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DOLLARIZATION AND MONETARY REFORM
Evidence from the Cochabamba Region of Bolivia*

MICHAEL MELVIN and KURT FENSKE
Arizona State University

Abstract:

Using data on informal market loans in the Cochabamba region of Bolivia, we test the hypothesis that monetary reform in the 1985-87 period resulted in a dedollarization of the economy. A theoretical model of the loan market suggests variables to be examined in the empirical analysis. A PROBIT model of the probability of dollar-denominated loans is estimated as a function of Bolivian inflation, exchange-rate depreciation, and exchange-rate volatility. In addition, policy reforms are modeled with dummy variables that switch on at the date of the reforms. In addition to the PROBIT estimates, we aggregate monthly average time series data for the informal market and investigate the hypotheses studied in this alternative data set. The evidence from the informal loan market suggests that the Bolivian stabilization plan was associated with an increase in dollarization rather than a decrease. Several possible reasons for this result are discussed, including a lack of credibility of the announced plan.

I. Introduction

In a recent paper, Melvin (1988) argued that dollarization may be considered a market-based monetary reform that occurs on the demand side in place of an official supply-side monetary reform. When public confidence in the domestic currency is eroded, but the government does not declare an official monetary reform, the public will substitute away from the low-confidence domestic money into a high-confidence foreign currency to the extent that such substitutions are possible.

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Dollarization is widely believed to be an important phenomenon in Latin America. However, a major barrier to conducting empirical analyses of the extent and pattern of dollarization is the lack of data on dollar currency circulating in Latin America. Some countries have permitted dollar-denominated deposits and researchers have analyzed the pattern of dollarization implied by such deposits (see Melvin (1988) or Ortiz (1983)). But legal constraints on depositors and risk of confiscation (as with Mexdollar deposits in 1982) should lead us to question the validity of the pattern of dollarization implied by legal dollar deposits in Latin American countries. Melvin and Afcha (1989) demonstrated how the unobserved amount of dollar currency circulating in a country may be estimated, but such estimates are surely subject to considerable error. As a result, researchers have only been able to speculate as to the extent and pattern of actual currency substitution into dollars in Latin America.

Recently, a new data set has surfaced that allows a more accurate assessment of dollarization in a region of Bolivia. As described in Melvin and Ladman (1991), the data are the record of informal loans made in the Cochabamba Upper Valley region of Bolivia. After providing a simple theoretical model of lender behavior, we will describe the data in more detail. Then we will present hypotheses to be tested using this data set. Specifically, we focus on the effect of official monetary reform in Bolivia on the pattern of dollarization as measured by the currency of denomination in the informal loan market. Following the econometric analysis, conclusions and a summary are presented.

II. Informal Loans as a Record of Dollarization

Rural areas in Bolivia have an active informal loan market where individuals make loans directly to one another without the services of an intermediary like a bank. The loans are recorded with local small claims judges in order to provide a legal document that may be used to force collection of delinquent repayments. Data on loans are available from the records kept by the judges. We obtained the data from Jerry Ladman who had the data collected as part of a study of informal credit markets in Bolivia by Ladman and Luna (1988) for the U.S. Agency for International Development. The data set includes loans recorded in three towns of the Cochabamba Upper Valley region: Punata, Cliza, and Arani. These three towns are the seats of government for three of the provinces in the valley. The loan records allow a comprehensive view of the informal market. For instance, in 1986, there were 1,161 loans registered with a total volume of \$764,000. Of the 693 different lenders registered, 78 percent made only one loan, 17 percent made two or more loans, and only 5 percent of the lenders made five or more loans. The lenders are farmers or businessmen who are employed in a principal occupation other than money lending. As a result, the source of loans is not concentrated in a monopolistic few, but a great many small scale individuals. A random sample of moneylenders revealed that only 20 percent of the lenders identified earnings from previous loans as an important source of new loanable funds.

There were 894 different borrowers in 1986, of whom 80 percent received only one loan. According to the survey of moneylenders, peasant farmers were the most frequent borrowers and agricultural financing needs the most frequent use of funds. With the exception of one outlier of 36 months, the terms of loans ranged from one to twelve months, but the typical loan was for one to two months.

Loans are made in either U.S. dollars or Bolivian currency. The survey of lenders indicates that the lenders choose the currency of denomination of loans, and the choice

of lending in dollars rather than Bolivian currency is based on avoiding unexpected currency devaluation. The currency of Bolivia was the peso until the monetary reform of 1987 replaced the peso with the Boliviano.

