-3.5	-2.9	-2.9

note: Four lags used for ADF

TABLE 3C: COINTEGRATION TESTS: VENEZUELA

	DF(t)	ADF(t)	DF(nt)	ADF(nt)
1. Equation (8)	-1.8	-2.4	-1.8	-2.2
2. Equation (11)	-5.0	-2.6	-5.0	-2.8
3. Cointegration btn. y and π	-3.5	-3.5	-1.8	-1.2
Critical Values 5%	-3.5	-3.5	-2.9	-2.9

note: Four lags used for ADF

VI. THE SHORT RUN MONEY DEMAND AND THE SPEED OF ADJUSTMENT: AN ERROR CORRECTION MODEL

Given the stable long run money demand which was estimated in Section V, I now turn to the estimation of the dynamic specification for real balances in the short run. Traditional studies of money demand for other countries have always used a partial adjustment approach which is relatively *ad hoc*. Salmon(1982) demonstrates that this mechanism will only reach the desired level of long run real balances if this level is constant in equilibrium, which as mentioned before is not the case when the variables are nonstationary. Additionally, Stock (1987) shows that inferences made on estimations by OLS when the lagged dependent variable is included as a regressor can lead to errors. Given these criticisms, and following the Representation Theorem by Engle and Granger (1987), I use an error correction model (ECM) to estimate the short run money demand for Bolivia, Israel, and Venezuela. This model is given by

$$\Delta m_t = \alpha_0 + \sum_{j=1}^{4} \alpha_{1j} \Delta m_{t-j} + \sum_{j=0}^{4} \alpha_{2j} \Delta y_{t-j} + \sum_{j=0}^{4} \alpha_{3j} \Delta \pi_{t-j} - \delta \hat{\omega}_{t-1} + \phi_t \qquad (12)$$

Where Δ is the first difference operator, ω_{t-1} is the estimate of the "equilibrium error" from the cointegration equations (9)-(11) and ϕ_t is white noise. In order to estimate equation (12) for each of the countries in the sample, I follow the methodology employed by Hendry et al (1984). This

method, of going from general to specific, applied to equation (12) implies that the equation is continuously simplified and reestimated. It is first estimated in its most general form with four lags for each variable except the error correction term. The final parsimonious representation is achieved after deleting all the insignificant variables. The results for the final version of each country's ECM are shown in Tables 4A-4C.

TABLE 4A: AN ERROR CORRECTION MODEL FOR BOLIVIA

Dependent var is Δm	(1)	(2)
Regressors		
constant	.004	.008
	(.35)	(.71)
Δm_{t-1}	.43*	.40*
	(3.6)	(3.36)
Δm_{t-3}	.50*	.51*
	(4.5)	(4.8)
Δy_t	1.6*	1.4*
	(4.8)	(4.1)
Δy_{t-3}	-1.2*	-1.2*
	(-3.3)	(-3.26)
$\Delta \pi_t$	-.27*	-.28*
	(-4.2)	(4.42)
$\Delta \pi_{t-4}$	-.12*	-.10*
	(-2.5)	(-1.94)
EC_{t-1}	-.20*	-.35
	(-2.6)	(-3.0)
DEC_{t-1}	-----	-.27**
		(1.7)
R^2	.71	.72
SSE	.22	.15
T	42	42

t-statistics are in parentheses
*=significant at 5%, ** sig at 10%

TABLE 4B: AN ERROR CORRECTION MODEL FOR ISRAEL

Dependent var is Δm	(1)	(2)
Regressors		
constant	-.005	-.004
	(-.78)	(-.67)
Δm_{t-4}	.26*	.27*
	(3.9)	(4.0)
Δy_{t-1}	.55*	.51*
	(3.2)	(2.9)
$\Delta \pi_t$	-.84*	.85*
	(-9.[illegible])	(-9.6)
$\Delta \pi_{t-1}$	-.46*	-.46*
	(-4.2)	(-4.3)
$\Delta \pi_{t-2}$	-.29*	-.30*
	(-2.9)	(-3.1)
$\Delta \pi_{t-3}$	-.34*	-.33*
	(-3.7)	(-3.7)
EC_{t-1}	-.10*	-.09
	(-2.9)	(-2.7)
DEC_{t-1}	-----	-.31**
		(1.7)
R^2	.69	.69
SSE	.17	.16
T	79	79

