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CURRENCY SUBSTITUTION IN DEVELOPING COUNTRIES: AN INTRODUCTION*

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Abstract

This paper reviews the main policy and analytical issues related to currency substitution in developing countries. The paper discusses, first, whether currency substitution should be encouraged or not; second, how the presence of currency substitution affects the choice of nominal anchors in inflation stabilization programs; third, the effects of changes in the rate of growth of the money supply on the real exchange rate; fourth, the interaction between inflationary finance and currency substitution; and, finally, issues related to the empirical verification of the currency substitution hypothesis.

I. Introduction

"In the post-World War I European hyperinflations, the lack of a stable domestic means of payments was a serious inconvenience in trade and production, and foreign currencies therefore came to be desired not merely as a store of value but actually as a means of domestic payment... Thus, in advanced inflation, 'Greshman's Law' was reversed: good money tended to drive out bad, and not the other way round: the reason being the irreducible need for a serviceable medium of exchange in any modern economy based on division of labour and interchange of goods and services".

League of Nations (1946, p.48)

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National currencies are tradable goods *par excellence*. They can be easily carried across borders, and some of them enjoy wide recognition around the world. There is thus a tendency for currencies that display high inflation to be replaced as *medium of exchange* by currencies like the dollar that have earned a reputation for being relatively successful in maintaining their purchasing power over time. This paper provides a selective review of the issues related to the phenomenon of "currency substitution", defined as the use in a given country of multiple currencies as *media of exchange*. Our focus will be on policy and analytical issues that are relevant to developing countries[1].

First, a note on terminology is due. The term "dollarization" has also been used in the literature to depict the phenomenon just defined as "currency substitution", especially when referring to Latin American countries. However, the term "dollarization" is also frequently used to indicate that a foreign currency serves as a *unit of account* or as a *store of value*, and not necessarily as a *medium of exchange*[2]. It is useful to keep this distinction in mind because any discussion of currency substitution will contain many references to dollarization (especially to the use of foreign currency as a store of value) for several reasons. First, as discussed below, casual evidence suggests that, in high inflation countries, foreign currency is first used as a store of value or unit of account and only later as a medium of exchange. In other words, currency substitution is normally the last stage of the dollarization process. More importantly, since there are usually no data on foreign currency circulating in an economy, dollarization ratios (such as the proportion of M2 denominated in foreign currency) are used as an indicator of currency substitution (see, for instance, Savastano (1992, this issue).

Currency substitution is usually the ultimate consequence of high inflation[3]. High inflation, in turn, is the result of fiscal imbalances. Although the empirical relationship between fiscal deficits and inflation is not a very tight one –because, for example, in the short run deficits could be financed by issuing debt– persistence of substantial fiscal deficits normally lies at the roots of high inflation (see, for example, Easterly and Schmidt-Hebbel (1991))[4]. High inflation, in turn, leads to dollarization and eventually to currency substitution, as suggested by the League of Nations (1946) in the introductory quote.

Assuming that there are no restrictions on foreign exchange holdings, the dollarization process usually begins with foreign money substituting the domestic money as *store of value*[5]. The reason is simply that, of the three basic functions of money, this is probably the one in which domestic money is the most vulnerable. The store-of-value function of domestic money has virtually disappeared in many high-inflation countries. As high inflation continues, some prices–particularly of real estate, cars, and other "big-ticket" items– start to be quoted in foreign currency. Inflation need not be either too high or too variable for this to happen. Not long after this, some transactions begin to be performed in foreign currency, especially those involving large transfers of funds. Domestic money, however, seems to retain its functions as unit of account and medium of exchange for almost all non-durable goods[6].

Institutional factors play a crucial role in the process of dollarization, as emphasized by Savastano (1992, this issue) in his study of dollarization in four Latin American countries (Bolivia, México, Perú, and Uruguay). In all cases, foreign currency deposits were allowed in the domestic financial system after a period of serious external imbalances. Financial liberalization was accompanied by large devaluations aimed at restoring external imbalances and preventing losses of international reserves as financial portfolios were adjusted. With the exception of Uruguay, the dollarization processes ended abruptly with a de facto conversion into domestic currency of foreign currency deposits held by the private sector.

The phenomenon of currency substitution raises many interesting and difficult questions, both from a policy and analytical perspectives. There are no clear-cut answers to most of these questions, which makes any discussion of currency substitution a rather demanding, but fascinating, endeavor. This paper discusses those issues that, in our judgment, are the most relevant for developing countries. The discussion, which deals first with policy issues, proceeds as follows.

A first policy issue, analyzed in Section II, is whether currency substitution should be encouraged or not. Views differ substantially on this point, with some arguing for higher interest rates on domestic money to induce people to hold domestic money, and others making the case for a "full" dollarization of the economy (i.e., adopting a foreign currency as the only legal tender, as in Panamá). We argue that there does not seem to be a good case for discouraging the use of foreign currency. On the other hand, the case for encouraging the use of foreign currency is also less than obvious, mainly due to the inflationary consequences of higher currency substitution. The extreme measure of fully dollarizing the economy may put unnecessary constraints on the economy and render the banking system more vulnerable.

The effects of currency substitution on the choice of nominal anchors in an inflation stabilization plan are discussed in Section III. Standard models suggest that the higher the elasticity of substitution between the two currencies, the higher the shift from domestic to foreign currency induced by a fall in expected inflation, and thus the higher the appreciation of the domestic currency. Hence, a sufficiently high elasticity of substitution is likely to make the exchange rate extremely volatile in response to policy changes and/or credibility problems. On these grounds, therefore, a high degree of currency substitution would strengthen the case for fixed exchange rates.

The introduction of currency substitution into standard models does not alter, from a qualitative point of view, the choice between "recession-now-versus-recession-later" when comparing money-based and exchange-rate-based stabilizations[7]. Quantitatively, however, the presence of currency substitution aggravates the initial recession in a money-based stabilization, and makes the initial boom more pronounced in an exchange-rate-based stabilization. Rostowski (1992, this issue), however, challenges the view that currency substitution should make the initial recession worse in a money-based stabilization. He argues that the availability of a second currency implies that the pre-stabilization level of liquidity is higher which, by reducing the size of the post-stabilization remonetization, should actually lessen the initial recession.

The behavior of the real exchange rate in response to a change in the rate of growth of the money supply, which motivated the early literature on currency substitution, remains as topical as ever[8]. This issue is reviewed in Section IV, which also provides some insights into how this literature developed. The original result of Kouri (1976) and Calvo and Rodríguez (1977) (i.e, the real exchange rate depreciates as a result of an increase in the rate of growth of the money supply) was challenged by Liviatan (1981). Later, Calvo (1985) showed, in a general model, that the effect on the real exchange rate of a change in the rate of growth of the money supply depends on the parameters of consumer preferences. The parameter values estimated by Bufman and Leiderman (1991) support the traditional result.