III. A Simple Model of Lender Behavior

Since the AID survey indicates that the lender chooses the currency of denomination of informal market loans, we will develop a simple two-period mean-variance model of the lending decision which will structure the empirical work to follow. The focus is entirely on the currency composition of loans rather than other interesting aspects of intertemporal substitution. We assume that utility (U) is a function of consumption (C), and the representative lender's utility function is:

$$U = E\,(C_1) - (\alpha/2)\,\mathrm{Var}\,(C_1) \tag{1}$$

where α is the coefficient of absolute risk aversion and E is the expectation operator. The subscript 1 indicates that consumption takes place at period 1.

Loans are made in dollars and in Bolivianos (even though loans were made in pesos in the early period, we will refer to Bolivian currency as Bolivianos) with loan decisions made in period 0. The exchange rate (S) measures Bolivianos per dollar, i^B is the rate of interest earned on Boliviano loans, and i^D is the rate of interest earned on dollar loans. Interest rates are set in period 0 at the time loans are made. A loan of \$1 will earn $(1+i^D)S_1/S=r^D$ in Bolivianos where S denotes the exchange rate in period 0 at the time the loan is made, and S_1 is the exchange rate in period 1 at the time of repayment. Lending 1 Boliviano earns $(1+i^B)=r^B$.

Lenders are assumed to be endowed with income (Y) from non-lending sources each period. Such income may be dollar-denominated (Y^D), as in the case of coca revenues, or Boliviano-denominated (Y^B). In this simple model, we assume that money holdings have no value to the lender so that income is used for either consumption or loans. So total loans made in period 0 (L) will equal Y-C, where C is the amount of consumption in period 0. Let L represent the total dollar value of loans, and D the ratio of dollar to total loans. Then writing the model in dollar terms, the consumption constraint is:

$$C_1 = Y_1 + L\,(1 - D)\,r^B + LDr^D \tag{2}$$

Once the loan decision is made in period 0, the random variables creating uncertainty regarding period 1 consumption are non-loan income (Y) and the dollar return $(1+i^D)S_1/S$. While we know the dollar interest rate (i^D), we do not know the future exchange rate (S_1) at time 0. The problem is to maximize utility from the perspective of the time 0 choice of loan portfolio. Substituting (2) into (1), and maximizing utility with regard to the choice of the dollarization ratio (D) yields the first-order condition:

$$dU/dD = E\,[L\,(r^D - r^B)] - \alpha DL^2\,\mathrm{Var}\,[r^D] - \alpha L\,\mathrm{Cov}\,[Y, r^D] = 0 \tag{3}$$

Solving for the dollarization ratio yields:

$$D = \frac{L\,(r^D - r^B) - \alpha L\,\mathrm{Cov}\,[Y, r^D]}{\alpha L^2\,\mathrm{Var}\,[r^D]} \tag{4}$$

The variance term in the denominator is positive; so as the interest differential rises in favor of the dollar, D rises. The covariance term divided by the variance term yields a beta from the regression of non-loan income on the return on dollar loans. With no data or information on non-loan income, we can only speculate about the factors that would contribute to this covariance term. But there is no reason to expect any particular covariance between the return on non-loan income and the return on dollar loans. If we assume that this covariance is zero, for simplicity, then the variance term in the denominator indicates that the greater the variability of the return on dollars, the lower the dollarization of the market. Since $r^D=(1+i^D)S_t/S$, the greater the volatility of the exchange rate, the greater the variance we would expect of r^D.

We now have some direction regarding empirical modeling of the dollarization process. The dollarization of the informal loan market should increase with: a rise in r^D, a fall in r^B, and a fall in Var[r^D]. The forward-looking lenders will consider the effect of government policy actions in determining their forecasts of loan returns and currency volatility. We will model how the Bolivian monetary and fiscal reform affected the dollarization process. In addition, we will consider the volatility or uncertainty regarding the future value of the dollar against the Boliviano as an index of the uncertainty of the return from dollar loans. Finally, we examine the role of exchange rate change on dollarization as an indicator of interest differentials between dollar and peso loans. Before turning to the empirical work, we consider the role of monetary reform in more detail.

IV. Monetary Reform and Dollarization

In the introduction, we stated that currency substitution away from domestic money into foreign money may be thought of as a market-enforced demand-side monetary reform. In the absence of an official monetary reform, high and unstable inflation in Latin America may have frequently resulted in dollarization of various economies. However, we should expect that the presence of a credible monetary reform would reverse the process of dollarization and induce a *dedollarization* of the economy. This is, in fact, the prediction of theoretical models of stabilization policies. Calvo and Végh (1990) provide a useful literature review of the issue along with a model of the effects of both exchange rate based stabilizations and money growth based stabilizations. In either the case of fixing the exchange rate against the dollar or reducing the money growth rate while allowing the exchange rate to float, we expect a stabilization program to involve an increase in the demand for home country currency and a decrease in the demand for foreign currency.

