DM/85/32

INTERNATIONAL MONETARY FUND

Research Department

Currency Substitution in Argentina, Mexico, and Uruguay

Prepared by C. L. Ramirez-Rojas*

Approved by Anthony Lanyi

May 23, 1985

Contents

		Page
I.	Introduction	1
II.	A Model of Currency Substitution	2
	1. Introduction	2
	2. Determinants of currency substitution	2
III.	Empirical Evidence	5
	1. Review of previous studies of CS in Latin America	6
	2. Definitions and construction of the variables	10
	3. Empirical results	12
	a. Argentina	12
	b. Mexico	15
	c. Uruguay	22
	d. Some comments on the comparison among countries	25
IV.	Currency Substitution and Macroeconomic Policy	26
V.	Summary and Conclusions	31
	Appendix on Data Sources	32
	Bibliography	33

* I am grateful to Saul Lizondo, Mohsin Khan, Malcolm Knight, Peter Montiel, and Omotunde Johnson, for their very useful comments and suggestions. In addition, I would like to thank Elbio G. Nattino of the Central Bank of Uruguay who kindly provided me with some of the data used in this paper. I am also grateful to Dragica Pilipovic-Chaffey for her assistance. The usual disclaimer applies.

Text Tables

Table 1	*Estimates of Currency Substitution* in Argentina, 1982-Q2 - 1984-Q1	16
Table 2	Mexico: Time Series of the Probability of Devaluation One Period Ahead	18
Table 3	Estimates of Currency Substitution in Mexico 1970-Q1, 1981-Q4, and 1982-Q2	20
Table 4	Estimates of Currency Substitution in Uruguay, 1970-Q1 - 1982-Q3	24

Charts

Chart 1	Argentina, Mexico and Uruguay: Deposits in U.S. Banks by Non-Bank Foreigners	12a
Chart 2	Argentina: Ratio of Foreign-Currency Deposits to Total Money Stock	12b
Chart 3	Uruguay: Foreign-Currency Deposits by Nonresidents	14a
Chart 4	Mexico: Ratio of Foreign-Currency Deposits to Total Money Stock	16a
Chart 5	Uruguay: Ratio of Foreign-Currency Deposits to Total Money Stock	22a

Figure

Figure 1	The Demand for Domestic and Foreign Money	6a

I. Introduction

The demand for foreign fiat money by domestic residents of a country is commonly referred to as currency substitution (CS). 1/ Holdings of foreign money by domestic residents may arise simply because certain kinds of transactions, such as tourism, require the use of foreign exchange. In some countries, however, the demand for foreign money by domestic residents has increased well beyond the requirements of international trade and tourism: these countries include, notably, Argentina, Israel, Mexico, Uruguay and Yugoslavia. In all these countries there has been a sharp decline in real balances of domestic currency during periods of high and variable inflation rates, large balance of payments deficits and recurrent devaluations. In some of these countries the use of foreign money has become so widespread that purely domestic sales and contracts are transacted in foreign currency.

From an empirical point of view, the phenomenon just described raises a variety of issues, ranging from the proper definition of "money" in the domestic economy to the formulation of domestic monetary policy. In particular, CS makes it difficult for the monetary authorities to control the volume of domestic liquidity. The type of CS that goes beyond the necessities of international trade and becomes a problem for the domestic monetary authorities is the subject of this paper.

Currency substitution can be classified as "symmetrical" when residents and non-residents simultaneously hold domestic and foreign money and "asymmetrical" when there is no demand for domestic money by non-residents. 2/ This paper is a study of the phenomenon of currency substitution in three Latin American countries--Argentina, Mexico, and Uruguay--where the type of CS experienced has been asymmetrical, with residents substituting foreign money (mainly U.S. dollars) for domestic money. The main focus of the analysis will be the empirical similarities of CS among the countries studied. In addition, there will be some discussion of the types of monetary policies implemented in the light of CS.

1/ The definition of CS covers a wide variety of possibilities, such as foreign deposits in the domestic financial system, foreign money held abroad by domestic residents, and foreign currency notes circulating within the boundaries of the domestic country.

2/ Symmetrical CS has been the subject of study of several authors, for example, Miles (1978), Wallace (1979), Girton and Roper (1981), Bordo and Choudhri (1982), and more recently Cuddington (1983). It has proved difficult to clarify and quantify the effects of symmetrical CS; see the paper by Cuddington (1983). The core of the controversy, at theoretical and empirical levels, lies in the fact that the capital and money markets of countries that possess hard currencies are highly integrated and transaction costs between these markets are relatively small, making it difficult to distinguish capital movements from CS.

This paper is divided as follows. The next section presents a simple model of CS. Section III examines the empirical evidence for Argentina, Mexico, and Uruguay. Section IV presents a preliminary discussion of the possible effects of CS on the conduct and effectiveness of macroeconomic policies in a country engaged in a stabilization effort. Section V summarizes the findings and the conclusions of the paper.

II. A Model of Currency Substitution

1. Introduction

The role of foreign money in the domestic economy raises a variety of issues of theoretical and empirical importance. From a theoretical point of view, the specification of the technology of transactions that allows domestic and foreign money to circulate simultaneously in the domestic economy is a very important issue in macroeconomics (see Sargent 1983). From an empirical point of view, the definition of "money" in the domestic economy becomes more difficult. In this paper no attempt will be made to develop a model that focuses on the technology of transactions, but rather it will be assumed that domestic and foreign money coexist and, with the help of a simplified model, economic and institutional factors affecting the demand for foreign money by residents will be analyzed. In addition, some insights regarding the definition of money in the presence of CS will be offered in the empirical section of this paper.

2. Determinants of Currency Substitution

The demand for foreign money by residents covers a wide variety of possibilities. These include foreign-currency deposits held either domestically or abroad and foreign-currency notes circulating domestically. As with any money demand function, CS depends primarily on the level of real wealth, as well as certain institutional factors and on the difference between the expected real rates of return of domestic and foreign money. 1/

The institutional factors that explain the demand for foreign money by residents are: the volume of international transactions, the lack of development of a domestic capital market, and the transaction costs incurred in the exchange of monies. With regard to the first of these, the demand for foreign money to carry out international transactions is likely to be held largely in the form of balances that tend to be related in a stable way to the volume of such transactions. With regard

1/ If allowance is made for domestic and foreign interest-bearing assets, the demand for the former will not be CS as defined above and the demand for the latter will constitute a capital outflow rather than CS.

to the second, the lack of a developed capital market limits the available alternatives for holding wealth to goods, domestic money, and foreign money; furthermore, the lack of financial investment opportunities for nonresidents contributes to the specifically asymmetrical nature of CS in these economies. Finally, as long as there are no severe controls or other types of deterrent to the holdings of foreign currency, the transaction costs incurred in the exchange of domestic for foreign money will tend to be smaller than those involved in the exchange of money for goods, thereby creating a further bias in these economies toward the holding of foreign money.

The crucial variable in explaning the demand for foreign money by residents is the difference between the real rates of return on domestic and foreign money which is approximated by the expected rate of depreciation of the domestic money. Changes in this expected rate can bring about major shifts in the desired composition of financial wealth.

Another element in the analysis of currency substitution is the rate of return on domestic interest-bearing assets. The following model does not include such assets, in order to simplify its exposition. 1/ Furthermore, from an empirical point of view the introduction of such assets would complicate the paper unnecessarily because the data is unavailable. Nevertheless, it should be borne in mind that in two types of circumstances interest rates can play an important role in the explanation of CS. First, if the domestic and foreign interest rates are freely determined by market forces the differential between them--corrected by country-risk--may be a good indicator of the expected change in the exchange rate. Second, in some less developed countries a policy of intervention that results in a fixed nominal interest rate for long periods, regardless of the level of inflation, has been widely employed and in such cases a highly negative real domestic interest rate will surely exacerbate CS. See Tanzi and Blejer (1982) and Lanyi and Saracoglu (1983).

A simple model of asymmetrical CS postulates two demand for money functions and two definitions, which can be expressed as: 2/

1/ Inclusion of such assets would require specifying the demand for these assets, including assumptions regarding the holdings of domestic interest-bearing assets by foreigners, along the lines followed by Cuddington (1983).

2/ The issue of stability of the money demand functions under CS and the resulting indetermination of the exchange rate under a free floating regime, have been studied by Brillembourg and Schadler (1979), Wallace (1979), Rubli (1981), Girton and Roper (1981), McKinnon (1982), and more recently by Lapan and Enders (1983) and Sargent (1983).

$$(1) \quad M_d = P_d L_d(w, E^*);$$

$$(2) \quad M_f = P_f L_f(w, E^*);$$

$$(3) \quad P_d = EP_f;$$

and

$$(4) \quad w = (M_d + EM_f)(1/P_d).$$

The first two equations show M_d, nominal holdings of domestic money, and M_f, nominal holdings of foreign money, as functions of w (real wealth) and E^* (the expected rate of depreciation of the home country's exchange rate), with P_d (price level in the home country)and P_f (foreign price level). Equation (3) gives the purchasing power parity determination of E, the nominal exchange rate, expressed in units of domestic currency and equation (4) defines real wealth. As mentioned before this highly simplified model contains no domestic interest-bearing assets and can therefore not be employed to analyze the use of interest rate policy to stem CS by increasing the return on holdings of domestic money. 1/

From equations (1) to (3) it is possible to obtain:

$$(5) \quad \frac{M_d}{EM_f} = \frac{L_d(w, E^*)}{L_f(w, E^*)}$$

Two interesting points are worth noting from equation (5). First, the scale variable is the same for the two liquidity functions, which is a relevant assumption when dealing with asymmetrical CS. Second, the expected rate of depreciation of the exchange rate is introduced as an

---

1/ However, in the very simple model presented in this section, such a policy can be represented by postulating that the government makes interest payments in the form of lump-sum transfers of goods whose size depends positively on E^*--i.e., the higher E^*, the larger the transfer--but is independent of holdings of domestic money. In the analysis presented here, it is assumed that the transfer of the government is a constant independent of E^*. This assumption will simplify the graphical exposition. Note that the "budget" constraint represented by (4) will have to be modified in order to incorporate such "interest" payments.

opportunity cost variable that represents the difference in the expected real rates of return between domestic and foreign money. 1/

If it is assumed that the demand for each type of money is homogenous in wealth, the ratio of domestic to foreign money can be expressed as:

$$(6) \quad \frac{M_d}{EM_f} = \alpha(E^*); \qquad \alpha' < 0.$$

Equation (6) is depicted graphically in Figure 1, where the distribution of residents' demand for domestic and foreign monies is given by the expected rate of devaluation of the domestic currency. In that figure, the slope of the "budget" line is given by (-1), which is the rate at which the exchange of monies takes place. $\bar{M}_d$ and $\bar{EM}_f$ denote the maximum holdings of domestic and foreign money that can be obtained for a given quantity of wealth. Initial holdings of domestic and foreign money are given by M_{do} and EM_{fo}, which are determined by the value of the expected rate of depreciation, in this case equal to E^*_o. An increase in the expected rate of depreciation, say, from E^*_o to E^*_1, is shown by the shift of the money demand function from $\alpha(E^*_o)EM_f$ to $\alpha(E^*_1)EM_f$; this shift implies an increase in the holdings of foreign money and a proportional reduction in the holdings of domestic money.