The issue that is at the core of currency substitution, inflationary finance, is reviewed in Section V. The notion that the presence of currency substitution should lead to higher, and more variable, inflation for a given budget deficit provides a unifying theme. A first approach to this issue takes monetary financing as given and analyzes how currency substitution affects both the level and variability of the inflation tax and revenues from money creation. A second approach follows the optimal taxation literature and examines whether the presence of currency substitution makes it optimal to resort to the inflation tax.

The empirical literature on currency substitution is very extensive and a review of the literature would fall outside the scope of this paper. Instead, Section VI reviews the main themes of this literature and discusses some conceptual problems that may arise in the empirical verification of the currency substitution hypothesis.

Finally, Section VII contains concluding remarks.

II. Should Currency Substitution be Encouraged?

Views about the optimal degree of currency substitution cover a very wide spectrum. They range from the idea that some countries should completely give up issuing their own money and adopt a foreign currency ("*full* dollarization"), to the notion that every effort should be made to induce the use of the domestic currency. This section discusses these two polar views.

1. *Full Dollarization*

This type of solution is usually proposed after several failed stabilization programs. By removing the power to produce high-powered money from the central bank, it is hoped that inflation will be stopped in its tracks. Actually, a fully dollarized economy should, in principle, inherit the inflation rate of the corresponding foreign currency that has been adopted. Besides, supporters of full dollarization could point to the case of Panamá where (a very close approximation of) such a system appears to have worked reasonably well[9-10]. The advantage of a fully dollarized economy over a fixed exchange rate is that the former regime should be more credible because it represents a higher degree of commitment, as argued by Cukierman, Kiguel, and Liviatan (1992, this issue). Credibility is higher because the public knows that the cost of reneging increases with the degree of commitment. In their view, the high costs of reneging from such a strong commitment in the face of a large external shock may explain why full dollarization, as a policy of inflation stabilization, has not been employed in recent history.

It has also been argued that the use of a foreign money should provide the domestic government with more discipline. Presumably, this means that a government that cannot resort to inflationary finance will feel constrained to "put its house in order", rather than find alternative sources of finance (like domestic debt)[11]. While there may be some merit to this argument–avoiding temptation is the first step towards abstinence–we tend to believe that policies follow discipline rather than the other way around[12].

Full dollarization may be criticized on several grounds. In the first place, there is never a complete guarantee that the system will not be discontinued in the future. As the case of Liberia shows, political instability may lead to a liquidity shortage which, coupled with increasing fiscal deficits, may induce the government to print massively. A war, for example, could also result in a swift return to the use of domestic currency to free up foreign-exchange reserves (circulating as means of payment) in order to finance the additional government expenditure (see Fischer (1982)). Furthermore, a large external shock could also lead the government to renege on its commitment in

order to recover the use of the exchange rate as a policy instrument, as argued by Cukierman, Kiguel, and Liviatan (1992, this issue). Thus, it would be naive to expect that full dollarization would result in a quick equalization of prices and interest rates with the rest of the world, since the "credibility" problem is not likely to go away immediately.

A traditional argument against full dollarization is that the government gives up revenues from the inflation tax. For example, Fischer (1982) shows that there are many countries in which seigniorage constitutes over 10 percent of total revenues. Thus, this argument against dollarization is best discussed in a public finance context. If the government is acting optimally, replacing the revenues from inflation by conventional taxes would lead to welfare losses (see section V). However, due to "time inconsistency" considerations, the government may end up not behaving in an optimal manner. Therefore, "tieing the hands" of the government through full dollarization could actually enhance welfare.

Perhaps a more fundamental criticism of full dollarization is that –unless domestic banks are also fully integrated with the "Fed" (i.e, the central bank issuing the foreign currency), the system will be forced to operate without a "lender of last resort". Optimists may actually argue that this is all for the better because the lack of a lender of last resort will impose stricter discipline on the domestic banking system. However, critics will have an easy time finding a plethora of historical examples in which, as soon as the domestic financial system threatened to collapse, rules were relaxed and the system was bailed out –which could lead to, at least, a temporary abandonment of full dollarization.

The above observation is particularly relevant if dollarization is implemented to cure a case of stubbornly high inflation. If the underlying fiscal imbalance is not wiped out at the same time that dollarization is adopted, banks will be under great pressure to lend to the government and to enterprises that were previous beneficiaries of the revenue from money creation. Thus, the quality of the loan portfolio held by domestic banks will tend to be poor according to international standards, a situation that could give rise to bank runs and a collapse of the financial system.

In sum, full dollarization appears like only a partial and, possibly, even counterproductive solution to the inflation/currency-substitution problem. Its effectiveness relies to a large extent on simultaneously solving the "fundamental" fiscal disequilibrium problem. And even in that case, dollarization will leave domestic banks at a disadvantage with respect to foreign banks, since the latter have normally the benefit of a "lender of last resort". Furthermore, once a government is willing to solve its "fundamental" fiscal problems, full dollarization may impose unnecessary constraints on the economy, unless it manages to effectively "tie the hands" of future governments.

2. *Discouraging the Use of Foreign Currencies*

The policy of discouraging the use of foreign currency tends to be favored by governments that rely heavily on the revenues from money creation. The "obvious" reason is that success on that front may increase the demand for domestic money, and thus help to attenuate the inflationary impact of government deficits. It has also been argued (see, for instance, Tanzi and Blejer (1982)) that currency substitution is undesirable because it reduces monetary independence and may thus endanger the ability of policymakers to implement stabilization programs (this issue is addressed in Section III).

Rostowski (1992, this issue) points out, however, that discouraging the use of foreign money –by, for instance, punishing those caught holding foreign currency– could be counterproductive because it deprives the economy of an attractive means of payment. This, in turn, tends to reduce total "liquidity" in the system and have a negative impact on domestic trade and output, thus *increasing* the inflationary impact of fiscal disequilibria, and directly impoverishing the economy. Rostowski (1992, this issue) argues that, in the limit, an economy that is unable to use a "secondary" currency will end up with a low-output barter equilibrium. In his view, the Russian hyperinflation of the early 1920's provides support for his arguments. In Russia, a second, stable currency (the "chervonets") was introduced 15 months before full stabilization was carried out. Industrial production increased by 30 percent in the last year of the hyperinflation. In contrast, in the German and Polish cases, production fell sharply in the last stages of the hyperinflation in 1923.

A movement towards employing domestic money can hardly be criticized if it reflects increased confidence in government policy. But this is not a very interesting case, because greater confidence normally reflects a belief that the fundamental disequilibria are more likely to be resolved. Thus, the greater use of domestic money would in this case be a *consequence* of good policies, and not an indication that encouraging the use of domestic money is a good policy in and of itself.