The effect of a credible stabilization policy on money demand may be summarized as follows. The reduced rate of devaluation of the domestic currency is associated with a lower domestic interest rate. As the opportunity cost of holding domestic currency falls, there is a substitution away from foreign currency into domestic currency. The preceding analysis pertains to money demand rather than the loan market that we analyze. In our case of informal loans, the reduced rate of devaluation of the Boliviano will lower the return on dollar loans relative to Boliviano loans and should lead to a dedollarization of the informal loan market, other things equal. However, one «other thing» is the volatility of the exchange rate. If volatility drops with a drop in the rate of depreciation of the Boliviano, then dollarization of the informal loan market could rise with a more stable exchange rate. Of course, there are many other issues and implications

of a successful stabilization policy, but our interest is solely in currency substitution. The important implication of theoretical models of monetary reform is the expected shift from foreign money to domestic money, reversing the dollarization pattern established prior to the reform. This result provides a testable hypothesis: *dedollarization should follow a successful monetary reform.* The essential goal of this paper is to explore the evidence contained in the record of informal loans in Bolivia regarding this hypothesis.

The Bolivian experience provides a good case study of the effects of monetary reform. We want to concentrate on the pattern of dollarization in Bolivia and determine if there is any evidence of dedollarization following the reform. We should note that there was an official program of dedollarization imposed by the Bolivian government in November 1982 that outlawed dollar-denominated contracts between Bolivian residents and converted all outstanding dollar-denominated contracts into pesos. The government hoped that the official dedollarization law would reduce the demand for dollars and increase the potential seigniorage revenue. Instead, it appeared to stimulate a capital flight and simply drive the dollarization process underground. Morales and Sachs (1990) provide a detailed review of the Bolivian experience and note that the dedollarization law «led to a massive disintermediation of the banking system and to a flight for safer assets, particularly foreign exchange and other foreign assets» (p. 263). We want to be clear that our sense of «dedollarization» is demand-driven in response to monetary reform and not the government plan imposed in November 1982. In September 1985, the official dedollarization program was ended and dollar-denominated contracts were again legal.

The Bolivian economy had experienced growing economic crises through the mid-1980s. When the new government took office in August 1985, there had been five years of falling real GDP along with rising inflation. Inflation was 123 percent in 1982, 276 percent in 1983, 1,281 percent in 1984, and 11,749 percent in 1985. In August 1985 when the new government ascended to power, the inflation rate was running at an annual rate of 23,000 percent. Given the poor economic record of the country, it is not surprising that dollarization was believed to be quite widespread by 1985.

In August 1985, the new government of Víctor Paz Estenssoro announced the following reform measures three weeks after taking office: a competitive exchange rate would be established through a daily foreign exchange auction following a 90 percent depreciation of the currency. In August 1985, the official exchange rate was 75,000 pesos per dollar. At the same time, the parallel market rate was 1,182,303 pesos per dollar. In September, the official rate changed to 1,077,887 pesos per dollar and the parallel rate was 1,087,441 pesos per dollar. The exchange rate continued to depreciate at a rapid rate until early 1986 when it finally stabilized around 1,900,000 pesos per dollar.

The convergence between the official and parallel market rate was but one aspect of the stabilization policy. The other elements of the policy included reducing the growth rate of the money supply, lowering the fiscal deficit by raising prices of goods and services provided by the public sector and freezing wages of public employees, freeing prices throughout the economy, and liberalizing the trade and payments system. Aside from the dramatic change in exchange rates, many of the other changes were quite dramatic. For instance, the price of gasoline was raised from $.05 to $.30 per liter. The reforms announced in August 1985 culminated in the introduction of a new monetary unit, the Boliviano, in January 1987 with a conversion rate of 1,000,000 pesos per Boliviano.

The hypothesis suggested by the theoretical literature on stabilization policies is that the reforms introduced in Bolivia should have been associated with a dedollarization of the economy. The model presented in Section III indicates that as the exchange rate depreciates at a slower rate and the uncovered return on dollar loans falls relative to Boliviano loans, domestic currency loans should have risen relative to dollar loans. In contrast to the stabilization policy literature, the loan market model in Section III indicates that as the variability of the exchange rate drops, the variability of dollar-denominated loans falls relative to Boliviano loans so that there is a greater dollarization of the economy. We will now turn to the evidence.

