Notes:

[1] Hansen and Sargent (1991) point out that these models, with linear quadratic objective functions and linear restrictions, have the advantage of combining good dynamic economics with good econometrics, since VAR and state-space representations are now the accepted empirical approaches for econometric analysis of dynamic systems. One can then proceed to estimation by simulation: compare the estimates of simulated data with estimates of actual data, and then alter the values of the "deep parameters" of the objective function until convergence.

[2] A copy of the Matlab (1990) program for these models, for use with the Hansen-Sargent (1991) solution algorithms, is available upon request.

[3] A copy of the Matlab program for estimating the GARCH parameters is available from the first author upon request.

[4] Data for Argentina were obtained from Hildegard Ahumada at the Central Bank of Argentina. A copy of the Matlab (1990) program for estimating the GARCH models, as well as the data sets, are available upon request.

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CURRENCY SUBSTITUTION AND INFLATION IN PERU

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Abstract:

This paper shows that there is a long-run relationship between the expected rate of depreciation in the black-market-exchange rate and the ratio of domestic to foreign money in Perú; that is, the hypothesis of currency substitution can explain the behavior of real holdings of money in Perú. The paper also shows that, while, the importance of currency substitution as a transmission mechanism through which domestic policies affected the dynamics of inflation was relatively small during a period of high but relatively stable inflation (January 1978-85), it became an important factor in the inflation process during the recent hyperinflation episode.

I. Introduction

This paper deals with currency substitution–the substitution of foreign money for domestic money by domestic residents–and its role in the dynamics of inflation in Perú during the period January 1978-December 1990. As documented in a number of studies[1], currency substitution is a widely spread phenomenon in many developing countries. In the context of high levels of inflation and expectations of exchange rate depreciation, residents in many developing countries have attempted to protect the real value of their wealth by increasing their holdings of foreign currency[2]. As the severity of economic

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imbalances has increased, an increasing number of transactions in both the financial and real sectors of the economy have been performed in foreign currency. Specifically, in some Latin American countries, this phenomenon is known as "dollarization", as residents have shifted away from transactions in domestic currency into transactions in U.S. dollars. In Perú, where the inflation rate rose from an average rate of 90 percent per year during the period 1978-87 to about 3,000 percent per year by mid-1990, and the exchange rate in the parallel market moved from 0.2 intis per U.S. dollar by the end of 1978 to 122,000 intis per U.S. dollar by July 1990, there is a widely held perception of dollarization[3].

A crucial issue related to currency substitution in developing countries deals with its effects on the design and implementation of monetary policy. Currency substitution increases the elasticity of the demand for money with respect to the expected inflation rate since expectations of higher inflation causes domestic residents to switch towards the foreign currency. Since governments have control only over the domestic currency, they must accept a loss of seignorage[4]. As a result, attempts to finance a given budget deficit with the inflation tax will reduce the monetary base for the inflation tax and will result in a higher inflationary tax than in the absence of currency substitution. In other words, for a given real fiscal deficit, the presence of currency substitution exacerbates the resulting inflation rate. It should, of course, be obvious that this result does not imply that currency substitution is the cause of inflation; instead it should be interpreted as the transmission mechanism through which fiscal deficits financed with money creation affect the inflation rate.

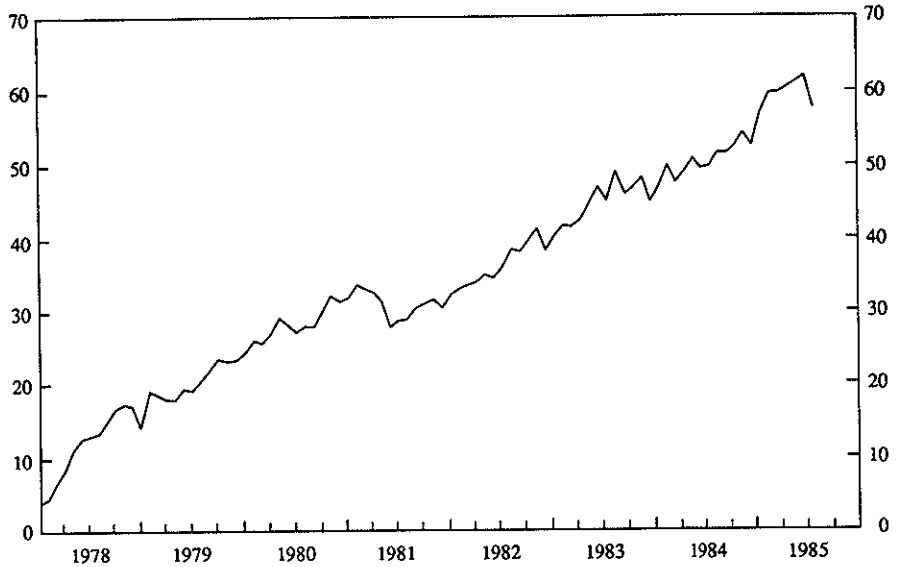
These considerations have been extremely relevant in the Peruvian economy during the period 1978-90. As documented by the World Bank (1990), monetary policy in Perú during most of this period has largely accommodated fiscal deficits and has been, to a significant extent, subordinated to developmental or redistributional objectives of the Government. The analysis of currency substitution may then be important to understand the dynamics of inflation in Perú.

In Perú, during the entire period under study, a black market exchange rate ran parallel to the official exchange rate (the "parallel" exchange rate), but bank deposits denominated in foreign currency were allowed only during part of the period. In particular, two clear sub-periods can be distinguished: from December 13, 1977 to August 2, 1985 Peruvian banks were allowed to issue freely negotiable Foreign Currency Certificate of Deposits issued in U.S. dollars (CBME deposits); these deposits were fully convertible and could be negotiated at a market determined exchange rates (the CBME rate); during this period, the CBME rate moved very closely to the parallel exchange rate. The importance of U.S. dollar denominated deposits relative to the total stock of money in Perú during this period is depicted in Figure 1[5]. It shows that foreign currency deposits increased from about 16 percent of total money stock at the end of 1978 to about 60 percent by mid-1985[6]. During the same period, the annual rate of depreciation of the CBME rate increased from about 60 percent to about 240 percent. In addition, the inflation rate, which ran at an average of about 70 percent per year during 1978-82, accelerated during 1983-85 reaching an annual rate of 200 percent by mid-1985.

From August 1985 to December 1990, convertibility into foreign currency deposits was abolished and those deposits could be converted into intis only at the official exchange rate. As a result, the CBME rate became inoperative and U.S. dollar-denominated bank deposits insignificant[7]. Fiscal deficits sharply accelerated during the second subperiod reaching almost 12 percent of GDP by mid-1990. Excluding arrears

FIGURE 1

RATIO OF U.S. DOLLAR-DENOMINATED DEPOSITS TO TOTAL MONEY STOCK: 1978-1985
(In percent)



(both domestic and external) as a source of financing, the Central Bank financed almost 90 percent of the fiscal deficit. The annual inflation rate sharply accelerated during this period reaching 3,000 percent by mid-1990.

In the context of these developments, this paper analyses the process of currency substitution in Perú and its implications for the conduct of monetary policy by testing the validity of the following two hypotheses:

1. There is a long-run relationship between the expected rate of depreciation in the parallel exchange rate and the behavior of the demand for domestic money (i.e., intis) relative to that for foreign money; that is, the hypothesis of currency substitution can explain the behavior of real holdings of money in Perú. While this hypothesis is tested using data on Peruvian holdings of foreign deposits, both in Peruvian and U.S. banks, during the period January 1978-July 1985, additional indicators are then used to shed light on the value of Peruvian holdings of U.S. dollars during the period August 1985-December 1990.

2. Currency substitution is an important channel of transmission through which domestic fiscal and monetary policies have affected the behavior of the Peruvian inflation, and that mechanism strengthened during a period when inflation sharply accelerated in the Peruvian economy. This hypothesis is tested by estimating a dynamic equation for inflation using a VAR representation which includes the lagged ratio of domestic to foreign money as a explanatory variable. That is, it is postulated that attempts of

Peruvian residents to attain their desired composition of currencies affect the dynamics of inflation in Perú. Since real money holdings constitute an important proportion of wealth in the Peruvian economy, currency substitution just reflects attempts of Peruvian residents to protect the real value of their wealth.

