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MONEY, PRICES, AND DOLLARIZATION: EVIDENCE FROM ECUADOR AND PERU

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Abstract:

Recent work on financial openness, currency substitution, and dollarization have brought into question the ability of small economies to have monetary independence or effective monetary control, even with a flexible exchange rate regime. With increasing degrees of openness, currency substitution, and dollarization there is the danger of increasing instability as key variables become either indeterminate or beyond the control of domestic monetary management. The purpose of this paper is to provide precise empirical definitions of financial openness, currency substitution, and dollarization in order to sharpen the discussion and scientific investigation of open-economy monetary policy. Results based on recent experiences of Ecuador and Peru, which have had very different results from stabilization measures in the early 80's, are presented to highlight the importance of careful definition of "stylized facts" when dealing with financial openness, currency substitution, and dollarization.

I. Introduction

Recent work on financial openness, currency substitution, and dollarization has brought into question the ability of small economies to have monetary independence

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or effective monetary control, even with a flexible exchange rate regime. With increasing degrees financial openness or capital mobility, currency substitution, and dollarization, there is the danger of increasing instability in money markets as key variables become either indeterminate or beyond the control of domestic monetary management. There may thus be a case for currency controls in order to regain some degree of monetary independence and restore stability.

Ecuador and Peru are interesting countries for studying these phenomena. Both countries experienced large inflows of dollars in the 1970's, and high inflation rates, as the economies progressively "opened-up" their domestic markets to trade and capital flows and accumulated foreign debt. In Ecuador these dollar inflows took place during the oil boom. Inflation jumped to very high levels by historical standards. However, Ecuador was able to bring about a rapid and virtually costless deflation in 1983 through a credible de-dollarization program. In Peru, the inflow of dollars grew with the expanding drug trade, and the demand for dollars increased with the uncertainty caused by frequent changes in exchange rate policies in this period. The government recognized the *de facto* dollarization of the economy by legalizing dollar deposits in the Peruvian banking system in 1977. As the percentage of dollar deposits to domestic-currency deposits steadily increased to levels over 60 per cent in the early 80's, inflation increased. The imposition of restrictive monetary policy, in accord with IMF "standby agreements" with Peru, made matters worse. Instead of reducing inflation, according to Rosemary Thorp, these policies helped push the economy from a state of "crisis" to "chaos" by 1984, as inflation persisted at a levels over 100 per cent, while consumption declined by 9 per cent and investment by 19 per cent in 1983 [Thorp (1986) p. 224].

The experiences of Ecuador and Peru thus suggest that domestic inflation may become "indeterminate" or beyond the control of domestic monetary policy with significant dollarization, and that a credible de-dollarization may be a necessary proviso for the implementation of a successful stabilization policy. Without a de-dollarization program, orthodox stabilization measures may prove ineffective in reducing inflation yet costly in terms of per-capita living standards and long-term growth.

The paper provides a categorization of recent literature on financial openness, currency substitution, and dollarization, and applies this categorization to the recent experiences of Ecuador and Peru with recent techniques in time-series modelling. The objective is to establish the different ways these economies evolved from relatively closed economies in the early 70's to semi-open or dollarized economies with different forms of currency substitution.

The literature on financial openness concentrates on the independence of domestic interest rates form domestic monetary conditions. The work on currency substitution shows that the exchange rate may be highly unstable or indeterminate when there is significant demand for domestic and foreign money by local residents. Finally, the dollarization literature stresses the growing use of foreign money as a medium of exchange and unit of account, as well as a store of value, in the domestic economy, with increasing loss of seigniorage by the government. Yet in all of this literature there is an identification issue: what precisely is the distinctiveness of dollarization as opposed to financial openness or currency substitution?

Edwards [1985] calls an economy financially "open" if the domestic interest rate is fully determined by interest parity and is independent of domestic monetary conditions. A financially open economy may be one with a fixed, freely flexible, or mixed exchange rate system. Since the openness property refers to the ability of agents to arbitrage

interest rate differentials, the regime with monetary policy serves only to identify which quantities adjust when a disequilibrium in interest rates appears.

A financially closed economy would be the reverse: the interest rate would be independent of the world interest rate and expected currency depreciation, and would be fully dependent on domestic monetary conditions. Edwards found Colombia to be a financially "semi-open economy", since his empirical results revealed that the interest rate was significantly influenced both by interest parity and domestic monetary conditions.

Currency substitution occurs when domestic residents both hold foreign and domestic money, and the "desired proportion is given by a liquidity preference function dependent on the difference between the expected rate of returns" of the two monies [Calvo and Rodriguez (1977): p. 617]. Currency substitution requires only "that there exist a group of individuals" in the economy that are willing "to hold both domestic and foreign currency balances and are indifferent at the margin between holding more domestic and more foreign balances" [Miles (1978): p. 429]. Girton and Roper [1981] have shown that the exchange rate will be "indeterminate" with perfect currency substitution, and that with high (but less-than-perfect) currency substitution, the greater will be the instability in exchange rate movements [Girton and Roper (1981): p. 16]. Thus currency substitution as an equilibrium phenomenon generally requires a fixed or controlled exchange rate to determine the relative values of the two monies and to prevent wide swings in financial markets.