V. Empirical Evidence

We will infer the pattern of dollarization using the data on the informal loan market in Bolivia described earlier. The data set employed contains 5,789 observations and begins in January 1980 running through June 1987. We exclude the period between November 1982 and September 1985, as this was the period when dollar-denominated contracts were illegal. We will test the dedollarization hypothesis by estimating a PROBIT model of the probability of a loan being denominated in dollars. If dedollarization occurs with a monetary reform, then the probability of a dollar-denominated loan being observed will drop following the reform. After reviewing the PROBIT results for the individual loan data, we will briefly the explore the evidence on monthly average data.

Each loan is coded as a 1 if the loan is denominated in dollars, and 0 if denominated in pesos or Bolivianos. The effect of the stabilization policy of 1985 is proxied by a dummy variable that is equal to 0 prior to the reform and 1 after the reform. Specifically, we have two reform dummies. One switches on in October 1985 to capture the announcement effect and the other switches on in January 1987 to capture the introduction of the Boliviano. Of course, the stabilization policy will affect other macroeconomic variables that would have an impact on the preferred currency for contracting. Data are available on the inflation rate and exchange rate depreciation as measured in the parallel market. As reviewed at the end of Section III, we include the rate of inflation as an index of changing economic conditions in Bolivia as the change in the price level signals to the rural public that macroeconomic conditions are changing. The higher the rate of inflation, the more uncertainty regarding future monetary values. The theory of Section III has the change in the exchange rate entering into the Boliviano return on dollar loans. The greater the depreciation of the Boliviano, the greater the differential between the return on the dollar versus the Boliviano, and the greater the dollarization of the market. The model also has dollarization a function of the variability of the return on the dollar. The greater the volatility of the exchange rate, the greater the volatility of the dollar loan return and the lower the predicted dollarization of the market.

We define our dependent variable CURR as the binary dependent variable coded for the currency of denomination. DP is the Bolivian inflation rate measured as the monthly percentage change in the consumer price index. DX is the monthly percentage depreciation of the Bolivian peso or Boliviano against the U.S. dollar as measured in the parallel market. VX is the conditional variance of the percentage change in the parallel market exchange rate[1]. Bolivian data are from Unidad de Análisis de Políticas Económicas in La Paz[2].

V.A. Exchange Rates and Inflation

Following the model specification in Section III, we first estimate the probability of a loan being denominated in dollars as a function of exchange rate depreciation, inflation, and exchange rate volatility. The estimates are:

$$\underset{(-21.62)^*}{\text{CURR} = -0.452} - \underset{(-4.56)^*}{0.964\,\text{DX}} - \underset{(-5.80)^*}{2.474\,\text{DP}} - \underset{(-7.84)^*}{2.388\,\text{VX}} \tag{5}$$

$-2 \log L = 253.9$
t statistics in parentheses, * denotes significance at 1% level

The results reported in equation (5) suggest that the probability of observing a dollar loan falls significantly with higher Bolivian inflation, a faster depreciation of the peso or Boliviano, and greater volatility of the exchange rate. These results might seem surprising in light of demand for money studies. However, the dependent variable is a binary choice variable indicating whether a loan is made in domestic currency (0) or dollars (1). Our model in Section III suggested that the greater the volatility of the exchange rate, and consequently, the volatility of the Boliviano value of dollar loans, the lower the dollarization of the market. This is the result reported in equation (5). The level of inflation was used as a signal to the rural market participants of changing macroeconomic policy. To the extent that higher inflation signals greater uncertainty regarding future policy, we would expect a switch to dollar loans. However, the inflation is shown to have a statistically significantly negative effect on dollarization in equation (5). This may be due to the fact that the inflation rate dropped dramatically with the reform in 1985, but the dollarization of the market was quite slow to respond. We will be able to discuss this further when the reform is explicitly modeled below. It may also be that the positive correlation between inflation and exchange rate depreciation makes the data relatively uninformative regarding individual effects of inflation and exchange rate change. While, the motivations and incentives for creditors and debtors in this market will differ from the standard money demand determinants, it is interesting that both the inflation rate and exchange rate change, have surprising negative signs that are inconsistent with the model of Section III, as well as with the money demand literature. However, we know that equation (5) has omitted other important policy-related variables that will play a role in the dollarization process. Before exploring a more fully specified model, we will consider the economic significance of the equation (5) results.