A method for increasing the demand for domestic money, which has gained popularity in Latin America and several industrialized countries since the mid-1970's, is paying attractive interest rates on bank deposits. This is an artificial method of discouraging the use of foreign money; it amounts to paying interest on domestic money. The demand for domestic money is likely to increase but, if the fundamental problems leading to high inflation are not being quickly resolved, such method postpones the "moment of truth", and contributes to magnifying the eventual inflationary explosion[13].

An extreme way of de-dollarizing the economy, which has been observed in several Latin American countries, is the forced conversion into domestic money of the stock of foreign-currency deposits in the domestic financial system, as discussed by Savastano (1992, this issue). This forced conversion took place in Bolivia (November 1982), México (August 1982), and Perú (July 1985). In all three cases, the forced conversion was accompanied by a large nominal devaluation and the subsequent adoption of a fixed exchange rate. Such forced de-dollarizations often have opposite effects to those intended by the authorities. As argued by Melvin and Fenske (1992, this issue), the Bolivian 1982 "official de-dollarization" was supposed to reduce the demand for dollars and increase the tax base for the inflation tax. Instead, it seems to have stimulated the capital flight problem and simply driven the dollarized economy underground.

Despite the above negative comments about discouraging the use of foreign money, the case for *encouraging* its demand is also less than obvious. We have already discussed the extreme case of full dollarization. Hence, the following discussion will refer to intermediate cases.

First, the greater is the use of foreign money, the greater will be the inflationary impact of fiscal imbalances. Thus, if a government has not yet been able to "put its house in order", facilitating substitution against the domestic currency may simply result in higher inflation (see Section V), thus jeopardizing the *credibility* of stabilization programs. Second, as argued by McNelis and Asilis (1992, this issue), even small changes in the degree of currency substitution may substantially increase the *variability* of inflation (see Section V). Third, once the dollarization process is underway, even a return to lower domestic inflation may fail to reverse the process (see Section III). Fourth, if encouraging the use of foreign money is done by allowing individuals to hold "dollar" bank accounts, one may be creating the type of financial vulnerability mentioned in connection with the full-dollarization case.

In sum, there does not seem to be a strong *general* case for or against discouraging the use of foreign currencies. We believe, however, that when the banking system is allowed to intermediate (i.e., borrow and lend) in foreign currencies, care should be taken not to unduly increase the vulnerability of the banking system. Such vulnerability could be attenuated, for instance, by imposing a large reserve requirement on "dollar" deposits and/or by imposing a minimum maturity on "dollar" deposits of, say, 6 months, making sure that those deposits mature evenly over time (to avoid "bunching")[14].

III. Currency Substitution and Nominal Anchors

In this section, we take currency substitution for granted and discuss how it affects the choice of nominal anchors in inflation stabilization programs. For the sake of brevity, we will confine our attention to the choice between fixed and flexible exchange rates systems.

The conventional wisdom on this matter appears to be that if there are substantial holdings of foreign money in circulation, fixed exchange rates provide a more effective nominal anchor. The reason is that, as a first approximation, the relevant concept of money includes "dollar" holdings. Thus, if the exchange rate is allowed to vary, the monetary authority would not be able to control the money supply (inclusive of foreign exchange) in terms of domestic currency. Conceivably, if domestic prices double, a devaluation of the exchange rate could accommodate nominal money supply to the higher nominal money demand provoked by the doubling of prices.

The last statement, although arithmetically correct, is only literally true in the extreme case considered by Kareken and Wallace (1981)[15]. They examine the case in which any two monies become perfect substitutes if people expect their exchange rate to be constant over time. This would happen if there were no legal barriers to the use and free exchange of the two monies, and these monies were fully and equally recognized as means of payment by everybody. Thus, once the exchange rate between the two monies is fixed, their risk characteristics are the same; hence, the two monies become perfect substitutes[16].

In all other cases, when currency substitutability is *imperfect*, it is far from obvious that under flexible exchange rates the system is left without a nominal anchor (see Girton and Roper (1981)). In standard simple models one can show that given a path of domestic money supply, the price level is uniquely determined. However, currency substitution is still important because it plays a key role in determining the magnitude of the recession that results from a money-based stabilization (see Calvo and Végh (1990a)). Specifically, a reduction in the rate of growth of the money supply causes the nominal interest rate to fall, which induces substitution away from foreign money and toward domestic money. This switch provokes a recession because, under sticky prices, the real domestic money supply cannot increase so that output must fall to equilibrate the money market. The higher the elasticity of currency substitution, the larger the intended shift into domestic money and, thus, the more pronounced the recession.

Rostowski (1992, this issue) takes a different view and argues that currency substitution may actually *lessen* the initial recession associated with a money-based stabilization. The idea is that, due to the costs of switching from one currency to the other, the initial fall in nominal interest rates will induce little substitution as the public weighs the costs of switching from the foreign to the domestic currency against the net present discounted value of the inflation tax. Hence, the channel emphasized above should not play much of a role in the first stages of a stabilization program. In addition, since the pre-stabilization *level* of liquidity in the economy is higher than in the absence of currency substitution, the "liquidity crunch" associated with the implementation of the stabilization plan will be less severe, which will result in a smaller output contraction.

In support of his arguments, Rostowski (1992, this issue) argues that in the Russian hyperinflation of the 1920's, where a second stable currency was widely available, growth was hardly affected by the stabilization, with industrial output growing considerably after the program was implemented. In sharp contrast to other hyperinflationary episodes, the total real money supply grew by 40 percent in the year prior to the stabilization. More importantly, the remonetization after the Russian stabilization was much smaller than in other hyperinflation episodes, lending support to the notion that the post-stabilization "liquidity crunch" was relatively less severe in Russia due to the presence of currency substitution.

In the case of exchange-rate-based stabilization, the domestic money supply can adjust endogenously (assuming, of course, perfect capital mobility), which renders irrelevant the considerations discussed above that lead to a recession in money-based stabilizations. If the stabilization is fully credible, however, the presence of currency substitution will result in a wealth effect as the public gets rid of foreign currency thus reducing seigniorage payments to the foreign government. This wealth effect causes a permanent increase in consumption (see Calvo and Végh (1990a)).

If the stabilization is not fully credible (in the sense that the public perceives it as temporary), the presence of currency substitution does not qualitatively alter the result –obtained in cash-in-advanced models without currency substitution (see Calvo and Végh (1991))– that the fall in nominal interest rates causes an initial consumption boom. As the inflation rate remains high, due to lack of credibility, the real exchange rate appreciates, which eventually causes a recession. Reinhart and Végh (1992) suggest that lack of credibility may account for a substantial amount of the consumption booms observed in the four major heterodox programs of the 1980's in Argentina, Brazil, Israel, and México. Bufman and Leiderman (1992, this issue) examine the initial consumption boom associated with exchange-rate-based stabilization for the case of Israel in terms of an optimizing model of currency substitution. Before the 1985 stabilization (i.e., between 1978-1984), the average rate of growth of per capita consumption of nondurable goods and services was 2.1 percent per year. This figure increased to 7.9 percent a year during 1986-1987. Bufman and Leiderman (1992, this issue) conclude, using actual assets' returns, that the model accounts for between 68 and 87 percent of private consumption growth during this period.