The dynamics of this very simple model depend on the assumptions about the exchange rate regime and on the model of expectations assumed for the expected change in the exchange rate. Both of these issues have been extensively discussed in the literature, and the reader is referred to Calvo and Rodriguez (1977) and Calvo (1982) for a detailed analysis of these and other related issues. Finally, it should be noted that equation (6) represents a quite general form of the CS phenomenon, and much of the empirical literature, in one way or another, has estimated different versions of it obtained from several models. 2/

III. Empirical Evidence

This part of the paper will first review the previous empirical studies of currency substitution in Latin America. Second, it will discuss the definitions and the construction of the variables to be used in the empirical part of this paper. Finally, the empirical results for Argentina, Mexico, and Uruguay will be analyzed and compared.

1/ See, for example, Calvo and Rodriguez (1977); Bilson (1979).

2/ Rubli (1981) contains a useful survey of the theoretical and empirical work done in CS.

1. Review of previous studies on CS in Latin America

The purpose of the empirical analysis in this paper is to analyze and compare the experiences, with respect to CS, of Argentina, Mexico and Uruguay for the period 1970 up to the early 1980s. Before doing that, it will be of interest to review some of the previous work on the subject. The empirical evidence on CS for Latin American countries is of recent origin and the number of studies is limited. Furthermore, since these studies have been devoted to the analysis of a single country, as in the case of Fasano-Filho (1984) for Argentina, Ortiz (1983) for Mexico, and Banda (1982) for Uruguay, they do not permit direct cross-country comparisons. 1/

Fasano-Filho obtains empirical estimates of CS for Argentina for the years 1960 to 1976, and quarterly from 1977 to 1981. 2/ For his annual sample, he estimates the following model:

$$(7) \quad \ln m_t = a_o + a_1 \ln y_t + a_2 \pi_t + a_3 x_t$$

where m_t equals real money balances, that are here defined, for the purpose of separate regressions, as currency (C), demand deposits (D), time and savings deposits (T) and M_1 all expressed in real terms; y_t is real income (GDP); π_t denotes the actual rate of inflation measured by the general wholesale price index (WPI); and x_t is the expected rate of depreciation defined as $\ln x_t = \ln P_t - \ln P_t^* - F_t$, in which P_t denotes the general WPI in Argentina, P_t^* is the WPI of the U.S., and F_t is the black market exchange rate. The expected signs are $a_1>0$; a_2, $a_3<0$. The empirical results that Fasano-Filho obtains are favorable to the hypothesis of the existence and importance of CS in Argentina. In particular, the expected rate of devaluation is a significant variable in the explanation of variations in the demand for domestic money.

The quarterly regressions that Fasano-Filho estimates are based on the following model:

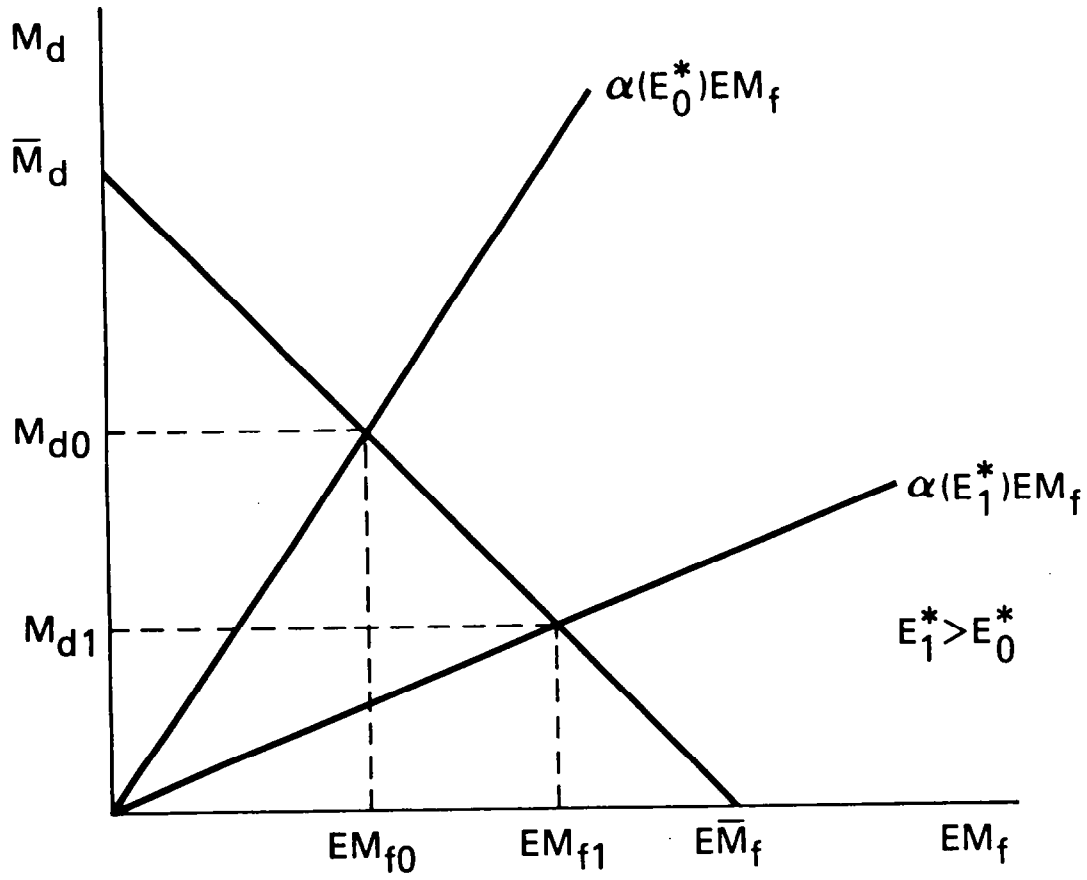
$$(8) \quad \ln m_t = b_o + b_1 \ln y_t + b_2 \ln \pi_t + b_3 x_t^e + b_4 r_t + b_5 E_{t-1} + b_6 \ln m_{t-1}$$

1/ For an early contribution to the study of the demand for foreign and domestic money, although in a different context, see Blejer (1978).

2/ In addition this author estimates a quarterly demand for dollars, from 1977 to 1981, that Argentines have in Uruguay.

FIGURE 1

THE DEMAND FOR DOMESTIC AND FOREIGN MONEY



where m_t denotes real money balances using M_1 or M_2, the variable x_t^e is defined as $x_t^e = i_t - i_t^* - q$; where i_t is the domestic nominal interest rate; i_t^* is the foreign nominal interest rate; and q is defined here as "expenses from borrowing abroad (e.g., taxes)." 1/ The variable x_t^e is then a proxy for the expected rate of devaluation. The variable r_t is the ex-post real interest rate, and E_{t-1} is a measure of inflation uncertainty. 2/ Despite the number of parameters to be estimated (7 for 17 observations) and the unknown sign of the variable E_{t-1}, Fasano-Filho obtains statistically significant coefficients for the inflation rate and the expected rate of devaluation.

The paper by Ortiz (1983) presents evidence for Mexico during the period 1933 to 1980. Specifically, he analyzes the behavior of the ratio (F/D), where F stands for foreign-currency demand deposits and D denotes domestic-currency demand deposits. The kind of relationship that Ortiz postulates is somewhat different from the one presented in equation (6) and adopts the following form:

$$(9) \quad (F/D) = \gamma(\pi^d, \pi^f, R^*, P^*);$$

where π^d and π^f are the domestic and foreign inflation rates, respectively; R* denotes foreign exchange risk; and P* represents a political risk variable.

The specific functional form that Ortiz adopts for equation (9) takes an exponential form that he linearizes. To this linearized model, he introduces lags and adds a stock adjustment term, obtaining:

$$(10) \quad \ln (F/D)_t = b_1 ED_{t-1} + b_2 ED_{t-2} + b_3 ER_{t-1} + b_4 ER_{t-2} + b_5 PRD + b_6 \ln (F/D)_{t-1}$$

where ED stands for the expected devaluation proxy, defined as the difference between the official and the real exchange rate; ER is the foreign exchange risk measure, defined as the deviations of the real

---

1/ Fasano-Filho, op. cit. p. 188. The variable "q" is generally regarded in the literature as a risk factor rather than taxes.

2/ The variable E was defined as the standard errors of moving first order autoregressive regressions of the inflation rate. Fasano-Filho op. cit. p. 184.

exchange rate from trend; PRD is the proxy for the political risk variable which was defined as a "dummy" variable in effect for the years when the national leadership changed. The expected signs in (10) are $b_i > 0$ where $i = 1,\ldots, 6$. 1/ The results that Ortiz obtains in the empirical estimation of (10) are satisfactory in terms of statistical significance and expected signs of all the coefficients.

Ortiz also estimates a quarterly demand for money function for the period 1960 to 1979, to examine the effects of the foreign interest rate on the behavior of the domestic money demand. The form of the estimated equation is:

$$(11)\quad \ln m_t = \alpha_o + \alpha_1 \ln y_t + \alpha_2 i_t + \alpha_3 i_t^* + \alpha_4 \pi_t^* + \alpha_5 \ln m_{t-1} + \Sigma \beta_i d_i;$$

where real money balances (m_t) were defined alternatively as M_1 and M_1 plus dollar demand deposits in the domestic financial system; i_t is the interest rate on short term peso deposits; i_t^* is the three-month Eurodollar deposit rate; π_t^* is the expected inflation rate, defined as a weighted average of current and past inflation rates; and the d_i's are seasonal "dummy" variables, $i = 1, 2, 3$.

The empirical results of estimating (11) show the expected signs for all of the variables, except for the foreign interest rate, for which a positive sign is obtained, though it is not statistically significant. Ortiz concludes that the behavior of the (F/D) ratio is influenced by expectations of devaluation and foreign exchange risk. He argues, however, that there is no evidence of currency substitution, since the foreign interest rate does not significantly affect the demand for pesos.