Since a PROBIT estimation technique is used, the coefficient estimates are not easily interpreted as in a standard linear regression. A simple simulation interpretation of the results is informative in demonstrating economic significance. The estimated coefficients, along with the independent variables evaluated at their means, allow us to calculate Z scores that permit an approximation of the area under the standard normal distribution below the Z values. The Z value associated with equation (5) is found by evaluating domestic currency depreciation, inflation, and the conditional variance of the exchange rate at their mean values of .038, .034, and .042:

$$Z = -.452 - .964\,(.038) - 2.474(.034) - 2.388\,(.042) = -.673$$

From a standard normal cumulative probability table, we find a Z score of -.673 associated with a probability of .25. Therefore, the probability of a loan being denominated in dollars when the Bolivian currency is depreciating at a rate of 3.8 percent per month and the inflation rate is 3.4 percent per month and the conditional variance of the exchange rate is 4.2 percent is equal to .25. From this baseline probability, the estimates in equation (5) suggest that if the rate of depreciation increased one standard deviation to .152, the probability of a loan being denominated in dollars would change to .217, ceteris paribus. This is a relatively small drop in the probability of a dollar-denominated loan of only .033 given a one standard deviation rise in the rate of currency depreciation. We would not consider this an economically significant exchange rate effect.

If the inflation rate increased one standard deviation to .088, then the probability of a loan being denominated in dollars falls to .212. This fall of roughly 3.8 percentage points given a one standard deviation increase in inflation is not economically significant. If the conditional variance of exchange rate change increased one standard deviation to .137, then the probability of a loan being denominated in dollars falls to .184. This fall of 6.6 percentage points is the largest change in response to a one standard deviation increase in any of the explanatory variables. We will now expand the model to incorporate other important effects and consider the statistical and economic significance of inflation, currency depreciation, and exchange rate volatility in light of a more realistic equation representing the Bolivian experience.

V.B. Currency Reform, Exchange Rates, and Inflation

Equation (5) indicated that the effects of domestic currency depreciation and inflation were small relative to the effects of exchange rate volatility in explaining the dollarization process in the informal loan market. While these effects are interesting, we are not focusing on these effects, as we utilize these variables to provide a setting in which to examine the effect of stabilization policy on the dollarization process. Considering the development of Bolivian policy over the 1980s, we first incorporate dummy variables to model the stabilization policy announced in August of 1985 and the introduction of the Boliviano in January 1987. REF85 is a dummy variable set to zero until October 1985 (the first observation following the legalization of dollar deposits), after which it equals one. REF87 is a dummy variable set to zero until January 1987, after which it is equal to one. Estimating the model with these two dummies included, we find:

$$\begin{aligned} CURR = & -2.041 - 0.425\,DX - 0.658\,DP - 1.044\,VX \\ & \quad (-39.00)^{*} \quad (-1.20) \quad (-1.06) \quad (-1.73)^{**} \\ & + 2.733\,REF85 + 0.311\,REF87 \\ & \quad (44.81)^{*} \qquad (4.54)^{*} \end{aligned} \tag{6}$$

$-2 \log L = 4269$

t statistics in parentheses, * (**) denotes significance at 1% (10%) level.

With the introduction of the reform dummies, the statistical significance of exchange rate depreciation (DX) and inflation (DP) disappears, and exchange rate volatility is now only marginally significant. The Z score consistent with the independent variables in equation (6) evaluated at their mean values equals –1.196. This indicates that the probability of a dollar-denominated loan equals .116 when the monthly exchange rate depreciation is .038, the monthly inflation rate is .034, the conditional variance of the exchange rate is .042, the stabilization policy is announced in 1985 and the Boliviano is introduced in 1987.

The economic significance of the first dummy is striking. The results of equation (6) indicate that the reform announcement in 1985 raised the probability of dollar-denominated loans by almost 10 percentage points. However, the introduction of the Boliviano in 1987 raised the probability by only 1.5 percentage points.

The effect of the 1985 stabilization policy announcement may be due to the fact that the data from November 1982 to September 1985 are omitted from the sample because of the prohibition against dollar-denominated contracts. We have a break in the sample that occurs when the dummy variable REF85 switches on. This dummy, then, proxies for more than the announcement of the stabilization policy. It also proxies for the break in the sample and, specifically, the legalization of dollar contracts after the hyperinflation. Prior to November 1982, there was little dollarization in the informal loan market. But by October 1985 when dollar contracts became legal, the majority of contracts were denominated in dollars. Using the entire sample period to estimate the model is probably a good example of ignoring the Lucas Critique with regard to treating parameters as stable over a dramatic change in regime. To deal with this issue of the break in policy, we estimate a separate model for the 1985-87 period containing the currency reform.