As suggested above, in money-based stabilizations, expectations will play a bigger role in the determination of the exchange rate in the presence of currency substitution. Specifically, the higher the elasticity of substitution between the two currencies, the larger the shift from foreign to domestic currency as a result of the fall in expected inflation, and thus the higher the fall in the nominal exchange rate. Therefore, we conjecture that a sufficiently high degree of currency substitution (measured by the elasticity of substitution between the two monies) will make the exchange rate significantly volatile and responsive to credibility issues. Hence, a high degree of currency substitution strengthens the case in favor of fixed exchange rates, particularly if an early deceleration of inflation contributes significantly to the credibility of the stabilization program[17-18].

Standard models of currency substitution predict that a successful stabilization program should lead to a de-dollarization process (see, for instance, Calvo and Végh (1990a)). The fall in the domestic nominal interest rate should induce the public to hold the same level of domestic currency as before. However, this has usually not been the case in Latin American countries (such as Bolivia, México, Perú, and Uruguay), in which the dollarization processes exhibit "hysteresis", in the sense that dollarization ratios do not fall once inflation has been reduced (see, for instance, Guidotti and Rodríguez (1992))[19]. For the same level of inflation, the public holds less domestic money than before. Melvin and Fenske (1992, this issue) conclude that dollarization in Bolivia actually *increased* following the 1985 stabilization plan[20].

Several explanations have been advanced to explain the "hysteresis" of the dollarization process. Dornbusch and Reynoso (1989) and Dornbusch, Sturzenegger, and Wolf (1990) emphasize the role of financial adaptation. They argue that high inflation forces the gradual development of new financial instruments and institutions (foreign-currency deposits being one of the manifestations of this process) that decrease the demand for domestic money for a *given* level of domestic nominal interest rates. Creating new financial products is costly and requires a learning process. Once this "investment" has been done, the public will continue to use these new financial instruments even if inflation falls.

A related explanation is provided by Guidotti and Rodríguez (1992) who argue that the switch from domestic to foreign currency that results from high inflation is costly and occurs only slowly over time. As a result, there is a "band" for the inflation differential above which de-dollarization continues to occur even if inflation falls, because the benefits from switching back to domestic currency (due to the reduced inflation tax) would not compensate the costs.

In the specific case of Bolivia, Melvin and Fenske (1992, this issue) argue that the absence of de-dollarization could be due to lack of credibility in the sustainability of the stabilization plan and/or the effects of external shocks such as the fall in the prices of tin and natural gas. Moreover, the inflow of "coca" dollars, as documented by Melvin and Ladman (1991), could also have more than offset the de-dollarization that one would have expected after stabilization.

IV. Monetary Expansion and the Real Exchange Rate

This section considers the effects of changes in the rate of monetary growth on the real exchange rate in a world of flexible exchange rates and prices and currency substitution. This an important policy issue given recent stabilization programs in countries like Brazil and Perú, in which the real exchange rate appreciated sharply. Furthermore, the early literature on currency substitution (Kouri (1976) and Calvo and Rodríguez (1977)) focused on floating exchange rates. This section reviews this issue while at the same time shedding some light on the context in which the literature was developed.

In the late 1970's, the "Monetary Approach to the Balance of Payments" –pioneered in academic circles by Mundell and Johnson, and earlier by Polak at the International

Monetary Fund (and much earlier by Hume)– brought forth the point that the exchange rate is the relative price of two monies. Hence, since monies are demanded as stocks, the stock of the different monies –not their flows, nor the demand for imports and the supply of exports– must be at the center of any theory of the exchange rate. The preeminence of stocks over flows was further strengthened by integrating into the monetary approach the Mundell-Fleming suggestion that in a world of capital mobility changes in flows are literally swamped by changes in stocks. The other key development in the 1970's that would determine the format of the early contributions on currency substitution was the "Rational Expectations" hypothesis, pioneered by Muth and Lucas.

The "Monetary Approach" and the "Rational Expectations" hypothesis were brought together by Kouri (1976) and Calvo and Rodríguez (1977)[21]. The motivation for Calvo and Rodríguez (1977) was the Argentinean experience during 1975 when a sizable increase in the rate of expansion of the money supply was accompanied by a strong depreciation of the real exchange rate (measured in terms of the black market exchange rate). A simple "Monetary Approach" model with perfectly flexible prices and without capital mobility (which was the standard assumption at the time), for example, would not help to explain this episode. The reason is that such a model implies that a once-and-for-all increase in the rate of expansion of the money supply leads to a once-and-for-all adjustment in prices and the exchange rate with no change in relative prices (even in the presence of non-traded goods). So new ingredients were necessary to make the then-standard model compatible with the facts.

Currency substitution seemed to be a natural "missing" ingredient, because the assumption was consistent with (a) some degree of capital mobility –a case that started to gain popularity in international finance theory due to the emergence of the so-called "petrodollars"– and (b) the fact that –in Argentina, as in many other inflation-prone countries– individuals appeared to hold substantial amounts of foreign exchange for transactions purposes. A key assumption in Calvo and Rodríguez (1977) is that foreign currency is the only internationally traded asset. Thus, the only way for the economy to alter its stock of foreign currency is through current account imbalances. An expansion in the rate of growth of the money supply increases the steady-state demand for foreign money relative to domestic money. The accumulation of foreign currency can only be brought about by a current account surplus, which requires an initial real exchange rate depreciation.

Liviatan (1981) reexamined the issue in the context of a utility-maximizing framework by including both monies in the utility function and turned the Calvo-Rodríguez result on its head: a permanent increase in the rate of expansion of the money supply gives rise to a transitory real exchange rate *appreciation* and a deterioration of the balance-of-payments. Liviatan (1981) argued that the key difference between his result and that of Calvo and Rodríguez (1977) lies in the response of the steady-state level of total assets to a permanent increase in the rate of monetary growth. While steady-state total assets remain constant in Calvo and Rodríguez (1977), they decline in Liviatan (1981). The reason is that the higher rate of growth of the money supply decreases the real return on domestic balances. By the "cooperancy" assumption (i.e., the assumption that the cross derivative between domestic and foreign money balances is positive), the fall in domestic real money balances reduces the marginal utility of foreign money balances and thus the steady-state demand for foreign currency. This implies that the decumulation of foreign currency must be brought about by a trade account deficit, which requires the real exchange rate to appreciate.