The rest of this paper is organized as follows. Section II presents a simple model from where the theory of currency substitution is derived. Section III tests the validity of the hypothesis of currency substitution in Perú. First, it shows that there is not a long run relationship between domestic money, prices and income in Perú, i.e., those variables are not cointegrated, limiting, therefore, the usefulness of a "traditional" demand for money for monetary policy purposes. Then, using data for the period January 1978-July 1985, an error-correction model technique is used to test the theory of currency substitution. It shows that there is a significant relationship between the ratio of domestic money relative to U.S. dollar-denominated bank deposits and expectations of exchange rate changes. In addition, a relatively high long-run elasticity of currency substitution was obtained from the analysis. The paper then examines two indicators of holdings of U.S. dollars during the subperiod when fully-convertible bank deposits denominated in foreign money were not permitted and evaluates the behavior of currency substitution during that period. The limitations involved with these calculations are stressed.

Section IV estimates a dynamic equation for inflation in Perú testing the hypothesis that currency substitution has been an important transmission mechanism through which domestic fiscal and monetary policy affected inflation. The evidence seems to indicate that currency substitution became an important factor in the inflation process during the recent period of hyperinflation experienced in the Peruvian economy.

Finally, Section V concludes the paper and discusses some implications of the analysis for the conduct of monetary policy in Perú.

II. A Model of Currency Substitution

Assume an economy that produces and consumes two kinds of goods: tradable and nontradable goods with P denoting the price of nontradable goods, P* the foreign price of tradable goods and S the exchange rate, i.e., the domestic value of one unit of foreign money. Without loss of generality, and following a common procedure, the foreign price of tradable goods will be set equal to one. In that case, the real exchange rate can be expressed as S/P.

Shallow domestic capital markets and limited access to international capital markets are assumed to imply that money is the only form of wealth. However, domestic residents may allocate their portfolio between holdings of domestic money and foreign money. In addition to being a store of wealth, money is assumed to be needed to purchase both kinds of goods. This assumption is reflected in the model by a liquidity in advance restriction imposed to the value of consumption during each period[8]. Moreover, foreign money is assumed to be an imperfect substitute for domestic money[9].

At period t, the representative consumer is assumed to maximize the following value function subject to the information available to him in every period, which is assumed to consist of all period t-variables.

$$V(M_t, M_t^*, P_t, S_t) = \max\ E_t\left[U_t(C_t^{NT}, C_t^T) + \beta V(M_{t+1}, M_{t+1}^*, P_{t+1}, S_{t+1})\right], \qquad (1)$$

where:

C_t^{NT} = consumption of nontradable goods.

C_t^T = consumption of tradable goods.

M_t = stock of domestic money at the beginning of period $t = M_{t-1} + \tau_t$, where τ_t, is a transfer of domestic money given by the government at the beginning of period t.

M_t^* = stock of foreign money at the beginning of period t.

β = the discount rate.

E_t = the expectations operator.

It is assumed that the utility function is separable in both commodities and that the marginal utilities of nontradables (U_{NT}) and tradable (U_T) goods are positive and diminishing.

Representative individuals start every period with a predetermined stock of domestic and foreign money. At the beginning of every period, they receive a transfer from the government in the form of domestic money (τ_t). During the period, the individuals engage in the production of goods and have to decide on their consumption plans of both commodities and on their demand for both types of money i.e.; holdings of money to be carried to the next period (M_t^d and M_t^{*d}). The individual faces the following budget constraint:

$$Y_t + \frac{M_t}{P_{t-1}}\,\frac{1}{1+\pi_t} + \frac{M_t^* S_{t-1}}{P_{t-1}}\,\frac{(1+\theta_t)}{(1+\pi_t)} = C_t^{NT} + \frac{S_t}{P_t} C_t^T + \frac{M_t^d}{P_t} + \frac{M_t^{*d} S_t}{P_t}, \qquad (2)$$

where: π_t is the inflation rate of the nontradable goods and,
θ_t is the rate of change of the exchange rate;
Y_t = Total real income derived from the production of both goods; i.e.,

$$Y_t = Y_t^{NT} + (S_t/P_t)\ Y_t^T$$

In addition, the individual faces a liquidity in-advance constraint of the following form[10]:

$$C_t^{NT} + \frac{S_t}{P_t} C_t^T \le \ell\left(\frac{M_t}{P_t}, \frac{M^* S_t}{P_t}\right), \qquad (3)$$

where, following Calvo and Végh (1990), $\ell(.t)$ is interpreted as a liquidity services production function. Moreover, $\ell(.t)$ is assumed to be a linear homogenous function where the marginal productivities of domestic and foreign real monies (ℓ_1 and ℓ_2) are positive and diminishing. In addition, to guarantee that domestic and foreign monies are imperfect substitutes as providers of liquidity services, it is assumed that $\delta\ell_1/\delta(M^*S/P) < 0$[11].

Denoting λ_t as the Lagrange multiplier for the budget constraint and γ_t as the Kuhn-Tucker multiplier for the liquidity-in-advance constraint, the Euler equations obtained from the maximization problem are:

$$U_{NT}(.t) = \lambda_t + \gamma_t \ , \tag{4}$$

$$U_T(.t) = \frac{S_t}{P_t}(\lambda_t + \gamma_t) \ , \tag{5}$$

$$\beta E_t\left[\frac{\lambda_{t+1}}{P_{t+1}} + \frac{\gamma_{t+1}}{P_{t+1}}\ell_1\left(\frac{M_{t+1}}{P_{t+1}} \ , \frac{M^*_{t+1}S_{t+1}}{P_{t+1}}\right)\right] = \lambda_t \frac{1}{P_t} \ , \tag{6}$$

$$\beta E_t\left[\frac{S_{t+1}}{P_{t+1}}\left(\lambda_{t+1} + \lambda_{t+1}\left(\ell_2\left(\frac{M_{t+1}}{P_{t+1}} \ , \frac{M^*_{t+1}S_{t+1}}{P_{t+1}}\right)\right)\right)\right] = \lambda_t \frac{S_t}{P_t} \ , \tag{7}$$

where (.t) means the arguments of the value function evaluated at period t.

The ratio of equations (4) to (5) yields the familiar result that the marginal rate of substitution between tradable and nontradable goods equals the real exchange rate. Equations (6) and (7) indicate that the marginal value of carrying an additional unit of money into period t+1 is set equal to its marginal cost, which is λ_t/P_t for domestic money and $(\lambda_t S_t/P_t)$ for foreign money[12].

The behavior of the demand for currencies in the steady state will now be investigated. Levels of real variables are assumed to be constant in the steady state and, therefore, the marginal utilities of consumption of both goods remain constant in the steady state[13]. Moreover, from the definition of the real exchange rate, the rate of change of the exchange rate needs to equal the inflation rate of the nontradable good; that is: $\theta_t = \pi_t$ in the steady state. These conditions imply that the ratio of equations (6) to (7) in the steady state can be written as:

$$\frac{\ell_1(M/P, M^* S/P)}{\ell_2(M/P, M^* S/P)} = 1 + \frac{\theta}{1-\beta} \tag{8}$$

Since the function $\ell(.t)$ is homogenous of degree one, equation (8) implies that:

$$\frac{M/P}{M^*S/P} = g(\theta), \qquad g'(\theta) < 0 \ . \tag{9}$$

That is, equation (8) shows that, in the steady state, the ratio of holdings of domestic to foreign money (expressed in terms of domestic money) and the rate of change of the exchange rate are negatively related. The next sections deal with measurements and implications of this result for the Peruvian economy.

III. Currency Substitution in Perú

The analysis in the previous section suggests that in the presence of currency substitution a traditional demand for real domestic money expressed as a function of income and the rate of return of alternative assets other than money may not be stable

since changes in expectations regarding the exchange rate would induce economic agents to shift between domestic and foreign currencies[14]. The analysis in this section is divided in three parts: first, the statistical properties of a traditional demand for money are analyzed. Second, the validity of currency substitution in Perú during the period January 1978-June 1985 is tested, and third, some indicators of the value of holdings of U.S. dollars during the period August 1985-December 1990 are presented.