In several studies, the degree of currency substitution has been measured by the responsiveness of domestic and foreign money demand by local residents to the differential between domestic and foreign interest rates taken to be the expected rate of depreciation, as in the case of financial openness. Miles [1978] reported a significant degree of currency substitution between the U.S. dollar and the domestic currency in an empirical study of Canada; Canto [1982] and Marquez [1984] found similar evidence vis-a-vis the dollar for the Dominican Republic and Venezuela, respectively. For a group of ten industrial countries, McKinnon [1982] observed that currency substitution "destabilizes the demand for national monies" so that "one can't make much sense out of year-to-year changes in purely national monetary aggregates in explaining cycles in purely national rates of inflation [McKinnon (1982): p. 320]. He states that American monetary policy must be "internationalized" in order to "stabilize international and American price levels" [McKinnon (1982): p. 321].

Cuddington (1983) has pointed out the problems of correctly specifying capital mobility (or financial openness) and currency substitution in empirical analysis. With capital mobility, foreign interest rates as well as domestic interest rates should affect the demand for domestic money, since both domestic and foreign rates (representing the returns on foreign *bonds*) are the correct opportunity costs of holding domestic money. However, with currency substitution, expected foreign inflation and domestic inflation are the correct variables for domestic money demand, since both represent returns on money. Browne (1986) has applied Cuddington's specification to test for capital mobility and currency substitution in Ireland. He found both effects present in his analysis of Irish demand for money. However, this approach, while useful, has certain limitations. With highly mobile capital the difference between domestic and foreign interest rate is the expected rate of devaluation. If foreign inflation is insignificant, this expected rate of devaluation may be quite close to the expected rate of inflation on domestic money. Hence there may be severe multicollinearity problems in specifying a demand for money with domestic and foreign interest rates as well as expected inflation.

In many cases, this framework may not be empirically operational for discriminating between capital mobility or financial openness, and currency substitution, especially in countries where the rate of devaluation is the main "anchor of expectations" for future domestic inflation.

A second problem with the Cuddington classification is the sharp distinction between demand for foreign money and the demand for foreign bonds. Certain foreign interest-earning assets may be short-term and thus highly liquid, and thus not very different from foreign money. It may be the case that capital mobility entails some form of currency substitution[1].

Dollarization occurs when an increasing share of real and financial transactions are preferred in dollars relative to those realized in domestic currency" [Ortiz (1983): p. 174]. Fischer defines dollarization simply as a "shift away" from domestic money to foreign money as a "store of value, as unit of account and as medium of transactions" when "inflation increases" [Fischer (1982): p. 295]. The phenomenon of dollarization is a disequilibrium phenomenon. It is the process of replacement of one store of value with another. This is most easily accomplished in economies with large export sectors and fixed overvalued exchange rates. With dollarization, Ortiz sees the danger of "importing a substantial degree of instability from abroad" if the "demand for domestic currency is strongly influenced by foreign variables" [Ortiz (1983): p. 179) However, Ortiz believes that the relevance of this danger "can only be evaluated empirically" and "to date the evidence is scarce" [Ortiz (1983): p. 180].

One reason for the scarce evidence on the dangers of dollarization may be due to the observational equivalence of dollarization phenomena with currency-substitution and financial-openness phenomena as they appear in the literature[2]. Openness is defined in terms of interest-parity determination of the domestic interest rate. Similarly, currency substitution bases the demand for money on the domestic and foreign expected rate of inflation. However, domestic expected inflation may simply be the difference between domestic and foreign interest, so that it may be impossible to detect the separate effects of both interest rates and expected inflation on demand for money. Finally, with dollarization, there is a shift away from domestic money, as in currency substitution, and the growing influence of foreign variables may bring increasing instability, as in financial openness.

The purpose of this paper is to provide precise empirical definitions of openness, currency substitution, and dollarization in order to sharpen the discussion and scientific investigation of open-economy monetary policy. Results based on the recent experience of Ecuador and Peru are presented to highlight the importance of careful definition of stylized facts.

II. Economic Change vs. Currency Accessibility

In this section we demonstrate with a series of models, each representing a true underlying economic structure, how the presence of foreign currency stocks in the domestic economy, loosely corresponding to openness, currency substitution, and dollarization, have very different implications for monetary policy and currency-control decisions. However, viewed from the current treatment of the literature, they are observationally equivalent. This paper provides a framework which redefines this categorization in terms of the fundamental behavior of the economy and thus provides a phenomenalogical approach to understanding volatile currency markets in developing countries.