For the 1985-87 period, we include the REF87 dummy for the introduction of the Boliviano. The estimates are:

$$\begin{aligned} CURR = & \; 0.755 - 2.767\,DX + 1.955\,DP - 4.034\,VX + 0.294\,REF87 \\ & (13.58)^{*} \quad (-4.42)^{*} \quad (1.86)^{**} \quad (-2.16)^{**} \quad (4.18)^{*} \end{aligned} \tag{7}$$

$-2 \log L = 54.61$

t statistics in parentheses, *(**) denotes significance at 1 % (10%) level

We see that the dollarization of the informal loan market was sensitive to all of the explanatory variables in the mid 1980s and the introduction of the Boliviano had a statistically significant effect of *increasing* the dollarization of the market.

The calculated Z score associated with equation (7) is .759. This indicates that the probability of a loan being denominated in dollars is .776 when the domestic currency is depreciating at a rate of .018 per month (the 1985-87 mean), the inflation rate is .022 per month (the 1985-87 mean), the conditional variance of exchange rate depreciation is .023, and the Boliviano has been introduced. The economic significance of DX is seen by calculating the Z score of .571 associated with a one standard deviation increase. This indicates that the probability of a dollar-denominated loan falls by 6 percentage points to .716 when the Boliviano depreciates by a one standard deviation faster pace. This is, again, a surprising result, since the increase in Boliviano depreciation increases the return differential in favor of dollar loans. Now the Bolivian inflation rate has a positive effect on dollarization, as we would expect. However, the effect is not very significant, economically, as a one standard deviation increase in the rate of inflation will increase the probability of a dollar loan to .805, an increase of only 2.9 percentage points. Greater exchange rate volatility decreases dollarization, as predicted by the theory of Section III. A one standard deviation increase in the conditional variance of the exchange rate change decreases the probability of a dollar loan by 3.1 percentage points. The economic significance of REF87 is seen by calculating the Z score without REF87 of .654 which is associated with a probability of dollar-denominated loans of

.742. Thus, the introduction of the Boliviano increases the probability of observing a dollar-denominated loan by 3.4 percentage points.

The evidence indicates that the currency reform introduced in Bolivia did not lead to a dedollarization. Instead, just the opposite occurred. The dollarization of the economy increased with the introduction of the new currency and new economic policies.

The only policy event that has been explicitly modeled so far is the currency reform of January 1987. Yet the introduction of the Boliviano was only a part of the stabilization policy that was announced in 1985. A major event in early 1986 was the substantial cut in the Bolivian money supply. In January 1986, base money fell by 10.3 percent, currency fell by 10.0 percent, and deposits fell by 3.9 percent. This was a tangible signal of a major policy shift that should have created greater credibility for the government's new economic program. Over 1985, the M1 money supply grew at a rate of 5,929 percent (from December 1984 to December 1985). Over 1986, M1 grew at a rate of 83 percent (from December 1985 to December 1986). The substantial cut in the money growth rate was signaled in January 1986 by the actual fall in the money aggregates that month. We model the change in monetary policy by creating a dummy variable MON86 that switches from zero to one in February 1986. Including this variable in the model for the 1985-87 period yields the following result:

$$\begin{aligned} CURR = &-0.391 + 1.399\,DX - 0.035\,DP + 3.208\,VX \\ &(-2.27)^{**} \quad (1.61) \quad (-.03) \quad (1.41) \\ &+ 0.187\,REF87 + 1.121\,MON86 \\ &(2.59)^{*} \quad (7.07)^{*} \end{aligned}$$

$-2 \log L = 106$

t statistics in parentheses, *(**) denotes significance at 1 % (10%) level

Equation (8) indicates that the new monetary policy signaled in early 1986 was associated with a statistically significantly higher degree of dollarization of the informal loan market. The Z score of equation (8) is equal to .770, indicating that the probability of observing a dollar-denominated loan equals .779 when the domestic currency depreciates at a rate of .018 per month, the inflation rate is .022 per month, the conditional variance of the change in the exchange rate is .023, the new monetary policy of 1986 is introduced, and the Boliviano is in circulation. The economic significance of MON86 is seen by calculating the Z score of –.227 with MON86 set to zero. This is associated with a probability of .41, so that the introduction of the new monetary policy increased the probability of observing a dollar-denominated loan by 37 percentage points.