Calvo (1985) provided a more general analysis, which included Liviatan's (1981) model as a special case[22]. He argued that whether or not the Calvo-Rodríguez result obtains critically depends on the magnitude of the elasticity of substitution between consumption and liquidity services relative to the elasticity of substitution between the two currencies in the production of liquidity services. Thus, depending on the parameter configuration, the real exchange rate may depreciate or appreciate as a result of an increase in the rate of growth of the money supply. Bufman and Leiderman (1991) have estimated a model similar to that of Calvo (1985) for Israel and concluded that the parameter estimates are in line with the Calvo and Rodríguez (1977) result[23]. But the field is still wide open to further empirical work.

It is worth noting that the above-mentioned literature assumes the absence of a "pure" foreign bond. Otherwise, all the interesting implications of currency-substitution theory under flexible exchange rates (in standard models in which the proceeds from the inflation tax are returned to the public in the form of lump-sum transfers) are eliminated. As shown by Engel (1989), in the presence of a "pure" foreign bond, a permanent increase in the rate of growth of the money supply still provokes a (permanent) real exchange rate depreciation but for completely different reasons. As a result of higher inflation, consumers increase the holdings of foreign currency (by selling foreign bonds), which increases seigniorage payments to the foreign government. This negative wealth effect leads to a once-and-for-all fall in the consumption of traded goods. Since output of home goods is constant over time, the lower consumption of traded goods implies that the relative price of traded in terms of home goods (i.e., the real exchange rate) must increase.

The above considerations indicate that the key to the results of the early currency-substitution literature was that the *entire* stock of net foreign assets in the hands of the public provided liquidity services (i.e., could be used as medium of exchange). As a result, there was not a second, non-liquid asset against which foreign currency could be exchanged in order to alter instantaneously the holdings of the liquid asset. In contrast, the presence of a "pure" bond implies, by definition, that only a fraction of the stock of net foreign assets provides liquidity services and, hence, more liquid assets can be readily obtained by changing the composition of the portfolio of net foreign assets. The rationale for attributing liquidity properties to the entire stock of net foreign assets was that long periods of high inflation would render liquid even interest-bearing foreign assets (the assumption of a zero nominal return on foreign assets was viewed as a convenient simplification). Hence, there would not be such a thing as a "pure" bond, since currency substitution (i.e., foreign assets being used as medium of exchange) would inevitably result from protracted high inflation.

Even in the presence of "pure" bonds, the traditional results of the currency-substitution literature are obtained in models, such as Obstfeld (1981, 1988), in which only domestic money enters the utility function but the subjective discount rate varies with the level of utility, as postulated by Uzawa (1968). Alternatively, if price stickiness is introduced into an optimizing model with two currencies and a "pure" foreign bond, as in Calvo and Végh (1990a), a permanent increase in the rate of monetary expansion induces the public to switch from domestic to foreign money, which results in a nominal, and real (since the price level is fixed), exchange rate depreciation[24].

V. Inflationary Finance under Currency Substitution

The presence of currency substitution has important consequences for inflationary finance. As already pointed out by Keynes (1923), in his masterful essay on inflationary finance, one of the ways in which the public can protect itself from the inflation tax is by employing "foreign money in many transactions where it would have been more natural and convenient to use their own (p.41)". Even if the government attempts to impose foreign exchange controls to prevent a flight from the currency, the public manages to circumvent these controls and resorts to foreign currency to satisfy most of its needs. Sargent (1982, p. 82), for instance, reports that "towards the end of the hyperinflation, Germans made every effort to avoid holding marks and held large quantities of foreign exchange for purposes of conducting transactions. By October 1923, it has been roughly estimated, the real value of foreign currencies circulating in Germany was at least equal to and perhaps several times the real value of Reichsbank notes circulating".

This section reviews the two main approaches to studying inflationary finance under currency substitution. The first approach takes monetary financing as a given and analyzes how the presence of currency substitution affects the level and variability of the inflation tax, as well as the level of seigniorage. The second approach follows public finance principles and views the inflation tax as resulting from an optimal choice among various distorting taxes. The main issue is thus how currency substitution affects the optimality of resorting to the inflation tax.

1. *Level and variability of the inflation tax*

A basic idea behind the effects of currency substitution on inflationary finance is that, by making the demand for real domestic money more elastic, the inflation rate that results from any given budget deficit is higher (see Nichols (1974) for an early discussion). Naturally, this should not be taken to imply that currency substitution "causes" inflation; quite to the contrary, currency substitution is usually the endogenous response of money holders subject to a high inflation tax. Rather, the implication is that the ready availability of sound currencies makes the use of the inflation tax less attractive than it would be otherwise.

In the context of the Cagan (1956) model, the higher elasticity of real money demand in the presence of currency substitution implies that the revenue-maximizing rate of inflation is lower than in the absence of currency substitution (see Khan and Ramírez-Rojas (1986)). Thus, this model predicts that the government will be able to collect less seigniorage if a foreign currency may also provide liquidity services. More recent studies of the effects of currency substitution on revenues from the inflation tax have used money demands derived from Ramsey-Lucas representative-consumer models. Bufman and Leiderman (1992, this issue) use parameters estimated in Bufman and Leiderman (1991) to assess the quantitative relationship between currency substitution and seigniorage for the case of Israel (using quarterly data from 1978 to 1988). Two main conclusions emerge: first, although at low rates of inflation the ratio of seigniorage to GDP increases as inflation rises, marginal increases in the seigniorage ratio become rather small for rates of inflation beyond 10-15 a quarter. Second, small changes in the liquidity properties of foreign relative to domestic currency have a substantial impact on the ratio of seigniorage to GDP. In the context of a similar model, Imrohoroglu (1991) analyzes, for various degrees of currency substitution, the shape of the Laffer curve. He concludes that, if the elasticity of substitution between domestic and foreign currency is high, the Laffer curve is sharply peaked, with the peak occurring around the exogenously given foreign inflation rate. As the elasticity of currency substitution decreases, the Laffer curve becomes less sharply peaked.

Currency substitution may not only lead to *higher* inflation, for a given budget deficit, but also to *more volatile* inflation, as argued by McNelis and Asilis (1992, this issue). Sudden spikes or inflationary explosions are consistent with the simulations of a model in which small increases in currency substitution cause the inflation process to become more unstable[25]. Hence, even deficits that are not large nor rising may lead to increasing inflationary instability. McNelis and Asilis (1992, this issue) show that the inflation variability predicted by the model is consistent with that observed in Argentina, Bolivia, México, and Perú.

The effects of currency substitution on the dynamics of inflation are also emphasized by Rojas-Suárez (1992, this issue), who focuses on the case of Perú. Specifically, she examines the role of currency substitution as the mechanism through which fiscal and monetary policy impact on inflation. The idea is that, as the public switches from domestic to foreign money holdings, the inflationary consequences of a given budget deficit are aggravated. Furthermore, this mechanism becomes more important as the inflation rate accelerates, since the public adjusts its money portfolio quicker.