The central point is that stocks of foreign monies, changes in foreign money holdings and currency choice are separate but not mutually exclusive aspects of monetary phenomena and that careful treatment of each is required for appropriate economic and econometric model specification. We employ the concept of currency choice –the distinct different ways economic agents view their domestic currency– as our primary categorization device. We illustrate the importance of these distinctions with a version of Cagan's money-demand model below and demostrate the non-vacuity of our point with our econometric results in the next section.

Our modelling posits a single equation logarithmic money demand:

$$m_t - p_t = -\alpha\pi_t + \epsilon_t \qquad (1)$$

where m is the quantity of nominal money, p is the general price level, α is a constant, π is a demand shift variable usually taken to be inflation expectations and ϵ is a net of secular trend real income shift variable. We assume ϵ to have mean zero, constant variance (σ_ϵ^2) and serially uncorrelated random variable. To close the model we require two additional equations, one to determine m and one to determine π. For the first, we assume that the government controls the nominal quantity of money but may follow a feedback rule:

$$m_t = A(L)X_t \qquad (2)$$

where X_t is a k x 1 vector of predetermined variables and A(L) is a 1 x k polynomial in the lag operator. The expectation shift variable π can take on different forms depending on the actions of economics agents. That more than one of these forms is consistent is a direct outgrowth of the rational expectations "multiplicity" literature. Introducing the exchange rate, e_t we write a general solution to π as:

$$\pi_t = B(L)m_t + C(L)P_t + F(L)e_t \qquad (3)$$

where B, C and F are 1 x P polynomials in the lag operator. The polynomials A, B, C and F are restricted by the assumption of rational expectations.

To differentiate semi-openness and currency substitution from dollarization, we must be more specific about the process determining the current money supply and expectations (m_t and π_t) in Cagan's model.

As pointed out above, Edwards (1985) sees a semi-open economy as one in which interest rates respond both to interest parity and domestic monetary conditions, implying a certain degree of (but not complete) monetary exogeneity. We categorize this type of economy as one with currency substitution and an exogenous money supply process. We thus define the strictly exogenous money process by its own history as well as by a current innovation term:[3]

$$m_t = \Sigma\phi_i m_{t-i} + \eta_t \qquad (4)$$

The innovation term η_t has a zero mean and a constant variance. Hence, $E(\eta_t) = 0$ and $\text{Var}(\eta_t) = \sigma_\eta^2$. Expectations under currency substitution with exogenous money respond to the expected rate of devaluation, $\text{Exp}(\Delta e_t)$ as well as to current money stock changes. In our notation Exp represents the expectation operator, and Δ the first-difference operator. With perfect foresight, however, the expected rate of devaluation corresponds

to the actual rate of devaluation. The expected rate of inflation thus becomes a function of current exchange rate and money supply *rates of change*, since both affect interest rate behavior:

$$\pi_t = \theta_1 \Delta e_t + \theta_2 \Delta m_t \tag{5}$$

Combining equations (1), (4) through (5), we way express the current price level as a function of current exchange rate and money stock rates of change, lagged money stocks, and a composite error term for money demand and supply:

$$p_t = \alpha[\theta_1 \Delta e_t + \theta_2 \Delta m_t] + \Sigma \phi_i m_{t-i} + (\epsilon_t + \eta_t) \tag{6}$$

The currency-substitution literature, as pointed out in the first section, emphasizes the role of expected devaluation rates for determining the desired proportion of foreign and domestic money held by domestic residents. There is no assumption about the exogeneity of the money supply. We thus categorize a second form of currency substitution, distinct from financial semi-openness, as one of currency substitution with accommodating money, in which current money supply adjusts to current exchange rate and lagged price levels:

$$m_t = \delta e_t + (1 - \delta)\, p_{t-1} + \eta_t \tag{7}$$

For price expectations, seen simply as the difference in the rate of return on the two money stocks, the rate of devaluation is crucial. Assuming perfect foresight, we express the expected rate of inflation π_t as a function of the rate of devaluation:[4]

$$\pi_t = \Delta e_t \tag{8}$$

Combining equations (2), (6) and (7), we express the current price level as a function of current exchange rate changes and levels, lagged price levels and the composite error term:

$$p_t = \alpha[\Delta e_t] + \delta e_t + (1 - \delta)\, p_t - 1 + (\epsilon_t + \eta_t) \tag{9}$$

Dollarization, like currency substitution, assumes accommodating monetary policy. However, with dollarization, expectations respond not simply to current exchange rate changes but also to changes in the stock of foreign money in the domestic economy, since an increasing share of domestic transactions are desired to be undertaken with the foreign money. Thus

$$\pi_t = \Delta e_t + \mu \Delta m_t^* \tag{10}$$

where m_t^* represents the stock of foreign money available to domestic residents[5]. Combining (1), (7) and (10), we can write the current price level as a function of exchanges and levels, lagged-prices, and changes in the foreign money stock as well as a composite error term:

$$p_t = \alpha[\Delta e_t + \mu \Delta m_t^*] + \delta e_t + (1 - \delta)\, p_{t-1} + (\epsilon_t + \eta_t) \tag{11}$$