1. *A traditional demand for money*

Before testing for the validity of currency substitution in Perú, it is necessary to analyze if there can be a long run relationship between domestic money, real income and prices such that the following relationship holds[15].

$$m_t - p_t = a_0 + a_1 E(p_{t+1} - p_t) + a_2 y_t + u_t, \tag{10}$$

where:

m is the log of the money supply, with alternative aggregates being defined below;

p is the log of the price level, which in this paper takes the form of the not-seasonally-adjusted Consumer Price Index (CPI);

y is the log of aggregate real income represented here by an index of industrial production; and

u is the error term of the relationship which should be stationary if equation (10) denotes a meaningful long-run relationship.

Equation (10) states that the expected inflation rate is the relevant opportunity cost of holding domestic money. This is consistent with the limited development of financial markets in Perú and with the presence of severe controls on domestic interest rate during the period under study.

To facilitate the analysis, a unitary elasticity of income is imposed in equation (10); this is equivalent to use the broadly accepted interpretation of the quantity theory of money as a long-run demand for money. In that case, equation (10) can be expressed in terms of the log of the velocity of circulation (v),

$$v_t = p_t + y_t - m_t = -a_0 - a_1 E(p_{t+1} - p_t) - u_t \tag{11}$$

As will be shown below, analysis of the time series properties for real money, real income, and prices indicates that these variables are nonstationary[16]. Specifically, they are integrated processes of order one, (I(1)) and, therefore, are stationary (I(0)) only after differencing[17]. Since the original series are nonstationary, their means and variances and asymptotic distributions are not well defined; therefore, inference making cannot proceed along the lines of traditional econometric analysis[18]. Recent developments in the theory of cointegration, however, have shown that a meaningful long-run relationship between variables that are I(1) processes can exist if those variables are cointegrated, namely if there exists a linear combination of those variables that is a stationary process[19].

This section examines the time series properties of prices, real money, real income, and velocity. Specifically, it is tested whether the variables are stationary. The Dickey-Fuller (DF) test and the Augmented Dickey-Fuller (ADF) test are used to test the null hypothesis that the series have a unit root.

Two domestic monetary aggregates are considered in the analysis:

m1 = the log of domestic currency in circulation plus demand deposits denominated in domestic money.

m2 = the log of the components in m1 plus time and saving deposits denominated in domestic money and held in the Peruvian commercial banks.

The results from the tests are presented in Table 1. The tests were applied to monthly observations covering the period January 1978-December 1990. As shown in the table, the null hypothesis of unit root cannot be rejected at the 5 percent significance level for prices and the two definitions of domestic real money, indicating that those variables are I(1) processes. The evidence on real income is mixed. While the A.D.F. test supported the hypothesis of a unit root, the D.F. test rejected it.

The behavior of the inflation rate deserves some additional attention. Although, as shown in Figure 2, the inflation rate sharply accelerated during the period April 1987-June 1990[20], adjustment policies introduced during the second half of 1990 resulted in a reduction of the inflation rate. The result that the price level is an I(1) process and that the inflation rate is stationary, was reinforced by further extending the series to cover the period March 1957-April 1991[21]. These results indicate that the inflation rate in

TABLE 1

TESTS FOR UNIT ROOT
JANUARY 1978-DECEMBER 1990

Variables	DF	ADF[1]
m1-p	-0.25	0.31 (2)
m2-p	0.32	-0.21 (1)
p	8.90	5.61 (1)
y	-2.93	-2.08 (2)
vm1	-0.66	-0.04 (1)
vm2	0.08	-1.52 (1)
Δ(m1-p)	-13.98	-10.23 (1)
Δ(m2-p)	-11.73	-9.78 (1)
Δp	-7.22	-5.00 (1)
Δy	-15.65	-9.93 (1)
Δvm1	-15.55	-12.37 (1)
Δvm2	-13.81	-11.72 (1)

Where: vm1 = velocity using m1
vm2 = velocity using m2

Critical values for the DF and ADF tests at:
1 percent level = -3.19
5 percent level = -2.53

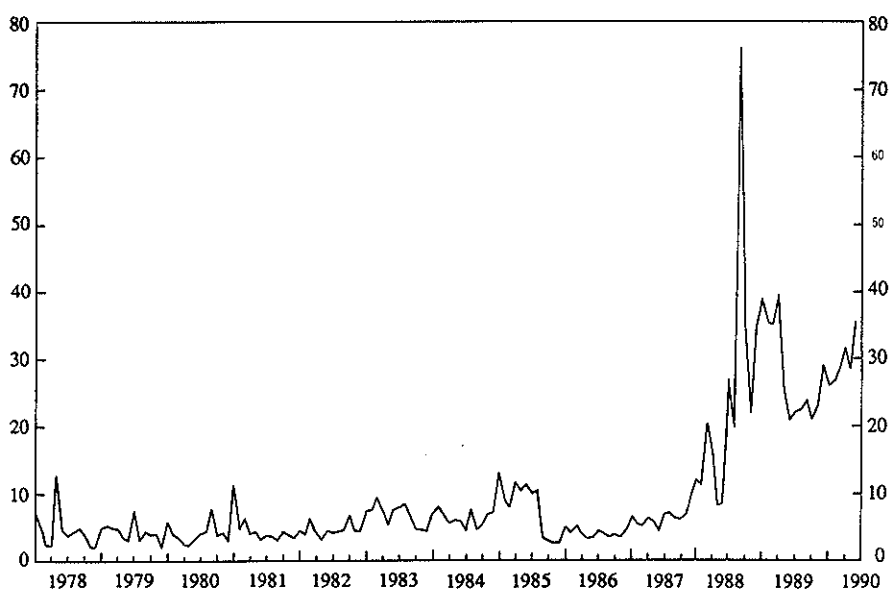
[1] The number in parenthesis indicates the number of lags sufficient for the error term in the ADF test to be white noise.

Perú is a mean reverting stationary process despite the presence of a transitory subperiod when consecutive and increasing positive deviations from its mean were present. This implies that rational economic agents' expected inflation rate is also a stationary process.

Table 1 also presents unit root tests for velocity; for both monetary aggregates, velocity is also an I(1) process. Since income velocity and the expected rate of inflation do not have the same order of integration, these variables cannot be cointegrated. Therefore, for the Peruvian economy the usefulness of a "traditional" demand for money as a tool for the conduct of monetary policy is limited.

FIGURE 2

MONTHLY INFLATION RATE: JANUARY 1978-JUNE 1990
(In percent)



2. *Currency substitution in Perú: 1978:1-1985:6*

Next, we proceed to analyze the empirical relevance of currency substitution in Perú.

The theoretical model presented in the previous section suggests that the following relationship should hold in the presence of currency substitution[22]:

$$m_t - f_t = \alpha_0 + \alpha_1 E(e_{t+1} - e_t) + w_t, \qquad (12)$$

where: $f_t = m^*_t + e_t$

m^*_t = log of holdings of foreign money.

e_t = log of the exchange rate, i.e., the domestic price of one unit of foreign currency.

w_t = the residual from the relationship.

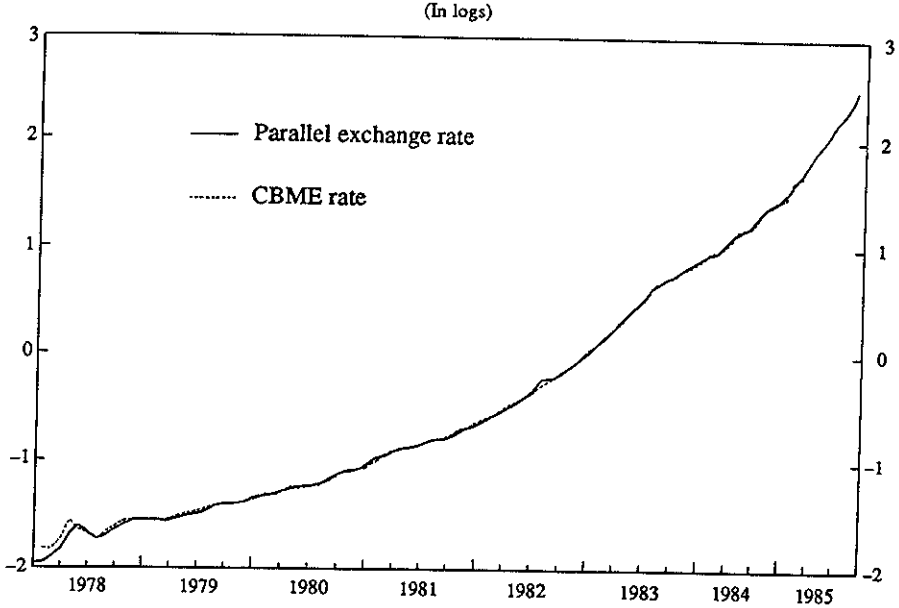
Equation (12) states that economic agents adjust their holdings of domestic money such as to achieve their desired ratio of domestic to foreign money and that such ratio depends on the expected rate of depreciation of the exchange rate.