The process of switching from domestic to foreign currency as inflation rises may not be without costs, which may have an important bearing on the income-distribution aspects of inflationary finance, as suggested by Sturzenegger (1992, this issue). Casual evidence suggests that high-income consumers can better protect themselves from inflationary taxation by resorting to a more efficient transactions technology than low-income consumers. To capture this phenomenon, Sturzenegger (1992, this issue) assumes that there is a fixed cost of switching from domestic to foreign currency. As a result, only high-income consumers find it optimal to switch to foreign currency, and hence they bear a lower inflation tax (relative to income) than low-income consumers.

2. *The public finance approach*

An alternative approach to studying the effects of currency substitution on inflationary finance follows the public finance approach pioneered by Phelps (1973). The government is assumed to optimally choose commodity (or income) taxes and the inflation tax to finance an exogenously-given level of government spending. Hercowitz and Sadka (1987) examine whether it is optimal for policymakers to impose restrictions on the use of foreign exchange that would allow them to resort to the inflation tax, in the context of a Baumol-Tobin model in which foreign money can act only as a store of value. With any positive inflation rate–and in the absence of any restrictions on the conversion between foreign and domestic currency– consumers would hold only foreign exchange and convert it into domestic currency just before carrying out transactions. Since collecting the income tax is costless while the inflation tax would generate a waste of resources associated with having to impose costs on the conversion of foreign into domestic currency, Hercowitz and Sadka (1987) conclude that the optimal inflation tax is zero and thus the optimal restriction is indeterminate, as Frenkel points out (1987).

The key assumption behind the result in Hercowitz and Sadka (1987) is that foreign currency cannot act as a medium of exchange. If, as argued in the Introduction, one considers the medium-of-exchange property of foreign currency as the defining characteristic of currency substitution, then it follows that Hercowitz and Sadka's (1987) analysis fails to capture the phenomenon of currency substitution. The medium-of-exchange property of foreign currency is explicitly modeled in Végh (1989a), where it is assumed that foreign currency reduces transactions costs (that is, it decreases the time that consumers need to devote to carrying out transactions), thus acting as an (imperfect) substitute for domestic currency. The government is assumed to resort to a consumption tax, in addition to the inflation tax. In this context, it can be shown that, if the foreign nominal interest rate is positive, then it is optimal to impose a positive inflation tax[26]. The intuition follows from second-best considerations: the foreign nominal interest rate acts as a tax on consumption because it affects the "effective" price of consumption (i.e., the price of consumption inclusive of the cost of transactions), thus imposing a distortion into the consumption-leisure choice. A positive domestic nominal interest rate enables the government to decrease the consumption tax, which reduces the original distortion[27].

A somewhat unappealing feature of Végh's (1989a) model is that the optimal inflation tax does not depend on government spending, which would seem to run counter to stylized facts. However, when the government resorts to an income, rather than a consumption, tax, Végh (1989b) shows that, in addition to depending on the foreign nominal interest rate, the optimal inflation tax also depends (positively) on government spending. Furthermore, Végh (1989b) shows that the higher the degree of currency substitution, the higher is the optimal inflation tax for a given level of government spending and the foreign nominal interest rate. This result thus supports the idea mentioned above that a higher degree of currency substitution will result in a higher inflation tax for a given level of government spending.

More recently, Kimbrough (1991) has reached conclusions opposite to those in Végh (1989a,b). In a model in which foreign money is used to buy imported goods and domestic money is used to buy non-traded goods, Kimbrough (1991) concludes that the optimal inflation tax is zero. However, since using foreign money only to buy traded goods is not what is usually regarded as currency substitution, his results have limited applicability in the present context. Furthermore, as argued in Guidotti and Végh (1992), Kimbrough's (1991) results critically depend on a specific assumption on the transactions technology. They also show that, if one appended Kimbrough (1991) with the assumption that foreign currency is capable of providing some liquidity services with respect to non-traded goods, the optimal inflation tax would become positive.

The way in which money is modeled can play a critical role in the determination of the optimal inflation tax. This is especially true when dealing with currency substitution since the microfoundations of currency substitution have not yet been satisfactorily worked out (see Sargent (1983) for a discussion). Either one posits imperfect substitutability (and is subject to the criticism of engaging in "implicit" theorizing) or one assumes that foreign currency can be used *only* for some subset of goods (and is subject to the criticism that this does not capture currency substitution)[28]. With all these caveats, we still feel more comfortable with the first approach, because when the microfoundations of currency substitution are satisfactorily worked out, the "reduced" form will not differ much from the imperfect substitution assumption –if it is to be consistent with the fact that both foreign and domestic currency co-exist in many high-inflation countries.

VI. Econometric Issues

In the final analysis, the relevance of currency substitution is an empirical issue. Hence, it is not surprising that a very large econometric literature on currency substitution has developed following the pioneering work of Miles (1978)[29]. This section makes no attempt at reviewing this voluminous literature; rather, it addresses what we feel are the main themes in the empirical literature.

1. *Currency substitution versus asset substitution*

At an empirical level, the study of currency substitution faces a fundamental problem: there is usually no data available on foreign currency circulating in an economy (i.e, foreign currency being used as a medium of exchange). Therefore, the importance of *currency substitution* (i.e., using foreign currency as medium of exchange) is basically unobservable. As a result, the proportion of foreign-currency denominated assets in M2 is usually taken as a proxy for currency substitution (see Savastano (1992, this issue) for a discussion of related measures)[30]. By the same token, econometric studies have also used the fraction of M2 denominated in foreign currency and/or foreign currency deposits abroad as the measure of currency substitution. For instance, Bufman and Leiderman (1992, this issue) use bank deposits linked to the exchange rate –known in Israel as Patam accounts– as their measure of dollarization [31]. Rojas-Suárez (1992, this issue) and Savastano (1992, this issue), on the other hand, use both foreign currency deposits at home and in the U.S.

Data restrictions, therefore, imply that econometric studies can only test the importance of *dollarization* (in this case, foreign currency as a store of value) and not necessarily currency substitution. Furthermore, since dollarization includes asset substitution (i.e., substitution between interest-rate bearing assets denominated in domestic and foreign currency), great care must be exercised in ensuring that what is being tested for is currency substitution and not simply asset substitution (i.e., capital mobility). This is the main point behind Cuddington's (1983) critique of the early empirical literature on currency substitution[32]. In this literature (see, for instance, Miles (1978) and Bordo and Choudri (1982)), the hypothesis of currency substitution was basically tested by regressing real domestic money balances on the rate of inflation and the rate of depreciation. A statistically significant negative coefficient on the rate of depreciation was taken as evidence of currency substitution. However, Cuddington (1983) argues that, in a portfolio model with highly developed capital markets, the demand for real domestic money balances depends negatively on the expected rate of depreciation *independently* of whether domestic residents hold foreign currency or not. Hence, currency substitution and asset substitution are indistinguishable from an empirical point of view. To prove his point, Cuddington (1983) controls for the existence of bonds and shows that the "CS coefficient" ceases to be significant in four OECD countries.