Comparing equations (6), (9) and (11) we can formulate restrictions on price determination equations for semi-openness, currency substitution with accommodating money, and dollarization. In semi-openness, lagged prices and foreign money stock should not matter; with currency substitution with passive money, neither domestic nor foreign money should matter; and with dollarization, domestic money should not matter; with currency substitution with passive money, neither domestic nor foreign money should matter; and with dollarization, domestic money should not matter. By our definitons, the distinction between these concepts is completely characterized by the exogenous or predetermined variables driving prices. These causality relations are testable implications of the categorizations we have chosen and thus provide substantive distinctions between the phenomena. For example, if a large inflow of dollars occurred at a certain time as a result of liberalization, then one could test for dollarization by imposing and testing appropriate restrictions on the parameters of an estimating equation for prices implied by the model of this section.

This framework encompasses the classification scheme put forward by Cuddington (1983) and Browne (1986). Capital mobility entails one or other form of currency substitution, depending on whether monetary policy is exogenous or accommodating. In a semi-open economy there is one form of currency substitution, in which the expected rate of devalution as well as rate of growth of domestic money matter for domestic money demand. Currency substitution with endogenous money, on the other hand, means that only the expected rate of devaluation matters for the demand for money. From this perspective, Browne's results show that Ireland is a country with currency substitution and passive monetary policy. The key issue for us is not whether capital mobility brings with it currency substitution, since it does, but whether capital mobility brings dollarization, which it may not.

It may be objected that it should not be the change of foreign money in the domestic economy, Δm^*, which should matter, but the change in foreign money, dollars, in the U.S. economy, which should matter for the demand for money and inflation in a dollarized economy. This would be true in the limiting case when all goods are costlessly tradeable, or when all domestic and foreign goods are perfect substitutes. Then, in a completely dollarized economy, domestic inflation would converge to inflation in the U.S. economy. However, with non-tradeable goods or imperfect substitutability between domestic and foreign goods, it is the change in the stock of foreign money in the domestic economy, now serving as the medium of exchange as well as store of value, which drives domestic inflation, *i.e.* the change in the overall consumer price index.

It is clear that the categorization set out above is not exclusive. In practice we expect to find episodes of transition in which the restrictions of closed monetary economies, financial openness, currency substitution with accommodating money and dollarization yield coefficient restrictions which are rejected by the data. However these restrictions provide a useful framework for interpreting rejections of the restriction and categorizes the monetary policies which have occurred[6].

III. Money and Prices in Ecuador and Peru

Ecuador and Peru are countries which have experienced switches in exchange rate regimes, from fixed to floating to passive crawls to preannouncing, oil booms, black markets in currency, the growth of large informal sectors, and changes in tariff policy. While there have been many changes, it is not clear which of these changes have produced

fundamental changes in the way agents form expectations of inflation, and how these changes have affected the relations between money, prices, and exchange rates. Aside from the categorizations of semi-openness, currency substitution with passive money, and dollarization, it is interesting to know when fundamental shifts occured in the underlying relationships among these macro variables.

Our analysis of the phenomenon of inflation for these two countries begins with a characterization of the money and price stochastic processes for the 1970's and early 1980's. Ideally we provide a complete set of facts which any model of inflation must confront. As will be seen, these facts pose difficult questions about monetary phenomena.

For our analysis we consider almost exclusively a single set of transformations of the raw data. Our price series are consumer price index concepts which have been written in logarithmic form and for which a log-linear trend has been removed. The results were unchanged when differenced data were employed. In addition, seasonal dummies were used to remove-seasonality from our analysis. Higher order trend terms were also probed and found to be insignificant in explaining the path of prices. Differenced levels which were not seasonally adjusted were also examined, as reported below. The money series is an M1 concept, currency in the hands of the public plus liquid deposits in commercial banks. These data were transformed in the same way as the price data. Our data series were collected by the central banks of the two countries, monthly for Ecuador and quarterly for Peru.

For our first test we project the price series (P) on one lag of itself and four lags of the money stock and test for homoskedasticity of the error term. In this way we implicitly test the linearity of the conditional expectation of prices given price and money data. The point of this test is to pick up evidence of heteroskedasticity. If "dollarization-like phenomena" gradually evolved in both countries, as monetary growth rates increased, we would expect increasing variance in the error term for predicting prices from money-supply information.

The results, reported in Table 1, indicate that for Ecuador homoskadasticity is rejected for significance levels of 10% and less and for Peru for significance levels of 2.5% and less. Although the Chow tests are somewhat sensitive to the degrees of freedom we have, there is an indication that the variability of P is directly related to the size of M. Although this is not a test of inflation effects, the large money stocks in our sample were associated with higher inflation rates.