Nevertheless, the estimates of equation (10) show the importance of CS in Mexico. As for the results of the regression estimates of equation (11) these may interpreted in several ways. For example, they may show the high degree of multicollinearity between the interest rate on Eurodollar deposits and on interest-bearing deposits in Mexico, or they may also reflect that the level of the uncovered foreign interest rate is not an important variable in the explanation of the behavior of real cash balances in Mexico, what matters for CS, however, is the difference between domestic and foreign interest rates, and not the level of the foreign interest rate per se. In any event, the results that Ortiz

---

1/ Note that (10) has no constant term and that is indeed an important restriction in the estimated equation.

obtains are an additional step in showing the importance of the expected rate of devaluation in the demand for domestic money.

The work by Banda emphasizes the importance of the substitutes for domestic money (defined as currency plus demand deposits of the private non-bank sector) for the effectiveness of a given monetary policy. This author not only considers foreign currency as a substitute for the narrow definition of money (M_1), but also for various definitions of broad money, including domestic time and savings deposits and several government bonds indexed to the exchange rate or to the price level.

The empirical evidence that Banda offers is based on ordinary least squares (OLS) regressions for two periods: an annual one covering from 1952 to 1981, and a quarterly one from 1975 to 1981. The basic form of his estimated equation was:

$$(12) \quad \ln m_t = \beta_o + \beta_1 \ln y_t + \Sigma \beta_i \ln r_t^i;$$

where m_t equals real per capita money balances (using M_1); y_t is real per capita income; and r_t^i stands for the nominal interest rate on saving deposits (S), time deposits (T), domestic bonds denominated in foreign currency (B_f), foreign currency deposits (D_f), and domestic bonds (B). 1/ The expected signs in equation (12) are $\beta_1 > 0$; $\beta_i < 0$.

The empirical results that Banda obtains for his annual sample are based on separate regressions for the interest rate paid on S, T, and D_f, as well as a regression including the three rates. His results support the hypothesis that interest-bearing deposits (S, T, D_f) are substitutes for currency and demand deposits; nevertheless, the coefficient of the interest rate paid on foreign currency deposits (D_f) is not statistically significant.

For his quarterly sample, Banda utilized the interest rates of all the financial instruments (S, T, B_f, D_f, B). He runs regressions with each separate rate and with all of them considered jointly. In addition, he introduces lags in his independent variables. Again, his results show the importance of interest-bearing assets as substitutes for the narrow definition of money, but the coefficient of the interest rate on D_f turns out once more to be statistically insignificant. 2/

1/ Two clarifications are necessary, first, the data for the interest rate paid on D_f also considers the return obtained due to changes in the exchange rate. Second, the quarterly regressions are in real terms only.

2/ Banda also estimated a constant elasticity of substitution (CES) function for money services (using M_1 and each of the possible alternatives). He does not report his results due to the poor fit obtained.

Banda concludes that the most important substitutes for narrowly defined money in Uruguay are savings and time deposits denominated in domestic currency. He argues that foreign-currency deposits were not statistically important, due to capital controls and expectations of intervention. He also notes that after the liberalization of the financial market in Uruguay in the second half of the 1970s, a good part of the monetary inflow experienced was not the result of a change or adjustment in wealth of domestic residents, but to speculative monetary flows coming from Argentina. 1/ Finally, it should be noted that Banda studied only the substitution between domestic narrow money and interest-bearing deposits, regardless of their currency denomination; he did not analyze the behavior of foreign-currency deposits vis-à-vis domestic interest-bearing deposits.

The studies cited here suggest that currency substitution is important in varying degrees and forms in Argentina and Mexico but not in Uruguay. However, the studies reviewed are difficult to compare, due to the different models estimated by each author, and because of the different periods analyzed by them. While Argentina and Uruguay have experienced high and variable inflation rates and recurrent devaluations for a number of years, and have therefore faced problems related to CS, Mexico's membership in the club of inflationary countries is very recent. Consequently, CS has become a problem in Mexico only in recent years.

2. Definitions and construction of the variables

Before proceeding with the empirical implementation of the model, it is necessary to discuss the shortcomings and limitations of the statistical data, as well as the construction of the empirical measures that will be used. As stated previously, currency substitution is the demand for foreign fiat money by domestic residents. This demand can be for foreign currency, or for foreign-currency deposits held in the country or abroad. However, even when it is possible to isolate foreign-currency deposits in the domestic financial system, it is not always possible to identify whether the deposits are held by foreigners or by residents. The bulk of those deposits are usually thought to be held by domestic residents, but one has to keep in mind this source of possible misspecification. An additional source of error in the measurement of CS lies in the amount of foreign-currency notes held by the public (in this case domestic residents) in the country. The quantitative importance of this component is extremely difficult to estimate, all the more so because the domestic monetary authority frequently has no effective control over the purchase or sale of foreign-currenty notes by domestic residents.

1/ Part of these inflows were monetized, creating another source of problems for the monetary authorities.

While statistics of foreign-currency deposits by domestic residents held abroad are sketchy or non-existent, a partial and rough estimate can be obtained from the statistics, reported by the U.S. Treasury, of the amount of deposits in U.S. banks by foreigners. 1/ Chart 1 presents this data for non-bank residents of Argentina, Mexico, and Uruguay. As is clear from examination of Chart 1, the three countries under analysis show some differences among them, particularly in certain periods. For example, in general, the trends in Argentina and Uruguay follow a very similar pattern, in which it is possible to observe an increase in foreign currency deposits held abroad between 1973 up to mid-1980. However, these deposits actually declined during 1978 up to 1980. On the other hand, Mexico did not experience this type of transitory reversal of its rising trend, except for very short periods. In addition, the amplitude of the movements in the Mexican case surpasses by far those observed in Argentina and Uruguay. Despite the differences among these countries, however, there are some remarkable similarities among them, especially in the "timing" of the changes of the series: for example, the upward swing in the series experienced for all countries since 1980, and the otherwise increasing trend in this type of deposits since 1973.

The magnitudes charted in Chart 1, have changed strikingly in recent years. During 1970 the average of these deposits for Argentina, Mexico, and Uruguay were US$254 million, US$276 million and US$75 million, respectively. By 1982, the average level of these deposits had reached US$1.8 billion for Argentina, US$6.2 billion for Mexico, and US$329 million for Uruguay, with these relative magnitudes largely explainable by the populations of these countries: the corresponding per capita holdings of dollar deposits may be estimated US$63 for Argentines, US$85 for Mexicans, and US$109 for Uruguayans. 2/ It is important to re-emphasize that these figures based on reporting institutions in the United States, are only a partial estimate of world-wide foreign-currency deposits.

The limitations of existing empirical measures of CS should be kept in mind when evaluating the following analysis and conclusions derived from it. Nevertheless, even the partial measures available show the importance of CS and the speed at which the process has occurred for the three countries examined.

For the purpose of the analysis in this paper, currency substitution is expressed by the ratio:

(13) (M/F),

1/ See U.S. Treasury Bulletin Table CM-I-4.

2/ Using population data taken from International Financial Statistics.

where M is the sum of currency in the hands of the public (C), demand deposits (D), saving deposits (S), and time deposits (T), and F is foreign-currency deposits in the domestic financial system expressed in units of domestic currency. C, D, S, and T are, of course, also denominated in units of domestic currency. 1/ The availability of data for one country, namely, Uruguay, permits distinguishing foreign-currency deposits held by residents and non-residents.

In Section II, it was argued that the relevant variable for the analysis of CS was E*, the expected rate of change in the domestic exchange rate. However, as with any expected variable, it cannot be directly observed and a proxy for its measurement is required. Depending on the availability of information for each country, this proxy can be defined in several ways that may differ among countries. Consequently, the description of the empirical implementation of E* will be left to the discussion of the results for each country, although the similarities among countries will be mentioned when the same type of measure is used.

3. Empirical results

a. Argentina

The existence of domestic holdings of foreign currency in Argentina has had a long history. Nevertheless foreign-currency deposits in the domestic financial system are a fairly recent development, beginning in 1979; a consistent time series of these deposits has been available only since the second quarter of 1980. In addition, it is not possible to distinguish foreign-currency deposits held by residents and non-residents.

The importance of foreign currency deposits (F) relative to the total money stock (M+F) in Argentina, from the second quarter of 1980 to the first quarter of 1984, is depicted in Chart 2, in which the upward trend in this ratio can be observed, as well as its high degree of variability. There are some particular events in Argentina that can be associated with pronounced changes in the behavior of the series presented in Chart 2. For example, the "spike" of the series in the second quarter of 1982 is due to the South Atlantic conflict; the political uncertainty during the third and fourth quarters of 1983 is also clearly reflected in Chart 2. In addition it also shows that the importance of foreign currency deposits in Argentina has increased rapidly, from 1 percent of total money stock in mid-1980 to around 7 percent by the first quarter of 1984.