In most of the analysis in this section, U.S. dollar-denominated deposits in the Peruvian commercial banks will be taken as the measure of holdings of foreign money. However, since deposits in U.S. banks by nonbank residents in Perú can also be identified as another source of currency substitution, the analysis will also be extended to include those deposits in the measure of foreign money held by Peruvian residents[23].

To proceed with the estimation of equation (12), f is first defined as the log of U.S. dollar-denominated deposits in the Peruvian commercial banks. In this case, the statistical analysis of equation (12) needs to be restricted to the period January 1978-June 1985 since, as mentioned before, only during that period U.S. dollar-denominated certificates of deposits (CBME) were allowed to be fully convertible at a market determined exchange rate called the CBME rate. As Figure 3 shows, the CBME rate and the exchange rate in

FIGURE 3

CBME AND PARALLEL EXCHANGE RATES: JANUARY 1978-JUNE 1985
(In logs)



the parallel market were almost identical. For consistency with the analysis involving the period after 1985 (when the CBME rate was inoperative), in this paper we take the parallel market exchange rate to be the relevant exchange rate for the decision-taking process of economic agents. Table 2 presents unit root tests for the variables entering equation (12). The tests, which covered the period January 1978-July 1985 show that m1, m2, f, and e are I(1) processes while the ratio of domestic to foreign money (m–f) is a stationary process, indicating that m and f are cointegrated. In addition, the rate of change of the exchange rate was found to be a stationary process that could be characterized as an AR(1) process. Therefore, the actual change of the exchange rate was taken to represent the expected rate of change of the exchange rate.

TABLE 2

TESTS FOR UNIT ROOT
JANUARY 1978–JULY 1985

Variables	DF	ADF[1]
e[2]	16.48	4.39 (1)
f	–2.44	–2.28 (1)
m1	1.59	2.43 (4)
m2	1.23	1.73 (3)
m1–f	–3.98	–4.30 (1)
m2–f	–4.12	–4.08 (1)
Δe	–4.93	–4.01 (1)
Δf	–9.83	–6.16 (1)
Δm1	–14.07	–4.48 (3)
Δm2	–12.58	–5.38 (2)
Δ(m1–f)	–10.43	–6.79 (1)
Δ(m2–f)	–9.61	–6.43 (1)

Critical values for the DF and ADF tests at:

1 percent level = –3.37
5 percent level = –2.56

[1] The number in parenthesis indicates the number of lags sufficient for the error term in the ADF test to be white noise.

[2] For the period January 1978–December 1990, the unit root test for the exchange rate gave the following values:

	DF	ADF
e	7.95	5.57 (2)
Δe	–7.04	–4.53 (2)

Since both the rate of change of the exchange rate and the ratio of domestic to foreign money are stationary processes, traditional econometric analysis applied to equation (12) is appropriate. To take into account the endogeneity of the expected rate of depreciation of the exchange rate, equation (12) was estimated using an instrumental

variables technique with two alternative sets of instruments. The first set contained one lag of the ratio of domestic to foreign money, one lag of the change in the exchange rate, and two dummy variables to take into account major exogenous events that affected the behavior of the exchange rate[24]. The second set also included two lags of real output, one lag of the rate of growth of domestic money and seasonal dummies. Inclusion of the additional instruments in the second set, however, did not change significantly the parameter estimates.

Estimation of equation (12) yielded serially correlated errors as indicated by the Durbin-Watson (D.W.) statistic[25]. Since both the dependent and the explanatory variables are stationary, the low value of the D.W. statistic can be interpreted as reflecting the presence of a partial adjustment mechanism. That is, it may indicate that economic agents did not fully adjust the relative composition of their wealth toward their desired long-run relationship within one period, i.e., one month[26]. Partial adjustment versions of equation (12) were then estimated for both alternative definitions of domestic money to obtain:

$$(m1 - f)_t = \underset{(0.0275)}{0.072} - \underset{(0.463)}{1.853}\ E(e_{t+1} - e_t) + \underset{(0.0146)}{0.915}\ (m1 - f)_{t-1} \qquad (13)$$

$$R^2 = 0.989$$

$$(m2 - f)_t = \underset{(0.032)}{0.111} - \underset{(0.410)}{1.546}\ E(e_{t+1} - e_t) + \underset{(0.016)}{0.907}\ (m2 - f)_{t-1} \qquad (14)$$

$$R^2 = 0.986,$$

where the numbers in parenthesis are standard errors.

Confidence interval testing reveals that the coefficients for the lagged dependent variable are different from one at the 1 percent significance level[27]; confirming that the ratio of domestic to foreign money is stationary but highly auto-correlated.

Two important results emerge from equations (13) and (14). First, as predicted by the theory of currency substitution, the expected rate of depreciation of the exchange rate significantly affects the desired ratio of domestic to foreign money. Second, the implied long-run semi-elasticity of currency substitution equals –21 using m1 as the domestic aggregate and –16.6 using m2. Comparing these values to the results obtained for other developing countries suggests a strong presence of currency substitution in Perú[28].

An alternative way to derive the long-run semi-elasticity of currency substitution is to estimate a dynamic model of the demand for either domestic or foreign money where the cointegration between m and f is recognized. That is, using an error correction model imposing the long-run relationship established by currency substitution[29]. This amounts to imposing the restriction that both m and f affect the equation with the same coefficient. With this technique, one would expect to obtain the same long-run semi-elasticity as those derived from equations (13) and (14).

The demand for foreign money (U.S. dollar-denominated bank deposits in the Peruvian banking system) will be estimated here since we are interested in obtaining some insights regarding the holdings of foreign money during the period after June

1985, when foreign bank deposits in Peruvian banks were canceled. The final estimation related changes in holdings of foreign money to the lagged levels of m, f, the lag in the expected change in the exchange rate and the change in the level of output[30]. Lags in the dependent variable were not found significant. To deal with a simultaneous equation problem arising from the presence of contemporaneous changes in the exchange rate and output, the equation was estimated using an instrumental variables technique[31]. To simplify the presentation, we only discuss here the results involving m2 as domestic money. The estimation gave the following results:

$$\Delta f_t = \underset{(0.02)}{-0.013} - \underset{(0.01)}{0.06}\ (f - m)_{t-1} + \underset{(0.31)}{0.98}\ E(e_t - e_{t-1}) + \underset{(0.14)}{0.39}\ \Delta y_{t-1} \qquad (15)$$

$$R^2 = 0.385$$

and the number in parenthesis are standard errors.

The results from equation (15) indicate that a large proportion of the variation in Δf is explained by changes in the exchange rate. From this equation, the value of the long-run semi-elasticity of substitution equals –16.2, which was found not to be statistically different from the one obtained from equation (14).

Finally, define f to include U.S. dollar deposits in both Peruvian and U.S. banks. In that case, the estimation of the partial adjustment version of equation (12) during the period July 1978 to June 1985 yields the following results:

$$(m1 - f)_t = \underset{(0.023)}{0.025} - \underset{(0.546)}{1.347}\ E(e_{t+1} - e_t) + \underset{(0.024)}{0.952}\ (m1 - f)_{t-1} \qquad (16)$$

$$R^2 = 0.983$$

$$(m2 - f)_t = \underset{(0.027)}{0.068} - \underset{(0.455)}{1.597}\ E(e_{t+1} - e_t) + \underset{(0.023)}{0.943}\ (m2 - f)_{t-1} \qquad (17)$$

$$R^2 = 0.985$$

and the numbers in parenthesis are standard errors.