TABLE 1

HOMOSKEDASTICITY TEST

Period	Model	F(20.20)	Marginal Significance Level
Ecuador 1969-1982	0.85	2.43	0.025
Peru 1969 IV-1984 IV	0.97	1.36	0.100

Model:

$$P_t = \alpha P_{t-1} + \sum_{i=1}^{4} \beta_i M_{t-i} + U_t$$

The second set of tests were for model stability. The results appear in Table 2. Again, the issue is to decide if any "structural change" took place as foreign money stocks increased in each country. The samples were split and F tests of coefficient homogeneity across the split for the coefficients on lagged money stocks in the price and in the money regression were conducted.

TABLE 2

HOMOGENEITY TESTS

Period of Split	Chi-Square Value	Degrees of Freedom	Marg. Significance
Ecuador			
75.12	8.39	6	0.21
76.12	9.18	6	0.16
77.06	14.67	6	0.02
77.12	18.64	6	0.02
78.6	31.33	6	0.00
Peru			
76.4	12.84	4	0.01
77.4	12.35	4	0.01
78.4	17.97	4	0.00
79.4	17.72	4	0.00

Model:

$$P_t = \sum_{i=1}^{\lambda} \beta_i P_{t-i} + d \sum_{j=1}^{\lambda} \delta_{1j} M_{t-j} + (1-d) \sum_{j=1}^{\lambda} \delta_{2j} M_{t-j}$$

$\lambda = 4$ for Peru and 6 for Ecuador.
$d = 1$ before break and 0 after break.

Test: $\delta_{1j} = \delta_{2j}$ for all j.

For Ecuador, sample breaks between 74.6 and 76.12 resulted in an acceptance of homogeneity in the price equation, while splitting the sample in 1977 and after rejected homogeneity. However, the money supply process displayed homogeneity throughout. For Peru, every sample break from 1975, 2 to 1980, 4 rejected homogeneity in the price equation. The evidence for the money equation was more equivocal, rejecting homogeneity of coefficients of lagged money stocks for sample splits before 1976, 4 and after 1980. We conclude that for each country a regression model relating current prices to past prices and past money stocks requires a sample break and that the evidence from the money equations suggests this break is due to behavioral changes rather than a change in monetary policy.

For further understanding, we examined the monetary laws of the two countries. For Peru, in November 1977 the Central Reserve Bank of Peru passed a law, *Decreto Ley 21953* which legalized the holding the dollar demand deposit accounts in domestic banks. Thus, the end of 1977 marked the opening of the Peruvian monetary sectors to currency substitution by reducing substantially the cost of transactiong in dollars[7]. The case of Ecuador is less clear. The economy of Ecuador went into a period of stagnation

after the 1972-1975 oil boom and in the late 1970's the military government was struggling with a large foreign debt and declining revenues. At the same time there was tacit liberalization in the free foreign exchange market as the gap between official and free rates widened without fostering a reaction by the monetary board.

For the entire sample and for sub-samples indicated by the homogeneity tests, we examined the Sims-exogeneity of money supplies. The results appear in Table 3. With this test we look for evidence of a change in monetary policy as dollarization-phenomena took hold. According to the categorization of the preceding section, we would expect money not to be exogenous in a highly dollarized economy.

TABLE 3

SIMS EXOGENEITY TESTS

Period	Numerator D.F.	Denominator D.F.	F-Stat.	Marg. Signif.
Ecuador				
69-82	6	137	0.30	0.94
69-77	6	77	0.76	0.60
78-82	6	29	1.33	0.28
79.7-82	6	17	2.56	0.06
Peru				
69.4-84.2	8	30	2.86	0.02
69.4-76.4	4	12	3.78	0.03
78.4-84.2	4	5	1.12	0.44

Null Hypothesis: M is exogenous relative to P.

For Ecuador, we find that exogeneity of money with respect to prices is accepted over the entire period and for sub-samples on 1969-1977 and 1978-1982. However the subsample 1979-1982 rejects exogeneity at the 6% significance level. For Peru we find that during the early period, 1969-1976 the money supply is not exogenous while in the later period, 1978-1984, it is exogenous. For both countries we conclude that monetary policy was probably accommodating for a period and activist for another, implying that different models of money and prices will be appropriate. This finding is not inconsistent with the finding of homogeneity of the money equation for Ecuador (at significance levels less than 10 per cent) if the speed with which money shocks are absorbed into prices changed.

To examine long and short run money price correlations we calculated coherence and phase angles for the subsamples. The coherence statistics indicate the correlation of money and prices at low and high frequencies. The phase angle indicate the lead/lag relationships between money and prices. A positive phase angle implies money *leads* prices; a negative one means money *lags* prices. If the countries became more dollarized toward the end of the sample, we would expect to see more negative phase angles in the period after the split. The results for the two countries appear in Tables 4 and 5.