t-statistics are in parentheses
*=significant at 5%, ** sig at 10%

TABLE 4C: AN ERROR CORRECTION MODEL FOR VENEZUELA

Dependent var is Δm	(1)	(2)
Regressors		
constant	-.005	-.006
	(-.72)	(-1.0)
Δm_{t-4}	.63*	.57*
	(6.2)	(6.1)
$\Delta \pi_t$	-.96*	.66*
	(-5.2)	(-3.5)
EC_{t-1}	-.29*	-.16*
	(-3.9)	(-2.0)
DEC_{t-1}	-----	-.52*
		(-3.6)
R^2	.59	.67
SSE	.11	.09
T	54	54

t-statistics are in parentheses
*=significant at 5%, ** sig at 10%

Column (1) of each table shows the error correction model for each country in its final form, after all of the insignificant variables have been eliminated. The model shows encouraging results for the short run income and inflation elasticities of money demand. For Bolivia, the short run

income elasticity is 0.37, and the inflation elasticity is -0.4 which is within the range of previous studies for less developed countries. In addition, the coefficient on lagged money is about 0.92 which is consistent with other studies. For Israel, the income elasticity is 0.5 which is in line with theoretical specifications, the inflation elasticity is -1.0, and the coefficient on lagged money is about 0.3. Finally, the results for Venezuela are as follows: the inflation elasticity is approximately -0.9, and the coefficient on the lagged money term is 0.63. Since output was not a significant variable, its elasticity is not very reliable, but it is approximately 1. All the coefficients are highly significant.

Having estimated an appropriate short run money demand for these countries, I now turn to the principal question of the paper. In the model of Section II, I showed that a decline in the transactions costs, or what I have termed financial innovation, causes people to adjust their real balances faster than before. The error correction model, ECM, of equation (12) specifies that the change in m_t depends not only on the lagged values of y_t and π_t, but also on the equilibrium error that occurred in the previous period. Viewed in this error correction framework, the matrix δ, the coefficient on ω_{t-1}, can be interpreted as a measure of the speed by which the system corrects last period's equilibrium error. This is why δ is usually called the "adjustment matrix." In Tables 4A-4C, column (1) shows that the EC term is always of the right sign

(i.e. it is negative) and highly significant. This implies that agents are taking into account the long run equilibrium error when adjusting their demand for real balances in the short run. When there is a positive error (i.e. when current money holdings are greater than the desired ones, $m_t > m_t^*$) in the long run equation, people will adjust their desired money balances downward.

Column (2) of Tables 4A-4C show the same ECM for each country but including an interactive dummy variable for the error correction term (DEC_{t-1}). Note that in each case the coefficient increases in absolute value, and is statistically significant. This confirms empirically what Section II sets out; that the speed of adjustment of money demand to its determinants increases when there is financial innovation. In essence, people adjust faster to deviations from the long run equilibrium relation. This makes sense since now financial institutions are more efficient and people can put their money in different assets at home.

VII. CONCLUSIONS

I have shown that financial innovation can increase the speed of adjustment of money demand to its determinants, and can lead to the instability typically found in other money demand studies. This is an aspect of the literature which has

not been explored much, particularly in terms of the new cointegration methods.

Using the appropriate cointegration techniques, I have shown that by introducing a proxy for financial innovation, a stable long run money demand function can be obtained for each country. For Bolivia, Israel, and Venezuela, the empirical estimates show that the long run demand for money not only shifted down, but that in the short run the effect of financial innovation has been to increase the speed with which people adjust their actual money holdings to their desired money holdings. Viewed in the Miller-Orr transactions demand for money framework, a fall in the transactions cost variable means a shorter period in which desired money balances are not equal to the optimal money balances. The empirical evidence shows that the coefficient on the error correction variable increases in absolute value indicating that once financial innovation takes place any disequilibria between desired and actual money holdings will by eliminated faster.

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