Not surprisingly, the implied long-run semi-elasticity of currency substitution derived from equations (16) and (17) is larger –about –28 in both equations– than the corresponding semi-elasticities derived from equations (13) and (14). Clearly, the results from equations (16) and (17) reinforce the conclusion that currency substitution was an important phenomenon in Perú during the period 1978-85.

3. *Estimates of currency substitution since August 1985*

As stated before, bank deposits denominated in U.S. dollars were inoperative in the Peruvian economy during the period August 1985-December 1990. The re-imposition of foreign exchange controls produced a temporary increase in the demand for domestic

money since this measure increased the effective cost of holding foreign money. Indeed, as shown in Figure 4 the ratio of domestic money (M4) to nominal income increased in mid-1985 and did not decline significantly during 1986. However, as fiscal deficits, largely financed with monetary expansions, increased and the depreciation of the inti relative to the U.S. dollar accelerated during the period 1987-90 (Figure 5), the incentives for holding foreign money *outside* the Peruvian banking system increased. Two forms of holding U.S. dollars were clearly identified by Peruvian residents: U.S. currency notes which could be obtained in the well-established domestic black market for U.S. dollars and deposits in foreign banks reflecting capital flight.

To obtain some insights on the process of currency substitution during the period August 1985-December 1990, two complementary indicators of holdings of U.S. dollars by Peruvian residents are presented here.

First, holdings of U.S. dollar deposits by Peruvian residents in U.S. banks are presented in Figure 6A. Consistent with the behavior of domestic inflation and the exchange rate, holdings of those deposits increased continuously from 1987 to mid-1990. The data indicate that by mid-1990 Peruvian residents held about US$2 billion as deposits in U.S. banks. Figure 6B presents the ratio of M2 to Peruvian deposits in U.S. banks. As one would expect, this ratio sharply declined during the period 1987-mid-1990.

Second, the estimation of currency substitution presented in the previous section may be used to obtain an additional indicator of holdings of U.S. dollars during the period August 1985-December 1990. Using equation (15) to forecast holdings of U.S.

FIGURE 4

RATIO OF M2 TO NOMINAL INCOME: 1978-1990
(In percent)

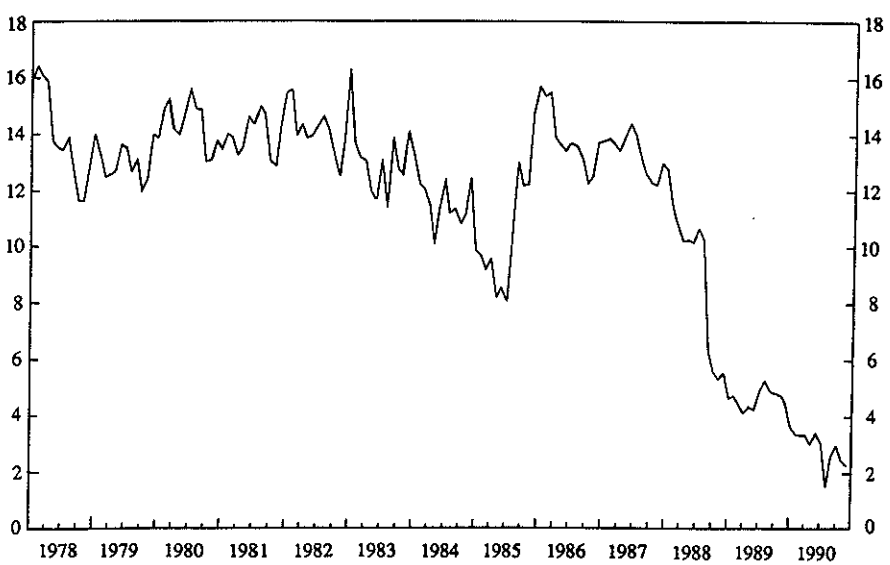
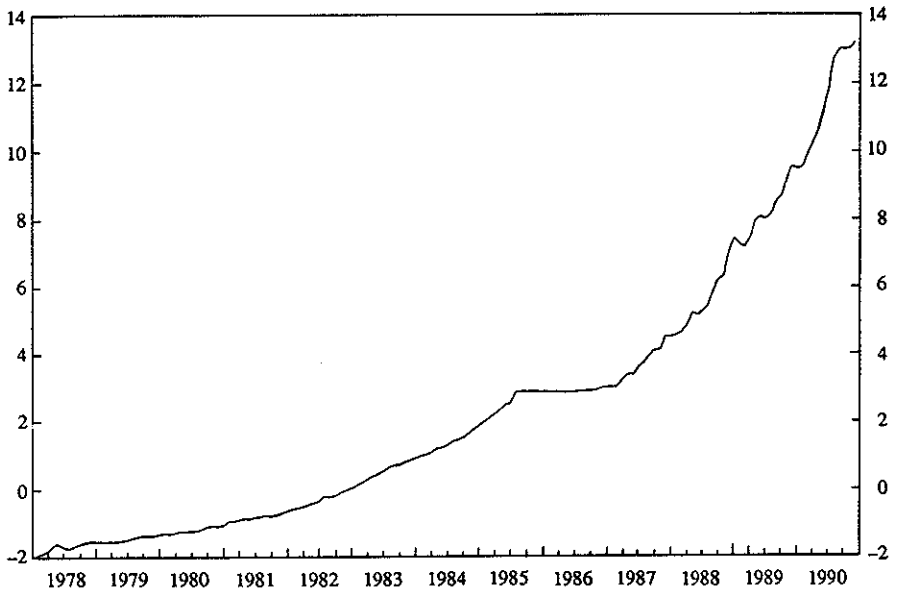


FIGURE 5

PARALLEL EXCHANGE RATE: 1978-1990
(In logs)

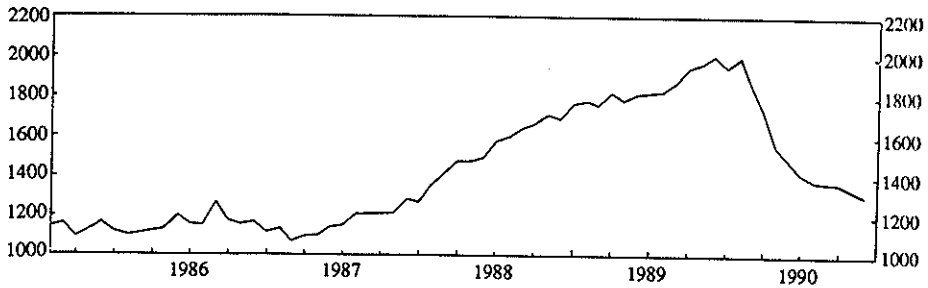


dollars by Peruvian residents outside the domestic banking system constitutes a counter-factual experiment since U.S. dollar denominated deposits in the Peruvian banking sector were inoperative during that period. It should be stressed, however, that this forecast suffers from strong limitations. Indeed, the forecasts assume that the parameters estimated in equation (15) remained constant outside the sample period. Clearly, there are at least two reasons to argue against that assumption. First, higher and more volatile rates of inflation were experienced by the Peruvian economy during the out-of-sample period. Since we would expect that accelerating inflation may deepen the process of current substitution, the forecasts represent a lower limit of actual holdings of foreign money. Second, and perhaps more important, by increasing the costs of holding foreign deposits, the re-imposition of foreign exchange controls affected the dynamic of the process of currency substitution in Perú, implying a change in the value of the parameters in equation (15)[32].