With the exception of periodicity 2, the coherence estimates for Ecuador 1969-1977 were insignificant. For 1978-1982 and 1979-1982 we found all of the coherence estimates significantly different from zero. Because the coherence were found to be insignificant, the phase angle for the first sub-period does not convey information. However for the second period they indicate a causal direction in the sense of one periodic component leading another in the bivariate time series. We found each phase estimate significantly different from zero and, as indicated in Table 4, the high frequency and low frequency phase angle estimates are negative. This leads us to conclude that short and long run price movements led money stock movements for the 1978-1982 period. This is consistent with our exogeneity results.

TABLE 4

MONTHLY MONEY AND PRICE
(Coherence and Phase Spectra - Ecuador)

Period	69.1-72.12		78.1-82.12		79.1-82.12	
	Coh.	Phase	Coh.	Phase	Coh.	Phase
2	0.72*	−0.43*	0.76*	0.73*	0.87*	−0.97
3	0.35	−0.51	0.78*	−0.67*	0.89*	−0.65*
4	0.19	−1.68	0.89*	1.42*	0.85*	1.53*
5	0.28	−1.28	0.59*	1.62*	0.65*	1.54*
6	0.23	0.58	0.66*	0.33	0.86*	1.00*
12	0.35	1.44	0.95*	5.80*	0.95*	−5.71*
24	0.34	−3.48	.70*	−7.24*	0.62*	−6.50*
36	0.41	11.09*	0.25	−3.06*	0.84*	−4.70*

* Significant at the 5% level.
** Significant at the 10% level.
Confidence intervals and marginal significance levels are available.

TABLE 5

QUARTERLY MONEY AND PRICE
(Coherence and Phase Spectra - Peru)

Period	69.4-76.4		78.1-84.2	
	Coherence	Phase	Coherence	Phase
2	0.70*	1.0*	0.89*	0.1
3	0.37	−1.2	0.94*	0.1
4	0.55**	1.8*	0.86*	0.6
8	0.70*	3.3*	0.72*	2.4*
12	0.73*	4.0*	0.26	4.4*
16	0.52	5.9*	0.56**	−7.3*
20	0.54**	8.1*	0.72*	−8.7*

* Significant at the 5% level.
** Significant at the 10% level.
Confidence intervals and significance levels are available.

For Peru we find many significant coherence estimates. However the low frequency components tend to be weakest for both subsamples, indicating a weak long-run relationship between money and prices. For the high frequency components –the short-run– we find a stronger relationship between money and prices, particularly in the 78-84 sample. Significant phase shift occurs at low frequencies and interestingly changes sign from the first to the second period. In the later sample, money lags prices. This result is consistent with a movement toward dollarization in this period. It is also somewhat puzzling since the money stock was found to be exogenous and indicates that the exogeneity result or the phase shift result or both could be spurious. At any rate, the question of exogeneity of the money supply in Peru in the 77-84 period remains open.

Finally we examined the equilibrium hypothesis of long run money and price proportionality. If dollarization phenomena became significant within the sample periods, we would expect these phenomena to overturn any long-run proportionality relationship between money and prices which may have existed before the influx of foreign currency.

To examine this we took our unadjusted logarithmic series and examined the data for the property of cointegration. If the money and price series were shown to be cointegrated, we formulated tests to determine how deviations from long run proportionality affected the change in prices. If the deviations did not significantly affect price changes, we are able to conclude that the trend in the series is secular and not related to a long-run quantity theory specification.

To test for cointegrated processes we follow the tests of Dickey and Fuller (1981) and the estimation strategy of Granger and Engle (1984). For each Ecuador subsample and the entire Peru sample we project n-th differences of price and money on lagged n-th differences and one lagged n-lst difference. If the coefficient on the n–lst difference is non-zero then the series is integrated of order n-1. If both money and prices are integrated series of order n-1, we may test for cointegrated processes by estimating the long-run equilibrium-error correction model.

Table 6 presents the results for Ecuador. We find that for the 1978-82 period prices are integrated of order zero. For the 1969-77 period prices are integrated of order 1 and money is integrated of order zero. Therefore, for the entire sample, we have no evidence consistent with the hypothesis that prices are in the long run proportional to money stocks based on trends in time series.

For Peru, Table 7 shows that during the entire sample period, 1970-1984, prices-are integrated of order 0. Moreover the money series was integrated of order 0. This suggests that the equilibrium model embodying the quantity theory may be appropriate for long run trends. However, estimation of this model, also seen in Table 7, yielded an insignificant coefficient on the equilibrium term. We therefore conclude that the trends in money and prices for Peru during this period do not exhibit a long run, stable equilibrium relation as suggested by a strict quantity theory of money approach[8].