Comparing equations (7) and (8), we see that the magnitude of the effect of the Boliviano introduction of 1987 falls once the monetary policy variable is included. This is not surprising, as the currency reform occurs in stages and the reduction of money supply growth precedes the new currency. Nevertheless, it is interesting to note that even with the MON86 variable included, there is still a statistically significant effect of REF87. Calculating the Z score with REF87 set to zero, indicates that the introduction of the Boliviano raises the probability of observing a dollar loan by 1.9 percentage points. Since the informal market exists outside of the formal financial intermediary system, it may be that the reduction in the official monetary aggregates did not fully convince participants in the informal market that a credible policy change had taken place. As a result, the introduction of the Boliviano was considered a significant signal of the new economic policy in force, particularly for those that transacted outside of the conventional financial intermediaries.

V.C. Monthly Aggregate Data

The individual loan data offer a very large number of observations on the informal loan market. Yet we thought it might be informative to aggregate the data to the monthly level over the 1985-87 period following the legalization of dollar contracts. Such aggregation permits us to compute monthly average interest rates so that return differentials can be directly incorporated into the regression equations. In addition, there is monthly data available on the interest rate charged on loans in the formal (bank) market that can be included in the analysis. One might think that the interest differential between the informal market and the formal market would be a determinant of the level of activity in the informal market. Therefore, in addition to the REF87 and MON86 dummy variables for policy change and the exchange rate volatility variable included in the PROBIT estimates, we now include two new variables: $(r^D - r^B) = (i^D{}_1 S/S - i^B)$, the monthly average return differential between dollar and Boliviano loans, and $(r^B - r^F)$, the monthly average return differential between Boliviano loans in the informal market and Boliviano loans in the formal market.

We aggregated the individual loan data in two different ways. First, we summed the number of loans made in each currency. Then, we summed the total dollar value of the loans made in each currency, where the dollar value of Boliviano loans is evaluated at the parallel market exchange rate. Table 1 reports the estimation results. The first column of Table 1 lists the independent variables. The second column contains parameter estimates when the total number of loans is the dependent variable. The third column presents estimates for the ratio of dollar loans to Boliviano loans. The fourth column has the results for the total dollar value of loans (where Boliviano loans are converted to dollars at the parallel market exchange rate). Finally, the fifth column lists the parameter estimates for the value of dollar loans relative to the dollar value of Boliviano loans.

Discussing each variable in turn, it is interesting to note that the return differential between dollar and Boliviano loans is only statistically significant (at only the 10 percent level) for total number of loans made. We would have expected this variable to have a positive impact on the composition of loans between dollars and Bolivianos. The return differential between the informal and formal bank market has no significant effect in any case. This is not entirely unexpected, as the markets are quite segmented. Those who transact in the informal market are generally excluded from bank finance in Bolivia. The volatility of the exchange rate is only significant in explaining the ratio of the value of dollar loans relative to Boliviano, and the effect is positive, in contrast to the theory of Section III and the PROBIT results. The dummy variable for the introduction of the Boliviano has a significant positive effect on the ratio of number of dollar loans to Boliviano loans, as expected. It is interesting to note that this variable also has a positive effect on the total value of loans but no effect on the composition of loan value between dollars and Bolivianos. Finally, the dummy variable for the shift in monetary policy has significant positive effects on both of the loan composition variables. In both cases, when monetary policy became restrictive, there was an increase in the dollar loans relative to Boliviano. This is a result also found in the PROBIT analysis, and

TABLE 1

MONTHLY DATA ON NUMBER AND SIZE OF LOANS

Variables	Tot. Nº	$ Nº/B Nº	Tot. Val.	$ Val./B Val.
Constant	104.87 (4.23)*	1.359 (1.41)	53075 (2.46)*	–0.169 (–.024)
$r^D–r^B$	399.82 (2.26)**	9.991 (1.45)	187911 (1.22)	–15.615 (–0.32)
$r^B–r^F$	18.245 (1.09)	0.661 (1.02)	7498 (0.52)	–3.786 (–0.81)
VX	–168.55 (–0.75)	10.023 (1.15)	–63267 (–0.33)	151.58 (2.42)**
REF87	1.585 (0.122)	1.452 (2.86)*	22973 (2.026)*	3.107 (0.85)
MON86	17.536 (0.961)	2.0456 (2.88)*	25274 (1.59)	15.741 (3.08)*
$\bar{R}^2$	.571	.729	.592	.444
SEE	22.20	0.866	19316	6.217

t statistics in parentheses, *(**) denotes significance at the 1% (10%) level

Variables: ($r^D–r^B$), return differential between dollar and Boliviano loans; ($r^B–r^F$), return differential between Boliviano loans in the informal and formal markets; VX, volatility of the change in the exchange rate; REF87, dummy variable for the introduction of the Boliviano in January 1987; MON86, dummy variable for the abrupt drop in money growth in February 1986.

seems counter to the standard theoretical stories regarding the effect of stabilization policy on dollarization.