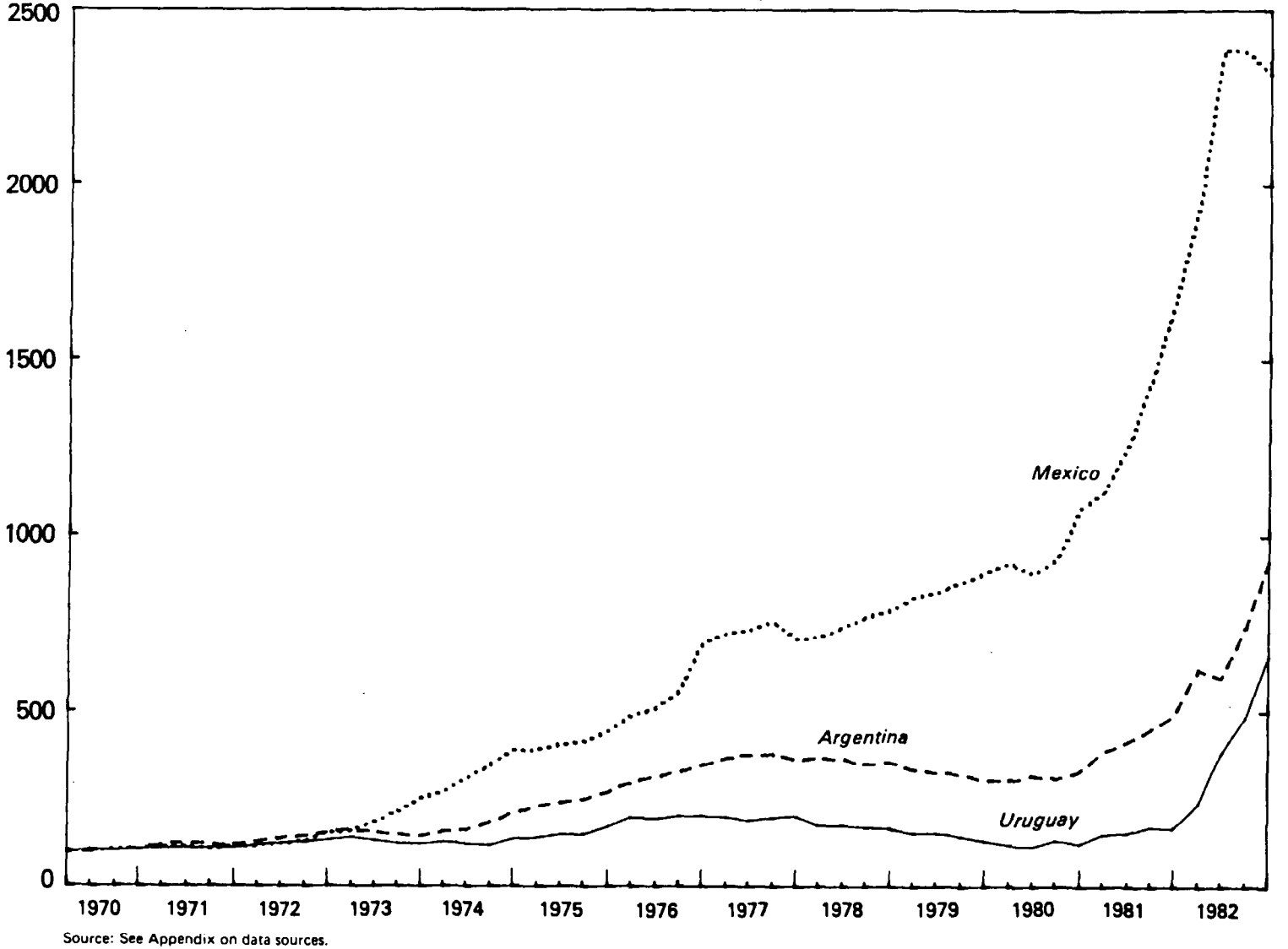
1/ A broad definition of money is being used in order to correct for fluctuations in (M/F) owing to changes in C and D that are related principally to changes in the interest rates on S and T and are not necessarily related to CS.

CHART 1

ARGENTINA, MEXICO AND URUGUAY

DEPOSITS IN U.S. BANKS BY NON-BANK FOREIGNERS

(Index 1970 = 100)



Source: See Appendix on data sources.

CHART 2

ARGENTINA

RATIO OF FOREIGN-CURRENCY DEPOSITS TO TOTAL MONEY STOCK

(In percent)

Source: See Appendix on data sources.

It is necessary to emphasize that the empirical measure of CS that is being used here underestimates--and probably greatly so--the importance of CS in a country like Argentina, where the use of foreign-currency notes is widespread. The amount of transactions carried out in foreign currency has been increasing in this country due to the high and variable inflation rate; consequently, the amount of foreign-currency notes circulating within the geographical boundaries of Argentina is likely to be quite important although its measurement is virtually impossible.

As mentioned before, our definition of CS also considers the amount of foreign-currency deposits held abroad (part of this component was presented in Chart 1). In the case of Argentina, an additional insight into the magnitude of CS can be obtained by looking at the amount of foreign-currency deposits by foreigners in Uruguay (Chart 3); most of these deposits are considered to be held by Argentine residents. 1/ The amount of foreign-currency deposits by foreigners in Uruguay increased slowly from 1975 to 1978, but from then up to mid-1982 their growth has been considerable. 2/ The amount of foreign-currency deposits by foreigners in Uruguay reached over US$1 billion by mid-1982 (which coincides with the South Atlantic conflict), and declined to about US $600 million by the end of the first quarter of 1983. Although the data in Chart 3 is an overestimate of the amount of dollars that Argentines hold in Uruguay, this is nevertheless additional information confirming the importance of CS in Argentina.

In order to estimate a statistical model of CS in Argentina, one should obtain an empirical counterpart to equation (6), and in order to do so it is necessary to specify the empirical proxy to be used for the expected change in the exchange rate. A possible candidate for this proxy might be the differential in interest rates between Argentina and the U.S.; however, since the control of interest rates has been a common practice in Argentina, except for a very short period, the use of this variable to construct the empirical proxy for the expected change in the exchange rate may be misleading. It was therefore decided to use as this

---

1/ However, Brazilians also have some foreign-currency deposits in Uruguay. A breakdown of these deposits by citizenship of the owner is not possible at this time.

2/ The increase of foreign-currency deposits by foreigners in Uruguay was due mainly to three factors, first, the financial reform that started around 1975 assured full convertibility; second, by the end of 1978 the future path of the exchange rate was announced in advance, erasing the uncertainty about exchange rate movements; third, interest rates paid in Uruguayan pesos were high in real terms.

proxy the current differential in inflation rates between Argentina and the U.S., both measured in terms of the wholesale price index (WPI). 1/

The empirical counterpart to equation (6) in the case of Argentina is given by the following regression model: 2/

$$(14) \quad \ln (M/F)_t = \alpha_o + \alpha_1 e_t + \alpha_2 \ln (M/F)_{t-1}$$

$$\alpha_1 < 0; \; 0 < \alpha_2 < 1.$$

In this equation e_t denotes the empirical proxy for the expected change in the exchange rate, defined, as just mentioned, by the current differential in inflation rates between Argentina and the United States. The introduction of a lagged term in (14) was based on two considerations. First, it could be argued that a short-run stock adjustment model is justified, given that the estimation is based on quarterly data. Second, from the examination of the series (M/F), it seems that a lagged term plays an important role in explaining the current behavior of (M/F). 3/

Finally, as discussed above, there were some events in Argentina that affected the behavior of the ratio (M/F), such as the South Atlantic conflict and the political uncertainty surrounding the elections. In

---

1/ It is well known that such a measure is based on a Purchasing Power Parity (PPP), notion of the exchange rate; that is why our proxy is called "rough". This paper does not address the virtues or defects of PPP as an explanation of exchange rate changes; the inflation differential was used due to the availability of data and, as mentioned above, as a first approximation. At a later stage it would be necessary to use a more meaningful, in an economic sense, measure of the expected change in the exchange rate.

2/ In addition to the semilogarithmic model i.e., regression model (14) that is presented in the text, a logarithmic and a linear approximation were also tested. The results of that exercise are similar to the ones presented in the text.

3/ Equation (14) could be derived from the following model:

$$(i) \quad \ln y_t^* = a_o + a_1 e_t + w_t; \; w_t \text{ iid } N(0, \sigma_w^2).$$

Assume that a relationship such as $\ln y_t - \ln y_{t-1} = \lambda (\ln y_t^* - \ln y_{t-1})$ exists. It is easy to show that (14) follow from such a stock adjustment model. In each case y_t^*, y_t, y_{t-1} should be replaced by $(M/F)_t^*$, $(M/F)_t$ and $(M/F)_{t-1}$. The resulting coefficients in (14) are given by:

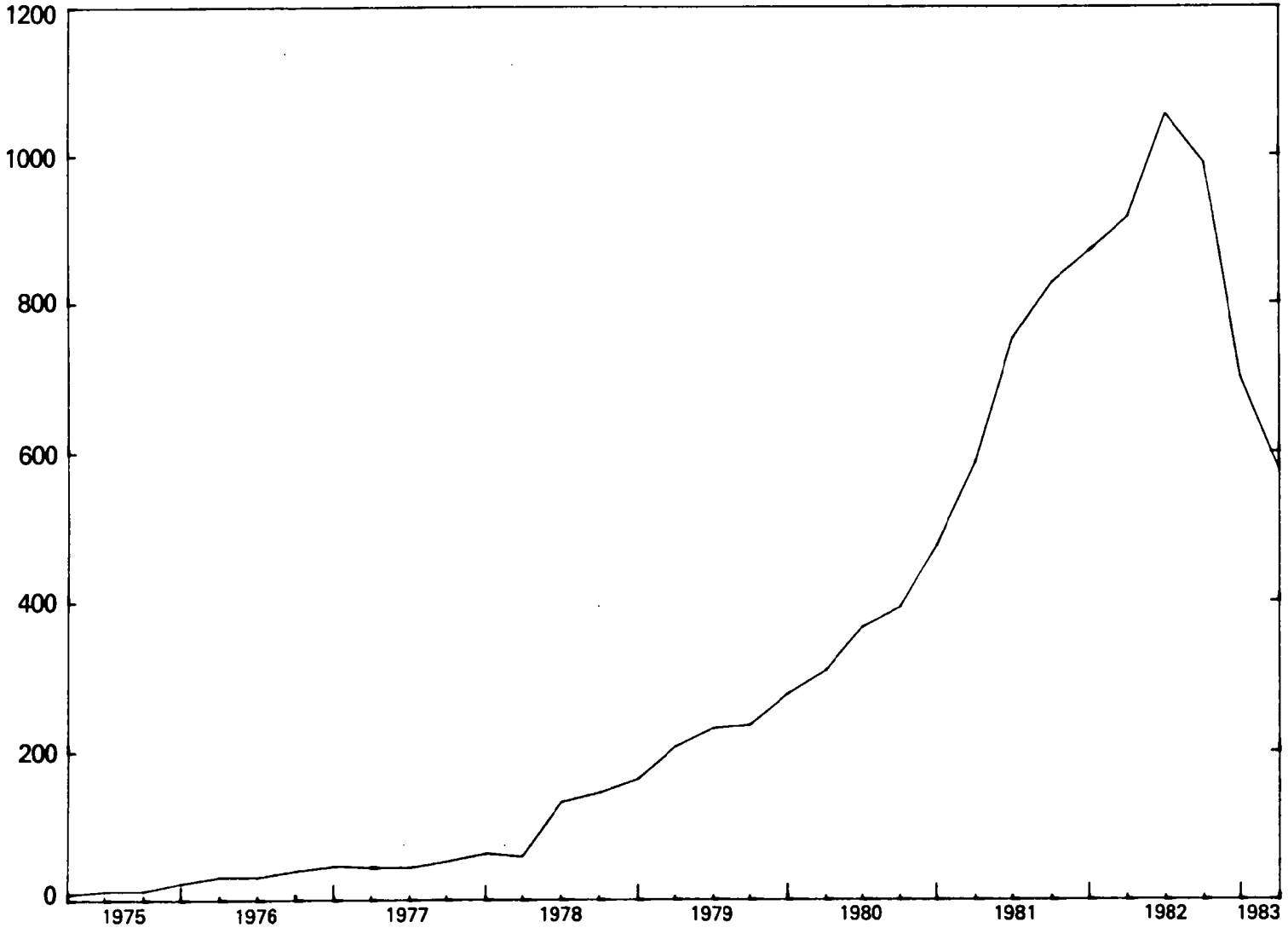
$$\lambda a_o = \alpha_o, \; \lambda a_1 = \alpha_1; \; (1 - \lambda) = \alpha_2 \text{ for equation (14).}$$

CHART 3

URUGUAY

FOREIGN-CURRENCY DEPOSITS BY NONRESIDENTS

(Millions of U.S. dollars)



Source: See Appendix on data sources.

order to include such events, two specific dummy variables were added to the regression model given by (14). The first one, denoted by D_1, is in effect for the second quarter of 1982. The second one, denoted by D_2, covers the third and fourth quarters of 1983. The results of the estimation of (14) for the period 1980 Q_2 to 1984 Q1 are presented in Table 1.