Even in countries that do not have highly developed capital markets, including both the rate of inflation and the rate of depreciation as right-hand-side variables is not an efficient way of testing for currency substitution due to the high collinearity between these two variables, as discussed by Savastano (1990).

In principle, optimizing models of currency substitution are not subject to Cuddington's (1983) critique, since the arguments of the money demand are derived from "first principles", and cannot be arbitrarily chosen. However, the fundamental distinction between currency substitution and asset substitution cannot be tested since data availability leaves no choice but to use foreign-currency denominated interest-bearing assets[33].

2. *Testing for currency substitution*

A traditional way of testing for currency substitution has been to take the ratio of domestic to foreign real money balances as the variable to be explained. In particular, standard *optimizing* models of currency substitution (see, for instance, Thomas (1985)) predict that the ratio of domestic to foreign money (in terms of domestic currency) should depend negatively on the domestic nominal interest rate (i) and positively on the foreign nominal interest rate (i*). Formally,

$$\frac{M}{EF} = f(i, i^*), \quad \frac{\partial f}{\partial i} < 0, \quad \frac{\partial f}{\partial i^*} > 0. \tag{1}$$

where M and F denote nominal domestic and foreign money balances, respectively, and E is the nominal exchange rate (in units of domestic currency per unit of foreign currency)[34].

Two characteristics of equation (1) should be noted. First, only the domestic and foreign nominal interest rates enter as explanatory variables of the demand for M/EF[35]. Therefore, econometric specifications which include *both* nominal interest rates *and* the rate of devaluation do not follow from standard optimizing models of currency substitution. Second, no scale variables (i.e., income or consumption) appear on the right-hand side of equation (1). In reduced-form models, such as Ramírez-Rojas (1985), it is assumed that the demand for each currency is homogenous of degree one in wealth in order to get rid of the scale variable. In optimizing models, the absence of the scale variable results from the assumption that the liquidity services produced by both monies apply to *total* consumption[36].

Equation (1) cannot always be implemented empirically because the domestic nominal interest rate may be controlled and, hence, may not adequately reflect the opportunity cost of holding the domestic currency. In this situation, the expected rate of devaluation, ε, is taken as a proxy of the opportunity cost of holding domestic currency. Hence, taken i* as a constant, equation (1) can be rewritten as[37]

$$\frac{M}{EF} = z(\varepsilon), \quad \frac{\partial z}{\partial \varepsilon} < 0. \tag{2}$$

Econometric studies, such as Rojas-Suárez (1992, this issue), take a log-linear (discrete time version) of equation (2):

$$\log\left(\frac{M_t}{E_tF_t}\right) = \alpha + \beta \log\left(\frac{E_{t+1}}{E_t}\right), \tag{3}$$

where the coefficient β is expected to be negative. Rojas-Suárez (1992, this issue) finds that both the ratio of domestic to foreign money and the rate of devaluation are stationary processes so that standard regression techniques can be applied taking into account the endogeneity of the change in the nominal exchange rate. Using foreign currency deposits in the domestic banking system, Rojas-Suárez (1992, this issue) concludes that, as predicted by the currency substitution hypothesis, the (expected) rate of devaluation significantly affects the desired ratio of domestic to foreign money.

Variations of equation (3), often incorporating some partial-adjustment mechanism, have also been estimated by, among many others, Ramírez-Rojas (1985) for Argentina, México, and Uruguay; Savastano (1990) for México, Perú, and Uruguay; and Ortiz (1983a,b) for México. The presence of currency substitution is usually supported by the data in the sense that the coefficient β in equation (3) is negative and statistically significant. Agénor and Khan (1992) extend the traditional econometric approach by embedding equation (1) in a multi-period costs-of-adjustment framework, which results in a reduced-form that contains both forward- and backward-looking components. They estimate the model for ten developing countries and find empirical support for the currency substitution hypothesis. Furthermore, a formal comparison of the forward-looking formulation with a traditional, partial-adjustment model suggests that the forward-looking formulation is generally to be preferred.

The previous discussion would seem to indicate that the empirical evidence supports the currency substitution hypothesis, and that a specification such as (1) –or variants thereof such as Agénor and Khan (1992)– performs adequately well in describing the phenomenon of currency substitution. However, two important caveats should be mentioned, which suggest that the empirical relevance of currency substitution is yet to be firmly established. First, as already discussed, it is not clear whether these tests are capturing currency or asset substitution. Second, even if these tests were indeed capturing currency substitution, there may be misspecification problems due to the presence of hysteresis in the dollarization process. Guidotti and Rodríguez (1992), for instance, argue via cointegration tests that, in four Latin American countries, equations such as (3) are misspecified. As discussed in Section III, hysteresis may result from permanent changes in real money demand due to financial innovation or adjustment costs of switching from one currency to the other.

3. *Stability of the demand for domestic money*

An indirect way of testing for the effects of currency substitution is to study the stability of the demand for domestic money. Savastano (1992, this issue), for instance, tests for both gradual and discrete shifts in the demand for real domestic money balances in Bolivia, México, Perú, and Uruguay using both M1 and M2. He concludes that discrete shifts in the broad aggregate, M2, capture rather well the effects of the presence of foreign-currency deposits. Interestingly, however, he finds that demands for M1 do not reflect as clearly the dollarization processes in these four countries as do demands for M2[38]. Savastano (1992, this issue) also shows how shifts in the demand for M2 in Perú and Uruguay were associated with corresponding shifts in the inflation-tax Laffer curves.

Arrau, De Gregorio, Reinhart, and Wickham (1991) provide related evidence on the instability of money demand in ten developing countries[39]. They consider whether "financial innovation" (defined as anything other than the scale and the opportunity cost variable that has a permanent effect on real domestic money demand) can help in eliminating problems of overprediction, implausible parameters values, and highly autocorrelated errors of traditional money demand functions. They find that for high-inflation countries (Argentina, Israel, and México), almost all unexplained shocks to real money demand are accounted for by "financial innovation", which they attribute, in these three countries, to the process of dollarization.

Instead of focusing directly on the demand for domestic money, McNelis and Asilis (1992, this issue) concentrate on the instability of the inflationary process that may result from even small changes in the degree of currency substitution. In their model, small changes in the degree of currency substitution lead to sharp explosive changes in the inflation path. In the empirical implementation of their model, McNelis and Asilis (1992, this issue) resort to GARCH (generalized autoregressive conditional heteroskedastic errors) modeling, which allows the variance of the inflation rate to change over time. They compute GARCH statistics for the inflationary processes in Argentina, Bolivia, México, and Perú and compare them to the GARCH statistics of time-series that result from simulating the model. The conclusion is that the GARCH statistics predicted by the model are in line with those observed in Bolivia, Perú, and México[40]. While significant GARCH statistics for the inflationary process may be due to other sources, the fact that small changes in the degree of currency substitution yield inflation paths similar to those observed in highly dollarized countries suggests that currency substitution may be at the heart of inflation instability.