Given an average rate of depreciation of the inti relative to the U.S. dollar of 16 percent a month during the period August 1985-December 1990, our estimates of the long-run semi-elasticity of currency substitution would suggest that, during the same period, Peruvian residents held, on average, a stock of about 4.4 billion U.S. dollars. This compares with registered holdings of U.S. dollar-denominated bank deposits of US$1.4 billion by mid-1985. These estimations also imply an average ratio of domestic money (M2) to the inti-equivalence of holdings of U.S. dollars of about 21 percent

FIGURE 6A

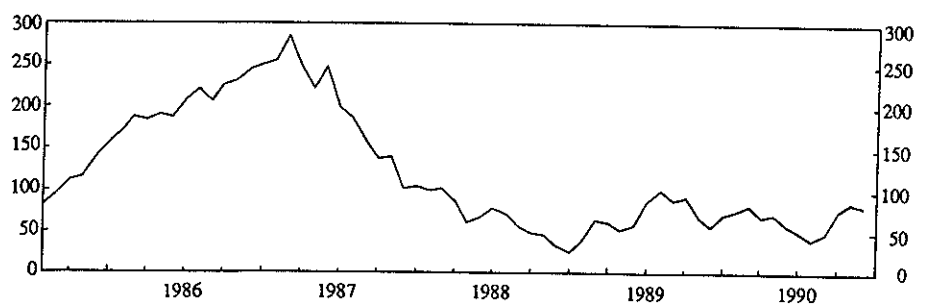
HOLDINGS OF US DOLLAR DEPOSITS BY PERUVIAN RESIDENTS IN U.S. BANKS: AUGUST 1985-DECEMBER 1990
(Millions of U.S. dollars)



Source: U.S. Treasury

FIGURE 6B

RATIO OF M2 TO HOLDINGS OF US DOLLAR DEPOSITS BY PERUVIAN RESIDENTS IN U.S. BANKS: AUGUST 1985-DECEMBER 1990
(In percent)

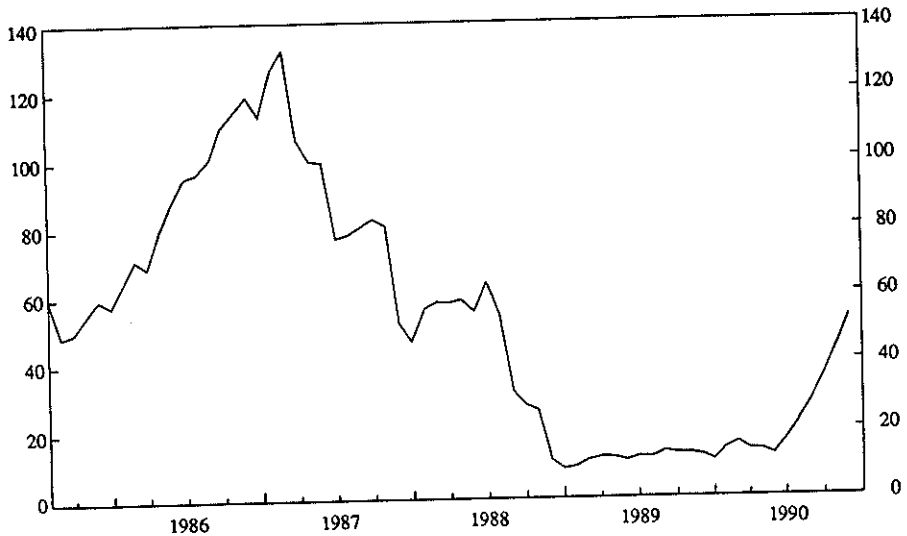


during the period August 1985-December 1990 (Figure 7). This compares with a ratio of about 74 percent by July 1985. Although subject to all the limitations mentioned above, these estimates are consistent with the sharp deterioration of economic conditions in Perú during the period 1987-mid-1990 and suggest a strong shift of Peruvian money holders towards the U.S. dollar. That is, even in the presence of strong restrictions in domestic capital markets which included the elimination of fully-convertible U.S. dollar denominated deposits, the existence of a well-established parallel market for U.S. dollars and the development of mechanisms to evade foreign exchange controls allowed Peruvian residents to reduce their real holdings of domestic money in favor of holdings of U.S. dollars. In fact, M2 as a proportion of nominal income declined from an

average of about 13 percent during the period 1978-85 to about 3 percent by mid-1990, implying that the velocity of domestic money sharply increased from 1986 to 1990 (Figure 4).

FIGURE 7

ESTIMATED RATIO OF M2 TO HOLDINGS OF U.S. DOLLARS
AUGUST 1985-DECEMBER 1990
(Based on Equation 15)
(In percent)



IV. Currency Substitution and the Dynamics of Inflation

As discussed in the introduction, a central implication of currency substitution is that monetary authorities have to accept a loss of seignorage since they can only control the supply of the domestic currency in an economy where foreign money is also used as medium of exchange and store of value. In that situation, currency substitution will act as a transmission mechanism through which expansionary fiscal policies financed with money creation affect the inflation rate. In those economies, the mechanics of inflation work as follows. As governments use monetary expansions to finance fiscal deficits, domestic money holders will attempt to avoid the inflationary tax by switching towards the foreign currency. With an eroded monetary base, the inflationary tax will have to increase further in order to finance the fiscal deficit. Hence, the velocity of domestic currency would increase. Increasing rates of inflation thus are the result of increasing fiscal deficits financed with monetary expansions with currency substitution being the transmission mechanism in the inflation process. In the long-run, however, expansionary fiscal and monetary policies need to be reversed or the government must accept a complete loss of seignorage as real holdings of the domestic money would be completely eroded.

This section explores the extent to which currency substitution constituted an important transmission mechanism through which monetary policy has affected the short-run behavior of inflation in Perú. This is done by estimating a dynamic equation which relates the inflation rate to the lagged ratio of domestic money to foreign money and to lagged values of the inflation rate and changes in economic activity[33]. Notice that the ratio of domestic to foreign money needs to enter in this equation in levels and not in first differences since, as noted before, such ratio is a stationary variable.

The intuition for including the lagged ratio of domestic to foreign money in the short-run equation for inflation follows from the argument presented above: As the desired ratio of domestic to foreign money declines in period t, the resulting loss of seignorage by the government will imply that the persistence of a constant or expanding fiscal deficit in period t+1 will require a higher rate of growth of the money supply and, therefore, a higher inflation rate. It should then be clear that currency substitution acts as a transmission mechanism in the inflationary process only if fiscal deficits are financed with expansions in the rate of growth of domestic money.

Since the proposed inflation equation requires data on holdings of foreign money, the estimations will first cover the period January 1978-July 1985. To evaluate how this equation behaved during the period since August 1985, the two indicators for holdings of U.S. dollar by Peruvian residents presented in the previous section will then be used in the estimations.

When f included solely U.S. dollar-denominated deposits in the Peruvian banking system, the final estimation for the period January 1978-July 1985 yielded the following results[34]:

$$\Delta p_t = \underset{(0.0072)}{0.0253} - \underset{(0.0028)}{0.0064}\,(m1 - f)_{t-1} + \underset{(0.0946)}{0.2414}\,\Delta p_{t-1} + \underset{(0.1012)}{0.3299}\,\Delta p_{t-4} - \underset{(0.0327)}{0.1198}\,\Delta y_{t-2}$$

$$R^2 = 0.42 \qquad (18)$$

$$\Delta p_t = \underset{(0.0085)}{0.0301} - \underset{(0.0032)}{0.0073}\,(m2 - f)_{t-1} + \underset{(0.0946)}{0.2385}\,\Delta p_{t-1} + \underset{(0.1015)}{0.3248}\,\Delta p_{t-4} - \underset{(0.0327)}{0.1204}\,\Delta y_{t-2}$$

$$R^2 = 0.42 \qquad (19)$$

where standard errors are in parenthesis.

Equations (18) and (19) have the same explanatory power and both show some persistence of the inflation rate, although the second and third lags were not found significant at the 5 percent level. The coefficients on $(mi\text{-}f)_{t-1}$ (i = 1, 2) although significant were very small. In contrast, two-periods lagged changes in economic activity significantly affected inflation. The negative sign of the coefficient affecting Δy is consistent with recent literature on developing countries which postulates a negative relationship between output and inflation in the short run[35].