The results reported in Table 1 show that all the coefficients have the expected sign and are statistically significant. The approximation used for the expected change in the exchange rate seems to perform reasonably well in terms of sign and magnitude. In addition, the semi-elasticity of $\ln (M/F)_t$ with respect to e_t is, on average, around -3.5 for the group of regressions presented in Table 1, which is a rather high estimate. The coefficient of the lagged term in the group of equations implies that, on average, about 55 per cent of the observed discrepancy between desired and current quantities is adjusted within the current quarter, suggesting a rapid process of adjustment. The inclusion of the dummy variables, whose coefficients are denoted by α_3 and α_4, improves the precision of the fit. In addition, the change in the SEE points out the statistical signficance of these variables.

The magnitude of the Durbin H-statistic, does not allow the rejection of the null hypothesis that errors are serially independent. 1/ However, two caveats are necessary when evaluating the magnitude of the H-statistic. First, autocorrelation of a higher order may be present. Second, the Durbin H-statistic is based on asymptotic properties, and for small samples such as the one used here, the results should be considered as suggestive rather than conclusive.

Summarizing, the rough empirical approximation used here to study the phenomenon of CS in Argentina indicates that currency substitution is indeed an important empirical event in this country, one that deserves more analysis, especially when formulating economic policies related to interest rates and exchange rate regimes. Additional research would be necessary, however to estimate more fully the effects of CS in the Argentine economy.

b. Mexico

As mentioned before, Mexico has differed from Argentina and Uruguay, in the sense that the problem of CS in Mexico is of very recent origin. The latter observation is confirmed in Chart 4, in which the ratio

---

1/ As it is well known, this test applies only for checking the existence of a first order Markov process.

Table 1. Estimates of Currency Substitution in Argentina, 1980-Q2 - 1984-Q1*

α_0	α_1	α_2	α_3	α_4	R^2	SEE	H
2.49	-1.99	0.36			0.67	0.36	-0.32
(0.70)	(0.81)	(0.17)					
2.02	-1.53	0.45	0.80		0.79	0.30	0.18
(0.62)	(0.71)	(0.15)	(0.33)				
1.83	-2.05	0.52	0.88	0.68	0.91	0.20	1.38
(0.42)	(0.49)	(0.10)	(0.22)	(0.18)			

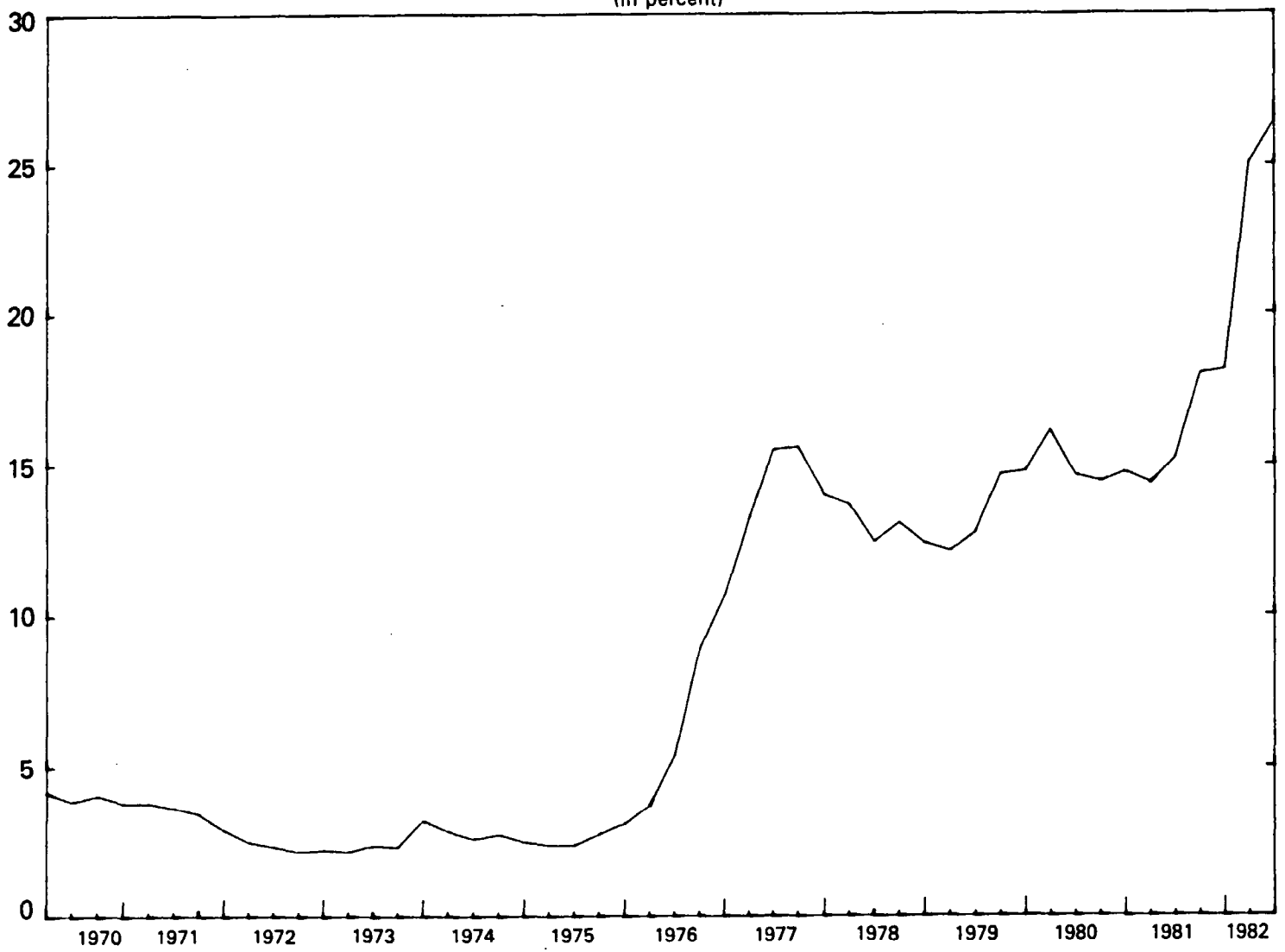
* Standard errors in parenthesis.
R^2: coefficient of determination.
SEE: standard error of the regression.
H: Durbin H-statistic.

CHART 4

MEXICO

RATIO OF FOREIGN-CURRENCY DEPOSITS TO TOTAL MONEY STOCK

(In percent)



Source: See Appendix on data sources.

(F/M+F) is plotted quarterly for the period 1970 Q1 to 1982 Q2. Here F denotes total foreign-currency deposits (mainly in U.S. dollars) in the domestic financial system; in Mexico as in Argentina, it is not possible to distinguish foreign-currency deposits between those held by residents and nonresidents.

From the examination of Chart 4, the meaning of CS as a "problem" becomes clearer than in the case of Argentina, because Mexico had a fixed exchange rate and no capital controls from the mid-1950s until the mid-1970s. During 1970 to 1974, no one in Mexico would think of foreign-currency deposits as a "threat" or "problem," to name a few of the adjectives applied to foreign-currency deposits from the second half of the 1970s until the expropriation of the private banking system in September, 1982. CS first became a "problem" for the monetary authorities during the period from 1975 until the devaluation of the peso in August 1976, during which there was a phenomenal change in the (F/M+F) ratio. Over the whole period, 1970 Q1 to 1982 Q2, foreign-currency deposits as a proportion of the total money stock grew from 4 percent to 25 percent (Chart 4).

One could argue that the change in the behavior of the (F/M+F) ratio was the result of the expectations about future exchange rate movements. This claim receives support from a paper of Blanco and Garber (1983), in which they estimate a time series of the probability of devaluation one period ahead for Mexico. Table 2 reproduces part of the time series calculated by Blanco and Garber. This table shows that the probability of a devaluation one period ahead increased considerably since the first quarter of 1975, reaching its peak in the second quarter of 1976, and decreased afterwards. In terms of Chart 4, the movements of the ratio (F/M+F) match very closely the behavior of the time series of the one-period-ahead devaluation probabilities; furthermore, the inflexion points in Chart 4 are in the second quarter of 1975, in the third quarter of 1976 and in the second quarter of 1977.

An additional insight that can be obtained from the analysis of Chart 4 is that the level of the ratio (F/M+F) did not return to the level experienced during the early 1970s. In other words, the public did not move significantly out of dollars during the years following the devaluation of 1976.

Interest rates in Mexico were fixed for a period during the 1970s and afterwards were managed. It is therefore not possible to obtain a consistent time series for interest rates. Consequently, as in the case of Argentina, it was decided as a rough approximation to measure the expected change in the exchange rate by the current differential in inflation rates between Mexico and the U.S., both measured in terms of the wholesale price index (WPI).

Table 2. Mexico: Time Series of the Probability of Devaluation One Period Ahead

1974 Q1	0.110
1974 Q2	0.039
1974 Q3	0.016
1974 Q4	0.019
1975 Q1	0.138
1975 Q2	0.152
1975 Q3	0.397
1975 Q4	0.342
1976 Q1	0.495
1976 Q2	0.542
1976 Q3	0.535
1976 Q4	0.011

Source: Blanco and Garber, Table 3.