Before exploring the implications of the empirical results further, we caution that the monthly data estimates reported in Table 1 are not very informative due to the short sample. With only 21 observations, it is clear that we should not push the inference very far. This is in contrast to the PROBIT estimates that employed thousands of observations on individual loans. We are quite confident that the PROBIT results display important and interesting results relevant to the analysis of dollarization around stabilization policy.

VI. Discussion and Conclusions

The evidence from the informal loan market in the Cochabamba region of Bolivia does not support the hypothesis that successful stabilization policies result in a dedollarization of an economy. In fact, just the opposite conclusion may be drawn. As the Bolivian stabilization plan is enacted, there is a significant *increase* in the dollarization of the informal loan market. This is true with respect to both the initial cut in money growth in 1986 and the introduction of the Boliviano in 1987.

One could speculate about why the dedollarization does not occur with the stabilization policy. It is possible that the public did not believe that the government was credible in its future ability to continue the reforms. After all, the stabilization program begun in August 1985 was the seventh program announced in four years and was announced by a President who did not have a legislative majority backing him. Furthermore, there were some important negative shocks hitting the economy at the time of the new policy enactment. The price of tin fell by 60 percent at the end of October 1985 due to the end of the global tin cartel. In January 1986, the price of natural gas fell and the value of Bolivia's gas exports to Argentina fell dramatically. Yet even in the face of such negative shocks, over time we might expect the government to gain credibility as a result of the fiscal and monetary reforms in place. The survey data end in 1987, and over a longer sample that extends into 1988 and beyond, the dedollarization may have occurred.

It is also possible that the dedollarization effect of the currency reform could have been overwhelmed by the inflow of dollars through the illicit coca trade. Melvin and Ladman (1991) provide evidence that the coca harvests have had a significant effect on the dollarization of the informal loan market in the Cochabamba region. This region is nearby the Chapare, one of Bolivia's two main coca-leaf-producing areas. Farmers and laborers from the Cochabamba migrate to the Chapare with the seasonal pattern of the coca crop to cultivate and harvest coca leaf and assist in the production of coca paste. The paste is generally believed to be sold and shipped to Colombia for further processing, although there are also some coca refining activities that are known to exist in the Cochabamba region. Since illicit drug transactions are largely financed in dollars, the coca industry has increased the local supply of U.S. currency. Other things equal, the greater the volume of coca trade, the greater the fraction of informal loans we expect to see denominated in dollars rather than Bolivian currency.

The data set employed in this study offers a unique look at dollarization in Latin America. There are no data available on actual quantities of dollars circulating, but the records of the informal loan market in Bolivia provide no evidence that the well-known currency reform that occurred in the mid-1980s was associated with a dedollarization of the Bolivian economy. This is in contrast to the predictions of theoretical models of stabilization policies and serves to remind us of the complexities that exist in countries that are widely believed to have very rudimentary financial institutions.

Notes:

1 The conditional variance of the exchange rate was estimated by an ARCH 1 model of the monthly change in the log of the exchange rate over the 1980-87 period.

2 We thank José de la Vina at UDAPE for his assistance in obtaining data.

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A DYNAMIC SIMULATION ANALYSIS OF CURRENCY SUBSTITUTION IN AN OPTIMIZING FRAMEWORK WITH TRANSACTIONS COSTS*

PAUL D. McNELIS and CARLOS ASILIS
Georgetown University

Abstract:

This paper investigates the dynamic paths of inflation and real balances in a general equilibrium intertemporal optimization model, with transactions costs and currency substitution, when budget deficits are financed by money creation.

The results show that inflationary paths show more "jumps" or explosions under the assumptions of lower transactions costs or an increasing degree of currency substitution. Even small changes in the degrees of currency substitution with positive transactions costs sharply change the paths of inflation and real balances. Similarly, small changes in transactions costs for foreign currency, even without prior currency substitution, have marked effects on the paths of inflation and real balances.

The results obtained from the simulated data are consistent with inflation processes in recent Latin American experience, where currency substitution may have taken place. Estimates of the simulated data for even a small degree of currency substitution generate generalized autoregressive conditionally heteroskedastic (GARCH) estimates of the inflation process, which are consistent with estimates for Argentina, Bolivia, México, and Perú. In these countries currency substitution may have gone hand-in-hand with inflationary instability through money-financed fiscal deficits.

Our results suggest that fiscal deficits financed by monetary expansion should be avoided under conditions of increasing financial openness, which provide greater opportunities for financial adaptation through currency substitution or lower transactions costs on foreign currency accumulation.

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