IV. Further Evidence on Structure

In the previous section evidence of four apparently different money-price experiences was presented. In this section we complete our illustration by interpreting this evidence with further evidence on the categorization and structural restrictions set down in Section II.

TABLE 6

TESTS OF MONEY AND PRICE COINTEGRATION
(Ecuador, 1969 to 1982)

Dependent Variables		Independent Variables	
ΔP	P_{-1}	ΔP_{-1}	ΔP_{-2}
69 - 77	0.002	–0.116	–0.098
	(2.211)	(1.140)	(0.960)
78 - 82	–0.001	–0.025	–0.016
	(0.231)	(1.140)	(0.127)
$\Delta^2 P$	ΔP_{-1}	$\Delta^2 P_{-1}$	$\Delta^2 P_{-2}$
69 - 77	–1.300	0.219	0.157
	(6.980)	(1.480)	(1.550)
ΔM	M_{-1}	ΔM_{-1}	ΔM_{-2}
69 - 77	0.003	–0.055	–0.317
	(0.523)	(6.740)	(3.270)

Numbers in parentheses are the t-stadistics.
A full set of statistics are available.

TABLE 7

TESTS OF MONEY AND PRICE COINTEGRATION
(Peru, 1969-1984)

Dependent Variables		Independent Variables	
ΔP	P_{-1}	ΔP_{-1}	ΔP_{-2}
	0.004	0.384	0.391
	(2.28)	(3.04)	(3.06)
$\Delta^2 P$	ΔP_{-1}	$\Delta^2 P_{-1}$	$\Delta^2 P_{-2}$
	0.012	–0.530	–0.540
	(0.270)	(0.362)	(0.380)
ΔM	M_{-1}	ΔM_{-1}	ΔM_{-2}
	0.005	0.810	–0.112
	(2.89)	(6.10)	(0.830)
$\Delta^2 M$	ΔM_{-1}	$\Delta^2 M_{-1}$	$\Delta^2 M_{-2}$
	–0.01	–0.09	–0.32
	(0.29)	(0.67)	(2.36)

Error Correction Model:

$$\Delta P = \underset{(7.39)}{0.750}\ \Delta P_{-1} \underset{(0.01)}{-0.001}\ \Delta M + \underset{(1.47)}{0.260}\ \Delta M_{-1} + \underset{(0.21)}{0.007}\ (P - \delta M)$$

$$\delta = \underset{(294.8)}{1.13}$$

Numbers in parentheses are t-statistics.
A full set of model statistics are available.

The early Ecuador period (1969-1977) was defined by a break in the price series. Corresponding to this episode we found that the domestic money supply was Sims-exogenous to prices and that everywhere except the short-run two-period cycle the two series were not significantly related. Moreover we found no evidence that the trends represented money market equilibrium processes as defined by Granger and Engle. The late Ecuador period (1978-1982) was characterized by an endogenous supply of money which was significantly related to the price level at most frequencies. Moreover only medium-run periods demostrated money leading prices instead of prices leading money. Our trend results were the same as early Ecuador.

The early-Peru episode (1969-1977) shows an endogenous money supply but unlike late Ecuador money leads prices at all frequencies. Moreover the relationship is weak. When combined with late Peru there are strong trends in the data. Finally, in late-Peru (1978-1984) we find an exogenous money stock which is strongly related to the price level. However, frequency domain analysis shows that in the medium-run money tends to lead prices and in the long-run to lag prices, leading to skepticism about our causality results.

The interesting aspect of these results is that casual observation would not lead to them. In both countries the early period was one of low inflation, petroleum-led growth and seeming stability of money markets, while the late episodes were ones of historically high inflation, declining oil revenues, liberalization and capital flight. Yet they are apparently of a quite different character. We explore this further by estimating the reduced form models of prices on money, exchange rates and past prices set out in Section 2. The missing variable in this analysis is stock of foreign money, a measure which is difficult to obtain. There are some possible alternatives for this variable, such as Peruvian or Ecuadorian dollar deposits in US banks or in domestic banks, but the former is more a measure of capital flight and the latter of international trade. Without further evidence of how these relate to the foreign component of the domestic money supply we prefer not to introduce spurious components.

The observational equivalence in the structural model is not as bad as it might seem. The presence of foreign money driving prices and driving out domestic money has certain time series implications. In the previous section we presented evidence on heteroskedasticity and cointegration consistent with dollarization and inconsistent with currency substitution. This is so because with currency substitution there exists another "money like asset" but not another money per se. The cointegration results picked up this subtle but important difference and thus provides the identifying side evidence which takes care of the observational equivalence problem in the structural model.

Our estimates are presented in Table 8. For the early Ecuador period we found that the only element present in the equation as a significant variable was the distributed lag on prices. This corresponds to none of our internationalization of money categories but does correspond to a closed economy with money in equation (3) being accommodating only to price changes. We suspect that real shocks and the administration of specific prices by the government are responsible for some price movements as well, but further investigation is required.