The empirical model to be estimated for Mexico can thus be represented as:

$$(15) \quad \ln (M/F)_t = \beta_0 + \beta_1 e_t + \beta_2 \ln (M/F)_{t-1}$$

$$\beta_1 < 0; \quad 0 < \beta_2 < 1$$

where e_t denotes the current differential in inflation rates between Mexico and the United States. Again, as in the case of Argentina, the lagged value of (M/F) seems to play an important role in explaining the current behavior of the ratio of pesos to dollars and one can justify the inclusion of a lagged term as the result of an adjustment model. The results of the estimation of (15) are presented in Table 3. 1/

From Table 3, the results show that this rough approximation to empirically testing the CS model in Mexico performs reasonably well. All the coefficients have the expected signs and are statistically significant. The reason for omitting the first two quarters of 1982 in regressions (ii) and (iv), was because in 1982 the expectations of devaluation and of intervention were made more uncertain by statements of policy intentions by the authorities. From Table 3 we see that the deletion of these observations does not change the signs and statistical significance of the estimates.

As is evident from the examination of Chart 4 and from the results reported in Table 3, there seems to be a change in the nature of the economic relationships occuring around 1977. Although, the sign and statistical significance of the coefficients are maintained, the hypothesis of stable coefficients of the regression models for different periods is rejected. 2/

1/ As in the case of Argentina a linear version of the model was also estimated. The results of that estimation do not differ significantly from the ones in the text.

2/ A test on the stability of the coefficients was performed and the hypothesis of equality of the regression coefficients among equations was rejected. The calculated F-statistics were F(27, 19) = 2.50 for regressions (i) and (iii); and F (27, 17) for regressions (ii) and (iv). The critical values at the 95 percent confidence level are 2.07 and 2.15 respectively.

Table 3. Estimates of Currency Substitution in Mexico, 1970-Q1, 1981-Q4, and 1982-Q2 1/

		β_0	β_1	β_2	R^2	SEE	H
		Period: 1970 Q1 - 1982 Q2					
(i)	ln (M/F)	0.06 (0.08)	-1.96 (0.57)	0.98 (0.02)	0.98	0.14	0.55
		Period: 1970 Q1 - 1981 Q4					
(ii)	ln (M/F)	0.06 (0.07)	-2.01 (0.62)	0.98 (0.02)	0.98	0.13	1.07
		Period: 1977 Q1 - 1982 Q2					
(iii)	ln (M/F)	0.67 (0.26)	-3.21 (0.81)	0.66 (0.14)	0.85	0.10	-0.98
		Period: 1977 Q1 - 1981 Q4					
(iv)	ln (M/F)	0.66 (0.26)	-2.43 (0.92)	0.65 (0.14)	0.63	0.08	0.62

1/ Note: see Table 1.

As mentioned before, the use of the inflation differential as a proxy for the expected change in the exchange rate was only a first approximation. In the case of Mexico, a more economically meaningful measure is given by the information contained in the future prices for Mexican pesos. 1/ From this information it is possible to calculate a measure of the expected change in the exchange rate of the Mexican peso. Theoretically, this measure is by far superior to the inflation differential proxy that has been used so far. Consequently, a regression equation was estimated for the period 1977 Q1 to 1980 Q4, with the information provided by the futures prices. The result of the estimation was the following: 2/

$$(16)\quad \ln (M/F)_t = \underset{(0.29)}{1.11} - \underset{(0.01)}{0.03}e_t^* + \underset{(0.15)}{0.46} \ln (M/F)_{t-1};$$

$$R^2 = 0.53; \quad SEE = 0.08; \quad H = 1.40.$$

Standard errors are in parenthesis, and for the definition of the summary statistics the reader is referred to Table 1. The variable e_t^* is the expected change in the exchange rate during a quarter defined as $e_t^* = (F_t - S_t)/S_t$, where F_t is the three-month futures price of a U.S. dollar in terms of Mexican pesos, and S_t is the spot price of a U.S. dollar in terms of Mexican pesos.

The results given by (16) show that all the coefficients have the expected sign and are statistically signficant. The H-statistic does not reveal the presence of autocorrelation of first order. 3/ All in all, these results, based on an improved measure of the expected change in the exchange rate, provide further statistical support for the model of CS in Mexico.

Summarizing, the results of the simple empirical model for Mexico seem to be reasonably good. Currency substitution became a problem in this country since the mid-1970s, and the statistical results provide evidence on this issue.

1/ See International Money Market Yearbook.

2/ Due to the current availability of information with regards to the futures prices the sample had to be restricted to this period.

3/ However, the sample size is very small and consequently this statistic should be considered only as suggestive of the absence of a first-order Markov process of the error term.

c. Uruguay

The existence of domestic holdings of foreign currency (mainly in the form of U.S. dollars) in Uruguay has had a long history, and its importance has been considerable. In Chart 5, the magnitude of foreign-currency deposits in this country is presented on a quarterly basis, from 1970- Q1 to 1982-Q3. In this instance, the variable F in the ratio (F/M+F) is foreign-currency deposits held by domestic residents, denominated in new Uruguayan pesos. As is clear from examination of Chart 5, the proportion of foreign currency deposits held by domestic residents in Uruguay represented for the whole period, on average, about 21 percent of the total money stock; this percentage had increased to about 42 percent by the third quarter of 1982.

It should be noted that the behavior of the ratio, (F/M+F) has been markedly different since the end of 1974 and the beginning of 1975, years in which a far-reaching financial reform was initiated in Uruguay. It may be possible that part, if not all, of the recorded increase in foreign-currency deposits that occurred in Uruguay at that time was the consequence of the lifting of controls, which led to the result that foreign money previously held outside of the domestic financial system and consequently not recorded was now placed in the domestic financial system. In other words, the observed change in (F/M+F) may not have been the result of an increase in the demand for foreign fiat money.

As a first and rough approximation to the statistical estimation of CS in Uruguay, we will propose as an empirical counterpart of equation (6) the following regression models:

$$(17) \quad \ln (M/F)_t = \gamma_o + \gamma_1 \ln e_t + \gamma_2 \ln (M/F)_{t-1};$$

$$(18) \quad \ln (M/F)_t = \delta_o + \delta_1 \bar{e}_t + \delta_2 \ln (M/F)_{t-1};$$

$$\gamma_1, \delta_1 < 0; \; 0 < \gamma_2, \delta_2 < 1.$$

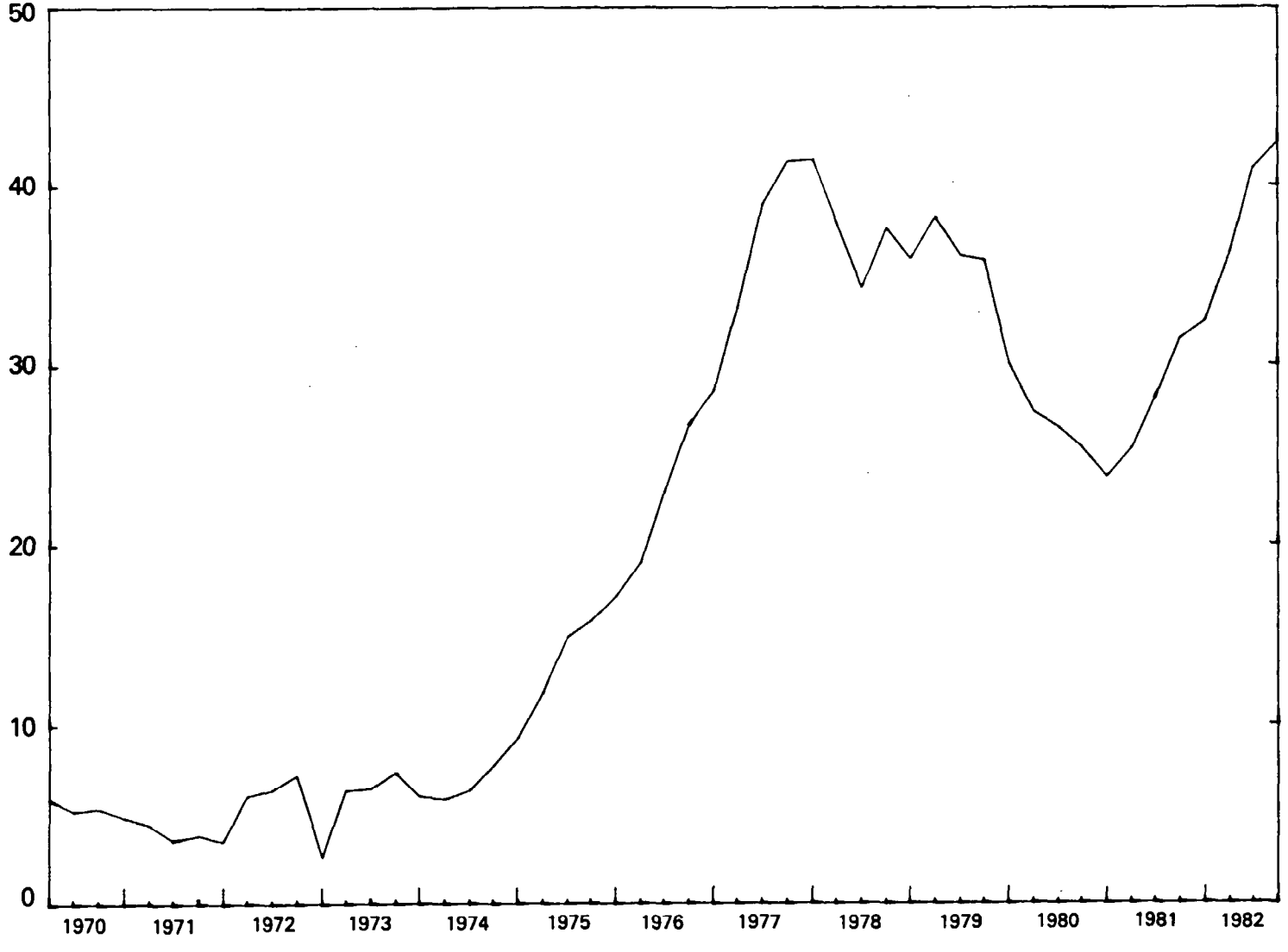
In these equations, e_t and $\bar{e}_t$ denote empirical proxies for the expected change in the exchange rate. The first proxy, e_t, was defined as the differential between the domestic interest rate paid on domestic-currency-denominated deposits (i_d), and the domestic interest rate

CHART 5

URUGUAY

RATIO OF FOREIGN-CURRENCY DEPOSITS TO TOTAL MONEY STOCK

(In percent)



Source: See Appendix on data sources.

paid on foreign-currency deposits in Uruguay (i_f). 1/ The other proxy, e_t, was constructed as the current differential in inflation rates, as given by the WPI, between Uruguay and the United States. 2/

As discussed in the previous section, the use of interest rate differentials to approximate the expected rate of depreciation of the domestic currency is likely to perform better in the absence of intervention, that is, when the rates are freely determined by the market. However, sometimes this measure will also include what is commonly known as a risk premium, i.e., that fraction that is not explained by the domestic interest rate paid in new Uruguayan pesos adjusted by actual movements in the exchange rate. This study does not attempt to break down e_t between risk and expectations. An additional consideration in the construction of e_t is that during the period being analyzed Uruguay experienced several profound changes in the behavior of i_d and i_f, because for some periods they were fixed by the government, for other periods they were managed and followed a kind of crawl (related to the inflation rate), and for yet other periods they were completely determined by market forces. It seems likely that such events, as well as other structural changes that took place, would affect the performance of (17) in different periods. In addition, the introduction of preannounced exchange rates (the "tablita") in Uruguay, from the end of 1978 imposed a declining path in the wholesale price index. Consequently, our second measure of expected depreciation, $\bar{e}_t$, would also be affected by the introduction of the "tablita."