In addition, when the definition of f was modified to include U.S. dollar deposits in both Peruvian and U.S. banks, the estimations (over the period July 1978 to July 1985) were as follows:

$$\Delta p_t = \underset{(0.0060)}{0.0247} - \underset{(0.0036)}{0.0140}\,(m1 - f)_{t-1} + \underset{(0.0973)}{0.2639}\,\Delta p_{t-1} + \underset{(0.0904)}{0.1765}\,\Delta p_{t-4} - \underset{(0.0276)}{0.1182}\,\Delta y_{t-2}$$

$$R^2 = 0.57 \qquad (20)$$

$$\Delta p_t = \underset{(0.0076)}{0.0373} - \underset{(0.0043)}{0.0187}\,(m2 - f)_{t-1} + \underset{(0.098)}{0.2198}\,\Delta p_{t-1} + \underset{(0.0897)}{0.1503}\,\Delta p_{t-4} - \underset{(0.027)}{0.1186}\,\Delta y_{t-1}$$

$$R^2 = 0.58 \qquad (21)$$

Thus, using the broader definition of foreign deposits improved the explanatory power of the regressions. Moreover, although the coefficients on $(m\text{-}f)_{t-1}$ remained small, their values increased significantly relative to those in equations (18) and (19).

The results from equations (18) – (21) seem to indicate that the lagged behavior of economic activity and lagged inflation rates were the most important factors behind the short-run performance of inflation during this period. Although significant, the effect of currency substitution on the dynamics of inflation was not very important.

Next, in order to estimate a short-run equation for the inflation rate during the period August 1985 to June 1990, the two indicators for the ratio of domestic to foreign money held by Peruvian residents (presented in the previous section) can now be used[36].

Using the ratio of M2 to holdings of US dollar deposits by peruvian residents in US banks produced the following result:

$$\Delta p_t = \underset{(0.0258)}{0.1067} - \underset{(0.0314)}{0.1036}\,(m2 - f)_{t-1} + \underset{(0.1325)}{0.4029}\,\Delta p_{t-1} \qquad (22)$$

$$R^2 = 0.60$$

If, instead, the forecast of holdings of US dollars based on equation (15) is used to construct a proxy for (m2 – f), the following result is obtained[37]:

$$\Delta p_t = \underset{(0.0191)}{0.035} - \underset{(0.0211)}{0.055}\,(m2 - f)_{t-1} + \underset{(0.133)}{0.507}\,\Delta p_{t-1} \qquad (23)$$

$$R^2 = 0.59$$

The most important result from equations (22) and (23) is the sharp increase in the value of the coefficient of the ratio of domestic to foreign money during the period August 1985-June 1990, implying that currency substitution strengthened as a transmission mechanism in the inflation process during that period. Moreover, only the first lag on the inflation rate (one month-lag) was found significant and no lag on the index of domestic activity was significant at the 5 percent level. These results are consistent with the response of rational economic agents to accelerating inflation. As inflation accelerates, its inertial effects decline since agents tend to quickly respond to economic news. Therefore, money holders quickly adjust to their desired composition of currencies. In the Peruvian case, the sharp drop of the indicators for the ratio of domestic to foreign money during this period (Figures 6B and 7) indicates that the process of currency substitution was reinforced. In addition, the absence of significant lags on changes in economic activity in the equation for inflation may indicate the presence of a vertical Phillips curve during this period; a result corresponding with the predictions of economic theory for economies experiencing accelerating inflation.

Taken together, the analysis in this section seems to suggest that the role of currency substitution as a mechanism of transmission in the inflation process in Perú was relatively modest during the period 1978-85, but became important during the period 1986-90 when inflation accelerated sharply.

V. Concluding Remarks

This paper has established the presence of currency substitution in Perú. The theory of currency substitution was formally tested for the period January 1978-July 1985, when fully convertible U.S. dollar denominated bank deposits were allowed in the Peruvian economy. Two indicators for holding of U.S. money by Peruvian residents for the period August 1985-December 1990 were then presented.

The results from the paper indicate that the importance of currency substitution in explaining the short-run behavior of inflation varied during the period under study. In fact, the evidence seems to suggest that while the importance of such mechanism was relatively small during the period of high but relatively stable inflation (January 1978-July 1985), its importance increased in the period August 1985-June 1990 which is consistent with the accelerating rate of inflation and higher volatility of the exchange rate in the parallel market experienced during most of that period. The presence of a well-developed black market for U.S. dollars in Perú implied that, in the presence of accelerating inflation, Peruvian residents could rapidly attempt to protect the value of their real wealth by switching into U.S. dollars.

What are the implications of these results for the conduct of monetary policy? As mentioned above, if governments attempt to finance constant or increasing fiscal deficits with the inflationary tax, the resulting inflation rate will be higher in the presence of currency substitution. While this is a disturbing fact for economies undertaking expansionary policies, it is appropriate to ask whether the presence of currency substitution may constitute "good news" for governments dealing with inflation by reducing the fiscal deficit and the expansion of the domestic money supply. The answer would depend on the credibility of the announced economic program and, therefore, on the perception of economic agents regarding the permanency of the adjustment efforts. If economic agents perceive the deceleration of money as permanent, they would expect an improvement in the value of the domestic currency and will tend, over time, to

increase their relative holdings of domestic money. As the monetary base for the inflation tax increases, the inflationary tax needed to finance a given fiscal deficit declines. Further reduction in the fiscal deficit will, of course, accelerate the reduction in the inflation rate.

In contrast, lack of full credibility in the announced policy may account for the persistence of the "dollarization" process and would, therefore, increase the degree of fiscal and monetary adjustment necessary to achieve a short-run reduction of inflation[38]. This paper has not dealt with the analysis of currency substitution during the recent stabilization program undertaken in Perú since the end of 1990 because the size of the sample period is too small to allow meaningful statistical results. By mid-1991, however, the ratio of domestic money (M2) to GDP had not increased relative to the level attained at the beginning of 1990. To the extent that the behavior of this ratio may reflect the persistence of the dollarization process in the Peruvian economy, the analysis in this paper would imply that a significant reduction of inflation in the short-run would require larger adjustment efforts than those required in the absence of persistence in the dollarization process.

Notes

1 Specifically, Ortiz (1983) analyzed the Mexican case, Ramírez-Rojas (1985) established the presence of currency substitution in Argentina, México and Uruguay. The Argentinean case was also the subject of study in Fasano-Filho (1986), while Canto (1985) dealt with currency substitution in the Dominican Republic. In addition, Márquez (1985) dealt with the issue of currency substitution in Venezuela and El-Erian (1988) tested the hypothesis for Egypt and the Yemen Arab Republic.

2 Severely limited capital markets and exchange controls in developing countries have usually implied that a large proportion of wealth is held in the form of real money.

3 For additional studies on the process of dollarization in Perú before 1987 see Beckerman (1987) and Savastano (1990).

4 The effects of currency substitution on seignorage in developing countries has been analyzed in Khan and Ramírez-Rojas (1986), Tanzi and Blejer (1982). Recent analysis on the optimal inflation tax in the presence of currency substitution is contained in Végh (1989).

5 Total stock of money is defined as currency in circulation plus bank deposits denominated in, both, domestic and foreign currencies.

6 If deposits of Peruvian residents in U.S. banks are added to foreign deposits in the Peruvian banking system, the ratio of foreign deposits to the stock of money increased from 33 percent at the end of 1978 to about 70 percent by mid-1985.

7 Fully convertible foreign currency deposits were reestablished, at the beginning of 1991. However, there is still not sufficient data to analyze the behavior of this market.

8 A cash-in-advance model for an economy where two currencies are demanded is contained in Helpman (1981) and Calvo and Végh (1990). Alternatively, one can include both monies in the utility function (Calvo (1985)) or assume that a proportion of a single good is subject to a cash-in-advance constraint (Guidotti and Rodríguez (1991)).

9 This assumption is consistent with developments in the peruvian economy, where U.S. dollars, while widely used, do not constitute a perfect substitute for intis. Indeed, a significant proportion of non-durable goods transactions (such as food, clothing, etc.) in Perú are carried out in intis.