For the late Ecuador period we find money, prices, and exchange rates significant in the equation. Our previous analysis of this episode suggests that the presence of money is due to its position as a passive variable and we conclude that this is a dollarized or currency-substitution economy with accommodating money. Our analysis thus points to an important behavioral shift in the Ecuadorian economy, knowledge of which is crucial for appropriate policy analysis.

TABLE 8

TESTS OF EXCLUSIONS IN PRICE EQUATIONS

Period	NDF	DDF	Variable	F(NDF, DDF)	Significance Level
Ecuador					
69-77	4	84	E	0.85	0.50
	4	84	P	30.57	0.00
	4	84	M	0.11	0.98
78-82	4	44	E	2.21	0.08
	4	44	P	16.67	0.00
	4	44	M	2.23	0.08
Peru					
69-77	4	17	E	1.39	0.28
	4	17	P	12.66	0.00
	4	17	M	0.78	0.55
78-84	4	10	E	3.20	0.06
	4	10	P	7.79	0.00
	4	10	M	0.97	0.46

The evidence from early Peru, like Ecuador, shows only prices to be important in the price equation. Since money was endogenous to prices, this suggests a passive monetary policy, possibly through an explicit funding of changes in administered prices. The evidence from late Peru shows only prices and exchange rates as significant variables, suggesting currency substitution with passive money or dollarization.

V. Conclusions

We have shown that time series analysis of money, prices, and exchange rate, when performed without strong prior beliefs, yields a varied and at times puzzling picture of the nature of monetary phenomena in these two countries. We provide a categorization which permits more careful study, an important antecedent to policy analysis.

Our models are highly aggregated and therefore subject to the Lucas critique if policy simultions were performed with them. However they are useful for uncovering important shifts in economic behavior. A fuller exploration of the structure of monetary markets, administered prices, credit systems and exchange rate regimes in economies with multiple currencies when structured shifts occur, such as those found here, is clearly desirable. We have seen that the treatment of monetary phenomena as "all one and the same thing" during a process of financial liberalization is misleading in the cases we studied. The fundamental question for us is to determine the conditions under which an economy evolves into semi-openness, currency substitution, or dollarization from an insulated economy, since optimal policy formulation requires a careful accounting of this evolution.

Notes:

[1] It should also be noted that Cuddington and Browne are not dealing with the problems of financial liberalization of less-developed small economies, but with the problems of small economies in a setting of high industrialized countries with tightly linked capital markets.

[2] By observational equivalence we mean that there are no empirical tests which help us to distinguish between semi-openness, currency substitution, and dollarization.

[3] It may be objected that a Granger exogenous money supply should not define a semi-open economy since policy-makers may use the exchange rate as a "signal" of excess demand conditions. However, in the economies in question in this paper, the exchange rate is the main anchor of expectations, and excess demand conditions have not varied very much. Thus, if the exchange rate does Granger-cause the money supply, it is most likely that money is passive.

[4] We thus assume a perfect foresight version of rational expectations.

[5] If we change the units of measurement of the foreign currency, the appropriate coefficients of the equation will change, so that expected inflation does not increase if we measure US currency in dollars or dimes.

[6] We assume in this model that foreign currency is the only substitute for domestic money. Commodities do not serve as substitutes for domestic currency, because of the availability of dollars and the ease with which the value of dollars can be assessed.

[7] One of the reasons why the Central Bank of Peru permitted the dollar deposits was the revenue effects of requiring reserves, and then lending these dollar reserves at LIBOR rates in the international markets.

[8] These results confirm our initial approach to work with detrended and differenced data, since the trends are purely secular.

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RELACION PRECIO-COSTO MARGINAL, CONCENTRACION INDUSTRIAL Y COMPETENCIA EXTERNA: UN ESTUDIO PARA CHILE*

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Abstract:

This article studies the effect of entry barriers on industrial concentration and the effects of external competence and industrial concentration on the price-marginal cost relation. This is done by using a model that explicitely considers collusion among firms.
Empirical results –based on the 1979 Chilean manufactured industrial census– show that entry barriers explain the degree of industrial concentration. For the consumer goods industry, external opening –but not market structure– explains market power. In the case of the industrial goods industry, the level of imports exerts a direct impact on the price-marginal cost relation, suggesting that collusion between domestic and external producers is possible.

I. Introducción

En un mercado competitivo, ya sea por la existencia de un gran número de firmas domésticas o por efecto de la competencia externa, en ausencia de barreras a la entrada, las firmas establecidas en dicho mercado prácticamente no tienen ninguna capacidad de fijar un precio por sobre el costo marginal, debiéndose conformar, en el largo plazo, con un equilibrio en el cual el precio de mercado se iguala al costo marginal y al costo medio y los beneficios anormales son iguales a cero.

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