The introduction of a lagged term in (17) and (18) was based on two considerations. First, it could be argued, as in the case of Argentina and Mexico, that a short-run stock adjustment model is justified, given that the estimation is based on quarterly data. Second, from the examination of the data, it seems that a lagged term plays an important role in explaining the current behavior of (M/F).

The results of the estimation of the whole sample, i.e., 1970 Q1 to 1982 Q3, are presented in Table 4. It is possible to observe that most of the coefficients in the regressions are significant and have the expected sign. The use of interest rate differentials to measure the

---

1/ There are some comments relevant to the construction of e_t; first the interest rates used are for deposits with a maturity of one to six months. Second, the rates were established at the beginning of the period for each deposit.

2/ As in the case of Argentina and Mexico several functional forms were estimated. The logarithmic approximation, as well as the linear one, were found to perform better when the differential in interest rates was used. Otherwise, the results are similar to the ones presented in the text.

Table 4. Estimates of Currency Substitution in Uruguay, 1970-Q1-1982-Q3

	γ_0	γ_1	γ_2	R^2	SEE	H
ln(M/F)	1.63	-0.42	0.75	0.95	0.24	-0.90
	(0.67)	(0.17)	(0.10)			
	δ_0	δ_1	δ_2			
ln (M/F)	0.00	-0.13	0.98	0.94	0.26	-1.53
	(0.00)	(0.60)	(0.04)			

1/ Note: see Table 1.

expected change in the exchange rate performs much better than the proxy given by the current inflation differential. The coefficient of the lagged term in both equations is highly significant. Nevertheless, for the model (18) it implies a very long adjustment process, compared to the one obtained with the model (17), in which about 25 percent of the observed discrepancy between desired and current quantities is adjusted within the current quarter.

The value of the Durbin H-statistic does not reveal the presence of first order serial autocorrelation in both equations; however, one may check, in the future, for autocorrelation of a higher order, or of a different kind. Examination of the residuals, not shown, indicates the absence of heteroscedasticity in them. The use of ratios and of logarithms probably took care of this problem if it was present.

In addition to the results shown in Table 4, several other tests were conducted that seem to indicate that structural changes took place in Uruguay around 1975 and possibly in some other years. Given the series of profound reforms that this country has undertaken during the last 10 years, it is very difficult to estimate with precision the timing and the type of structural changes that have occurred. Consequently, the results given by our regressions should be considered only as suggestive. Nevertheless, the available evidence indicates that currency substitution is empirically important in this country and needs to be taken into account in the implementation of policies. Additional work would be necessary to analyze the way in which the different episodes of liberalization and institutional changes during the last ten years affected the degree of currency substitution in Uruguay.

d. Some comments on the comparison among countries

The overall picture of the empirical evidence provided in this paper suggests that CS is an important feature of the economies in Argentina, Mexico and Uruguay, although these countries have experienced CS in different degrees. In comparison with Argentina and Uruguay, the size of the change in CS, measured by changes in the (F/M+F) ratio, has been far more rapid in Mexico. This observation supports the view that CS can become a problem in a very short period of time, even in a country which has been very stable. 1/

1/ When comparing Mexico with Argentina and Uruguay in terms of CS, recall that foreign currency deposits in Mexico, as well as in Argentina, are not divided by residency of the owner. This effect may explain some differences.

Another point of interest is that from the analysis of the three countries it seems that once the public has moved into dollars, it does not move out again to any significant degree. 1/ This observation, that is suggested from the inspection of Charts 1, 2, 4 and 5, seems to suggest that regaining the confidence of the public tends to be a long and difficult process. All of these countries face the challenge of controlling monetary aggregates in the presence of substitution between domestic and foreign monies. This problem highlights the importance of the proper definition of money when the country is engaged in a policy of monetary targeting. An empirical definition of money that includes foreign-currency deposits, such as (M+F), may appear very appealing, because movements in this aggregate are likely to exhibit a smoother path compared to one which considers only domestic money (M). 2/ The problem is more complicated when money demand functions are estimated with a definition of money that considers foreign-currency deposits in the domestic financial system, and the outcome of such estimates is used to provide the basis for economic policy. 3/ The crucial assumption of such an exercise is that foreign-currency deposits in the domestic financial system are not a very good substitute for foreign-currency deposits held abroad, and this may indeed be a very fragile assumption, as the evidence of this paper suggests. (See Chart 1 for all the three countries and Chart 3 for Argentina).

IV. Currency Substitution and Macroeconomic Policy

The phenomenon of CS has recently received much attention because of the impact of CS on the design and effectiveness of macroeconomic policies. For example, in a country where the government engages in a policy of inflationary finance, residents may discount or anticipate the future inflation resulting from this policy by reducing their holdings of domestic money balances, and they may do so by substituting foreign for domestic money. Such monetary substitution will produce an immediate deficit in the balance of payments and/or an instantaneous depreciation of the exchange rate. In any case, the revenue from money creation (segniorage) will fall, and the base of the inflationary tax will be reduced, thereby bringing down revenues of the consolidated government sector (including the central bank) and changing the future path and composition of revenue. Furthermore, due to these changes the government deficit may well be larger than before. 4/

1/ As mentioned before some transitory reversals occurred in Argentina and Uruguay.

2/ This problem is similar, on a different level, to the one faced when comparing definitions of money with and without interest bearing deposits.

3/ Ortiz (1983) deals with this problem in a different context.

4/ For a discussion of this issue, see Khan and Ramirez-Rojas (1984).

On the other hand, a country may benefit from the substitution among monies when the government is engaged in a stabilization effort that is credible to the private sector. In such a situation, residents may reduce their demand for foreign money and increase their holdings of domestic real cash balances. As a result, residents may very well repatriate foreign money and thus produce a further once-for-all increase in their domestic money holdings. All of these changes may be reflected as a surplus (or a reduction in the deficit) in the balance of payments and/or as an appreciation (reduction in the rate of depreciation) of the domestic exchange rate.

In an environment characterized by a high and variable inflation rate, recurrent devaluations, and a declining demand for domestic real balances, the authorities may devise certain policies to deal directly with the problem of CS. 1/ Short of foreign exchange restrictions, one of the most popular of such policies is to promote foreign-currency deposits in the domestic financial system. This device is based on the idea that by reducing the transaction costs and increasing the liquidity to the depositor, it may diminish, at least in part, the outflow of foreign currency, and consequently it will reduce pressure on international reserves or the exchange rate. An additional "advantage" of such deposits is that if reserve requirements are imposed on them, then, other things being equal, the central bank's balance sheet will show an increase in net foreign assets, 2/ and these deposits with the central bank enable the central bank to provide additional financing to the rest of the government sector.

Underlying the promotion of foreign-currency deposits is the illusion that by keeping foreign money within the boundaries of the home country, the monetary authorities avoid and offset outflows of hard currency. Nevertheless, the introduction of foreign-currency deposits in the domestic financial system does nothing to change the extent of CS in the system. If, however, foreign-currency deposits are subject to reserve requirements, then the distribution of foreign money in the economy has changed. Furthermore, foreign-currency deposits in the domestic financial system are potentially under more control by the authorities than deposits located abroad.

1/ The specific types of problems that the domestic financial authorities will face due to CS depend on several factors, such as the exchange rate regime, the existence of capital controls, the type of interest rate policy, government spending, inflation, and on the behavior of the demand and supply of domestic money.

2/ Rubli (1981) recognizes this point explicitly. His message, as well as the one of this paper, is that it is incorrect to record as net foreign assets the foreign exchange holdings of the central bank arising from foreign currency liabilities to commercial banks.

In addition, if the fundamental factors that promoted CS--such as the inflationary financing of government expenditure, an inappropriate interest rate policy, and the general lack of consistency and credibility of overall economic policy--are not corrected, foreign-currency deposits as a percentage of total deposits will grow and may themselves become a destabilizing force within the domestic financial system. The extent of such a destabilization effect depends in part on the perceptions of the public about government intervention in the banking system, as well as government expenditure and financing. 1/

In short, the use of foreign-currency deposits in the domestic financial system does nothing to avoid and offset CS. Whether foreign-currency deposits should be excluded or eliminated from the domestic financial system is a separate question that depends on what they are used for. If these deposits are used simply as a means to facilitate international transactions related to trade activities, thereby merely replacing such deposits held abroad, they do not interfere with the conduct of monetary policy. If, however, they are used as a means to reduce monetary outflows, the demand for foreign money has increased relative to the demand for domestic assets, regardless of whether CS takes the form of foreign money holdings that residents hold abroad or domestic foreign-currency deposits. The only difference is in the immediate impact on the balance of payments. 2/

A politically more problematic means of counteracting CS is the use of interest rate policy. In order to reduce or stop CS, the required change in the nominal domestic interest rate usually implies a high positive ex-ante real rate, and this effect can produce a substantial reduction in investment and real output. 3/

The purpose of interest rate policy to reduce CS is to make deposits denominated in domestic currency a more attractive alternative to holding foreign currency, as well as to allow individual depositors to hedge against the future value of the exchange rate. The commercial banks also require a means of providing themselves with a short-term hedge against

---

1/ The case of Mexico, where the government expropriated the private banking system and paid the dollar-denominated deposits in pesos at an exchange rate lower than the market rate, represents the extreme result of government intervention.

2/ Foreign-currency deposits normally imply the freedom to withdraw the amount deposited, in foreign currency, at any time, so that such deposits always represent a potential outflow.