10 This form of liquidity-in-advance constraint is taken from Calvo and Végh (1990).

11 Where δ represents a partial derivative.

12 The marginal indirect utility of holding domestic and foreign money V_M and V_{M^*}, respectively, is the partial derivative of the value function with respect to the corresponding stock of money. Therefore:

$V_M(.t) = (1/P_t)(\lambda_t + \gamma_t \varrho_1)$, and

$V_{M^*}(.t) = (S_t/P_t)(\lambda_t + \gamma_t \varrho_2)$

[13] As the marginal utility of consumption of tradable goods is constant in the steady state, i.e., $\lambda_t + \gamma_t$ is constant, the value of γ has to be non-zero since, otherwise, equation (7) would imply that λ is moving over time, which is a contradiction. Since γ is non-zero, equation (3) holds as an equatility in the steady state.

[14] Studies by Brittain (1981), Miles (1980) and Melvin (1982) among others showed that currency substitution can account for the instability of velocity in some industrialized countries. The paper by Batten and Hafer (1985), however, raises doubts on those results.

[15] Although the model presented in section II indicates that consumption is the appropriate scale variable in the demand for money function, lack of reliable data has forced us to use the index of industrial production as the scale variable.

[16] Although, as will be shown below, the results for real income are borderline.

[17] Stationary implies that a series tends to revert over time either to a constant mean or to a trend.

[18] As a result, traditional regression analysis relating the behavior of nonstationary variables might just reflect "spurious correlations".

[19] Two variables, a and b, following an I (1) process are said to be cointegrated if there exists a non-zero constant G, such that

$c_t = a_t - Gb_t$

is a stationary process; that is the series c_t is integrated of order zero, I (0). For further elaboration on the theory of cointegration see Granger and Weiss (1983), and Engle and Granger (1987).

[20] As mentioned in the introduction, during that period (when the government of the APRA (American Popular Revolutionary Alliance) party was in place) heavily expansionist measures were undertaken.

[21] For the period March 1957-April 1991, the unit root tests for the price level gave the following results:

	DF	ADF
p	16.50	9.04 (1)
Δp	–10.39	–7.01 (1)

[22] Since at every period of time economic agents do not have full information about the future course of government policies, the expected rate of change of the exchange rate is the relevant variable to be used in an empirical investigation of currency substitution.

[23] Data on Peruvian deposits in U.S. banks was obtained from the U.S. Treasury Department. Notice also that since U.S. currency notes also circulate widely in the economy, our measure of f should be taken as a "lower" bound indicator.

[24] The two dummies correspond to the following months: August 1982 (the outbreak of the debt crisis), and June 1985 (to reflect the winning of the candidate of the American Popular Revolution Alliance (APRA) to the Presidency).

[25] The estimation of equation (12) was done using the two alternative definitions of domestic money. The results were respectively:

$$(m1_t - f_t) = 1.331 - 22.114\ E(e_{t+1} - e_t)$$
$$(0.127) \quad (2.252)$$
$$R^2 = 0.53 \qquad D.W. = 0.59$$

and:

$$(m2_t - f_t) = 1.677 - 17.557\ E(e_{t+1} - e_t)$$
$$(0.115) \quad (2.010)$$
$$R^2 = 0.467 \qquad D.W. = 0.621$$

where the numbers in parenthesis are standard errors. In addition, the first stage R^2 equaled 0.47.

[26] For a discussion of these issues, see Goldfeld and Sichel (1990). The presence of a partial adjustment mechanism in a high-inflation economy like the Peruvian one can be justified on two grounds: First, equation (12) was estimated for a period where inflation, although high (an average of 70 percent per year) only accelerated at the end of the period and second, we are using monthly data. Partial adjustment mechanisms would be more difficult to justify if we were using quarterly or lower frequency data. Also, as will be discussed in the next section, such mechanism seems to have either disappeared or decreased significantly in the second subperiod under study, when inflation accelerated rapidly.

[27] At the 1 percent significance level the confidence intervals for the coefficients affecting the lagged dependent variable are:

(0.882, 0.948) (equation (13))

(0.874, 0.94) (equation (14)).

[28] The study by Ramírez-Rojas (1985) implies a semi-elasticity of currency substitution for Argentina during the period 1980-84 which equaled –3.5. The corresponding value for Uruguay during the period 1970-86 is –6.5. Ortiz (1983) reported a semi-elasticity of –6.9 in his study of México during the period 1933-80.

[29] Recall that since m and f are I (1) variables, specification of the money demand (domestic or foreign) equations should be made in first differences.

[30] The error correction model was derived in the following way: From the long-run relationship imposed by currency substitution, and the implicit homogeneity of the demand for both domestic and foreign money on prices, we have that:

$f_t = b_0 + m_t + b_1\ E(e_{t+1} - e_t) + \epsilon_t$

The error correction model for Δf_t can then be formulated:

$\Delta f_t = z_0 + z_1 + f_{t-1} - z_1 m_{t-1} - z_2\ E(e_t - e_{t-1}) +$

lags of dependent variable and lags of changes of output + ξ_t.

The long-run semi-elasticity of currency substitution will then equal:

z_2/z_1.

[31] The instrument were those describe above.

[32] Also, during the forecast period, illegal sales of drugs increased, at times, the amount of U.S. dollars circulating in the economy. This reinforces our contention that the forecasts are on the lower side.

[33] Lagged rates of growth of the money supply were also included but they were found to be non significant.

[34] There is the possibility that equation (18) may not be identified because the presence of $(m - f)_{t-1}$ may merely reflect the relationship between the expected rate of change of the exchange rate and the ratio of domestic to foreign money, as represented in equation (13). Indeed, the rate of change of the exchange rate is somewhat correlated with the inflation rate (the partial correlation coefficient equaled 0.5). However, because Δp_{t-1}, Δp_{t-4} and Δy_{t-2} appear in equation (18), this interpretation of equation (18) does not seem very plausible. In principle, these issues could be explored further in the context of a simultaneous equation model.

[35] For example, see Edwards (1983).

[36] Given the similar results obtained using either m1 or m2, we only report here the estimations using m2.

[37] The proxy for holdings of U.S. dollars based on equation (15) was also used to estimate the equation for the inflation rate during the entire period under analysis (January 1978 to June 1990). However, a Chow-test for parameter stability for the subperiods January 1978-July 1985 and August 1985-June 1990 revealed a structural break in the equation for inflation. This result is not surprising. During the period August 1985-June 1990, the government in charge followed an heterodox approach that attempted to deal with inflation by means of imposing wage and price controls but gave no priority to the fiscal deficit (see Thorp (1990)). Increasing fiscal deficits financed by the issuance of domestic credit fueled the inflation rate, which accelerated rapidly from mid-1987 to mid-1990 (see Chart 2). In addition, the exchange rate in the parallel market moved from 20 intis per U.S. dollar at the beginning of 1987 to 71,932 intis per U.S. dollar in June 1990. These developments are largely consistent with a structural break in the parameters of the inflation equation and, also may indicate a change in the parameters of the equation estimating the demand for U.S. dollars (equation (15)). This result stresses the limitations of our forecasts for holdings of U.S. dollars based on equation (15).

[38] See Guidotti and Rodríguez (1991) for a theoretical model that explains the persistence of dollarization as a reflection of costs involved in switching the currency denomination of transactions.

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CURRENCY SUBSTITUTION AND THE REGRESSIVITY OF INFLATIONARY TAXATION

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Abstract:

The purpose of this paper is to show that in the presence of financial adaptation or currency substitution, the inflation tax is extremely regressive. This regressivity arises from the existence of a fixed cost of switching to inflation-proof transactions technologies. This fixed cost makes it optimal only for those agents with sufficiently high incomes to switch out of domestic currency. The effects are illustrated and quantified for a particular case.

1. Introduction

The Austral and Cavallo plans implemented in Argentina in 1985 and 1991, respectively, point to a drastic change in the perception of proper economic policy. In both cases, stabilization programs that stressed the need for fiscal adjustment and monetary restraint were seen as the only way out of Argentina's history of high inflation. What makes both experiences so remarkable is that in both cases, they were implemented with clear electoral purposes in mind. Three months after the Austral plan and six after the Cavallo plan were launched, general elections for the legislative assembly took place[1].

Table 1 summarizes some of the main developments of economic policy relevance for Argentina, between January 1991 and the elections in October. As can be immediately seen from a quick browsing of this table, the government chose a strategy of strict

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