3/ See Tanzi and Blejer (1982); IMF (1983); and Lanyi and Saracoglu (1983) for a more complete analysis of these and other issues regarding interest rate policy.

their foreign currency liabilities. 1/ Such an interest rate policy requires a monetary contraction, and this may be achieved by the imposition of reserve requirements on domestic deposits of all kinds. 2/

The scope for interest rate policy to reduce CS depends on the consistency and credibility of overall economic policy. If an effective demand management policy is being maintained, the effect of a change in interest rate policy--say from one that produces negative real interest rates to one in which positive real rates are achieved--is to reduce the extent of CS. Indeed, it may stop CS completely and may even induce domestic residents to move out of foreign money. In addition, the net monetary contraction via reserve requirements both reinforces the credibility and effectiveness of the demand management stance and reduces the scope for CS by the private and public sectors. 3/

Other measures that have been proposed to reduce CS include a futures market for the domestic money and domestic-currency deposits that are indexed to the exchange rate. Both these proposals are intended to deal with an essential feature of CS, namely, the uncertainty associated with the future value of the domestic currency, which tends to produce a decline in the demand for assets denominated in it. 4/

Perhaps the main advantage of a futures market for foreign exchange would be to reallocate resources previously devoted to collecting information, to some more productive activity, thereby raising the level of output. 5/ It may be questioned, however, whether a futures market could stop or reduce CS. A futures market by itself will reduce the uncertainty about the future exchange rate, but more certain knowledge of

---

1/ The banks may make loans denominated in foreign currency on the basis of foreign currency loaned to them, but these would normally be of longer term than the term of the deposits.

2/ This argument assumes that the central bank does not finance the government with these funds, or if it does there is a more than proportional reduction in its other lines of credit to the government.

3/ Of course there are other ways to produce a monetary contraction, for example open market operations. However, the experience of countries with high and variable inflation rates seems to indicate that this type of public debt, i.e., bonds, is associated with future inflation, and consequently it may have a positive effect on CS rather than a negative one.

4/ A necessary condition for regaining confidence in the country's money is implied by confidence in the government itself; the latter is partly achieved by a set of consistent and credible economic policies.

5/ At this level of generality the role of the government in the futures market, as well as the size of the market, and other important and related issues are not discussed.

the future value of the exchange rate does not necessarily result in an increase in the demand for domestic money. In order for a futures market to have some impact on CS, interest rates on domestic-currency-denominated deposits must be geared to prices in the futures market so as to eliminate unexploited profit opportunities. In addition, reserve requirements on such deposits are desirable as a means to ensure a net monetary absorption. It is important to note that when an active interest rate policy is implemented together with a futures market for domestic currency, the resulting domestic interest rates, both nominal and real, are likely to be lower than the ones achieved with an interest rate policy alone; this result arises because a futures market reduces uncertainty with respect to the future exchange rate.

The use of domestic-currency-denominated deposits indexed to the exchange rate (DE) is similar to the use of the interest rate policy on domestic deposits discussed before, and shares a characteristic of a futures market. 1/ However, there are significant differences among DE deposits and the other instruments. The total yield associated with the DE deposits should be at least equal to the interest rate paid on foreign money plus the percentage associated with changes in the exchange rate. 2/ This yield is likely to be smaller than the interest rates paid on domestic-currency deposits under a policy designed to combat CS through manipulation of such rates, the reason being the reduction in uncertainty associated with movements in the exchange rate. Funds placed in DE deposits will be lent by commercial banks at terms that are the same as those at which they are deposited, plus a commission. Alternatively, the banks will hedge their DE deposits by purchasing foreign currency. 3/

In summary, to halt the process of CS--to prevent further increases in, or to reduce, the existing level of foreign currency holdings--three requirements must be met. First, the expected return on domestic financial instruments has to be increased. Second, to accomplish a rise in this return, a net monetary contraction is required. Finally, overall demand management policies must be consistent and credible. Failure to meet any of these requirements will seriously hamper any attempt to counteract CS.

1/ The proposal for the use of the DE assumes that the exchange rate is freely floating or with a very limited intervention.

2/ Two caveats are necessary here: (1) risk considerations may affect the rate paid on DE; and, (2) the transaction costs associated with sending money out of the country may also affect the rate paid on DE.

3/ Note that if the public and the commercial banks perceive the overall economic policy of the government as consistent and credible, then the private sector may not engage in CS. However, credibility is a scarce resource in a country in which the government is trying to stabilize. In other words, credibility takes time to build.

V. Summary and Conclusions

The subject of study of this paper was the phenomenon of currency substitution, defined as the demand for foreign fiat money by domestic residents of a country. In particular, the asymmetrical nature of this process in three Latin American countries namely, Argentina, Mexico, and Uruguay, was theoretically and empirically analyzed.

The theoretical determinants of asymmetrical currency substitution were discussed within the framework of a simple model that highlighted the importance of the expectations of exchange rate movements in the individuals' desired composition of financial wealth between holdings of domestic and foreign money. A review of empirical evidence presented in previous research confirmed the importance of currency substitution in the countries under consideration. The empirical evidence provided in this paper included a graphical exposition of some of the magnitudes involved in the currency substitution phenomenon for Argentina, Mexico and Uruguay. The statistical analysis confirmed the importance of the expected change in the exchange rate (for which proxy measures were developed) in the behavior of currency substitution in all three countries. Of special interest were the speed at which this process takes place and the apparent irreversibility of currency substitution in all of the countries under study.

A discussion of policies directed towards counteracting CS considered several devices that have been attempted. It was concluded that any set of policies to stem CS must be credible and must involve both a net monetary contraction and an increase in the expected real return of the domestic money. On this last point, the role of domestic interest rates, as a means of increasing the relative cost of foreign money, was highlighted.

In view of the increasing trend of currency substitution in countries such as Argentina, Mexico and Uruguay, the search for appropriate economic policies to deal with this problem is an urgent one, and to this end there is great need for further research in this area. There are several directions that such research could take. First, there is need for a more detailed analysis of how an economy operates in the presence of widespread currency substitution. Specifically, the relationship between monetary and exchange rate policies requires further study. Second, additional efforts at data collection are necessary. Third, methods for estimating the statistical relationship between currency substitution and other economic variables would be refined, in part by using additional data; the latter should also make it possible to construct a better empirical measure of the expected change in the exchange rate than the ones used in this paper. For example, the use of prior information could play an important role in improved estimation techniques, especially in the case of Uruguay, given the series of economic reforms that this country experienced in the last 10 years. Finally, the presence of currency substitution provides a new variant to the question of whether monetary policy should be geared to a target rate of growth of a monetary aggregate or to rules related to interest rates and exchange rates.

Appendix on Data Sources

Data on domestic and foreign deposits for Argentina, Mexico and Uruguay, were obtained from the respective Central Banks. Data on prices were obtained from various issues of the International Financial Statistics. Deposits in U.S. Banks by Non-Bank Foreigners of Argentina, Mexico and Uruguay were obtained from various issues of the Treasury Bulletin of the U.S. Treasury Department.

Bibliography

Banda, Ariel., "Una Aproximacion Empirica al Estudio de los Sustitutos del Dinero en el Uruguay," paper presented at the Reunion de Tecnicos de Bancos Centrales del Continente Americano. Vina del Mar (Chile), October 31 - November 5, 1982.

Bilson, John, "Recent Developments in Monetary Models of Exchange Rate Determination," IMF Staff Papers, (June 1979), pp. 201-223.

Blanco, H., and P. Garber, "Recurrent Devaluation and Speculative Attacks on the Mexican Peso," unpublished manuscript, (December 1983).

Blejer, Mario I., "Black-Market Exchange-Rate Expectations and the Domestic Demand for Money: Some Empirical Results," Journal of Monetary Economics (November 1978), pp. 767-773.

Bordo, M., and E. Choudri, "Currency Substituion and the Demand for Money: Some Evidence for Canada," Journal of Money, Credit, and Banking, (February 1982), pp. 48-57.

Brillembourg, A., and S. Schadler, "A Model of Currency Substitution in Exchange Rate Determination, 1973-78," IMF Staff Papers, (September 1979), pp. 513-542.

Calvo, G., and C.A. Rodriguez, "A Model of Exchange Rate Determination under Currency Substitution and Rational Expectations," Journal of Political Economy, (June 1977), pp. 617-625.

Calvo, G., "Currency Substitution and the Real Exchange Rate: the Utility Maximization Approach," International Economics Research Center, Paper No. 12, Columbia University (September 1982).

Chicago Mercantile Exchange, "International Monetary Market Yearbook," various issues.

Cuddington, John T., "Currency Substitution, Capital Mobility and Money Demand," Journal of International Money and Finance, (March 1983), pp. 111-133.

Fasano-Filho, U., "Currency Substitution, Interest Rate, and Exchange Rate Policy: the Case of Argentina," unpublished Ph.D., dissertation, University of Illinois at Urbana Champaign (March 1984).

Girton, L., and D. Roper, "Theory and Implications of Currency Substitution," Journal of Money Credit and Banking, (February 1981), pp. 12-30.

International Monetary Fund, "International Financial Statistics," various issues.

International Monetary Fund, Research Department, "Interest Rate Policies in Developing Countries," Occasional Paper 22, (October 1983).

Khan, Mohsin S., and C. Luis Ramirez-Rojas, "Currency Substitution and Government Revenue from Inflation," IMF, DM/84/58 (September 1984).

Lapan, H., and W. Enders, "Rational Expectations, Endogenous Currency Substitution, and Exchange Rate Determination, "The Quarterly Journal of Economics (August 1983), pp. 427-439.

Lanyi, A., and R. Saracoglu, "The Importance of Interest Rates in Developing Economies," Finance and Development, (June 1983), pp. 20-23.

McKinnon, R., "Currency Substitution and Instability in the World Dollar Standard," American Economic Review, (June 1982), pp. 320-333.

Miles, Marc, "Currency Substitution, Flexible Exchange Rates, and Monetary Independence," American Economic Review, (June 1978), pp. 428-436.

Ortiz, Guillermo, "Currency Substitution in Mexico: the Dollarization Problem," Journal of Money, Credit and Banking, (May 1983), pp. 174-185.

Rubli, Federico, "An Analysis on the Theory and Implications of the Currency Substitution Phenomenon," unpubished manuscript, Columbia University, 1981.

Sargent, Thomas, "Comment," in Financial Policies and the World Capital Market: The Problem of Latin American Countries, ed. by P. Aspe, R. Dornbusch and M. Obstfeld. National Bureau of Economic Research (The University of Chicago Press, 1983), pp. 95-106.

Tanzi, V., and M. Blejer, "Inflation, Interest Rate Policy, and Currency Substitutions in Developing Economies: A Discussion of Some Major Issues," World Development (September 1982), pp. 781-790.

U.S. Treasury Department, "Treasury Bulletin," Washington, D.C., various issues.

Wallace, Neil, "Why Markets in Foreign Exchange are Different from Other Markets," Federal Reserve Bank of Minneapolis Quarterly Review, (Fall 1979), pp. 1-7.