In the same spirit, Rojas-Suárez (1992, this issue) analyzes the effects of currency substitution on the short-run behavior of inflation in Perú. This issue is examined by estimating a dynamic equation for inflation using a vector-autoregression representation which includes the lagged ratio of domestic to foreign money as an explanatory variable. The idea is that, as the public switches to foreign currency, the inflationary process is worsened. Rojas-Suárez (1992, this issue) finds that the coefficient of the lagged ratio of domestic to foreign money increased sharply in the period August 1985-June 1990 when inflation accelerated. This is taken to reflect that, as inflation rises, the public adjusts quicker to the desired composition of money holdings, which in turn aggravates the inflationary process.

4. *Estimating the parameters of consumer preferences*

Traditionally, econometric analysis of currency substitution have been limited to estimating log-linear reduced-form equations. More recently, money demands have been derived from optimizing consumers (see, for instance, Rojas-Suárez (1992, this issue)). While, as argued above, this approach has the advantage of being explicit about what variables should appear in money demands, it still forces log-linearity, ignores cross-equations restrictions, and does not explicitly account for uncertainty.

These points have been addressed in recent econometric work by Bufman and Leiderman (1991) and Imrohoroglu (1991) who, in the context of a stochastic, intertemporal currency-substitution model, estimate jointly the parameters that characterize consumer preferences, using the Generalized Method of Moments (see Hansen (1982)). Bufman and Leiderman's model (1991) belongs to the non-expected utility class of models, which allows for the separate estimation of intertemporal substitution and risk aversion parameters. Both studies posit a constant-elasticity-of substitution production function for liquidity services, which implies that both the elasticity of currency substitution and the share of foreign currency in the production of liquidity services can be estimated. The latter is an important parameter because, even if the elasticity of currency substitution is high, a low share of foreign currency in the production of liquidity services would imply that currency substitution is not relevant.

Bufman and Leiderman (1991) estimate the model for Israel for the period 1978-1988. They conclude that the elasticity of currency substitution is generally greater than one, and that the share of foreign currency is slightly below 50 percent and significantly different from zero. These results suggest that, in the case of Israel, currency substitution is an important factor in the optimal choice problem faced by the consumer.

The results for Canadá found by Imrohoroglu (1991) are less favorably to the currency substitution hypothesis. Imrohoroglu (1991) finds that the elasticity of currency substitution is only about 0.3. Furthermore, while the share of foreign currency in the production of liquidity services is significantly different from zero, the magnitude is always below 3 percent.

This line of econometric investigation will undoubtedly be extended in the very near future to Latin American countries, in which the dollarization process has been particularly acute, thus shedding further light on the empirical importance of currency substitution.

VII. Concluding Remarks

Our survey of the literature and discussion of the central issues shows that there are no simple policy prescriptions. On the one hand, for example, promoting the use of the domestic currency gives the government extra leeway to collect taxes and to react to exogenous shocks. On the other hand, such extra freedom invites excess reliance on the inflation tax. Thus, extreme measures against the use of domestic currency, like full dollarization, may at least provide temporary relief against inflation. However, we argued that full dollarization without a "lender of last resort" may make the domestic banking system vulnerable to runs and –if such system is not abandoned when a run is in the offing– full dollarization may lead to possibly deep financial crisis.

Thus, we suspect that the reader who expected simple answers will be greatly disappointed. We believe, however, that there are no simple answers, particularly when dealing with monetary matters. The economist and the astute politician (who are rarely combined in one person) should be aware of the pros and cons of different policies and make their choices based on their perceptions about objective factors, like the potential for terms of trade shocks, and subjective factors, like the state of their credibility and their ability to resist the temptation of "time inconsistency".

Ultimately, the lack of simple policy answers reflects the fact that the analytical work has not been able to provide clear guidance in many important issues. This is not surprising given that the theory of currency substitution faces, in addition to many of the well-known problems confronted by monetary theory, the problem of modeling the role of a *second* currency. For instance, an issue such as the dynamic process whereby a second currency becomes a medium of exchange, which we suspect plays an important role in the real world, is still wide open.

At an empirical level, the problem of not having data on the stock of foreign currency circulating in an economy is in itself a formidable obstacle, because it makes it difficult to differentiate between asset and currency substitution. In addition, the presence of hysteresis in the dollarization processes raises issues of misspecification that need to be addressed.

Notes

1 We abstract, therefore, from the vast literature that followed McKinnon's (1982) important contribution arguing in favor of focusing on world, as opposed to national, monetary aggregates. We also abstract from currency-substitution issues related to the EMS (see Giovannini (1990) for a discussion). Even with respect to currency substitution in developing countries, this review is *not* intended to be comprehensive. The paper reflects our own views on what issues are important, and how they should be approached.

2 Hence, an economy in which the foreign currency serves only as unit of account and/or store of value is dollarized, but is not subject to currency substitution. Sachs (1986) argues that this was the case in Bolivia.

3 See Bernholz (1989) for a discussion of historical episodes in which a secondary currency replaced the primary currency as a result of high inflation.

4 Drazen and Helpman (1990) conclude that there may be lack of contemporaneous correlation between fiscal deficits and inflation even when the budget deficit is clearly the ultimate cause of inflation.

5 The observations made in this paragraph are based on casual evidence and may vary from country to country. We are not aware of any evidence that documents the dynamics whereby a foreign currency displaces the domestic currency. This is certainly a fascinating, but rather unexplored, issue which lies at the core of monetary theory.

6 In hyperinflationary conditions, almost all prices are quoted in (i.e., indexed) to foreign currency, as argued by Sachs (1986) for the Bolivian hyperinflation. Interestingly, however, Sachs (1986) claims that dollarization stopped short of actual transactions in U.S. dollars. In contrast, Sargent (1982) argues that, in the German hyperinflation, large amounts of foreign currency were held for transactions purposes.

7 Theory suggests, and evidence in high-inflation countries seems to confirm, that money-based, stabilization leads to an initial recession, while exchange-rate-based stabilization leads to an initial boom and later recession (see Calvo and Végh (1990a) and Kiguel and Liviatan (1991)).

8 The recent money-based stabilization in Perú which led to a sharp real exchange rate appreciation has brought this issue to the forefront once again.

9 Money in Panamá comprises U.S. notes and coin, Panamanian coin, and demand deposits. However, the amount of Panamanian coin in circulation is negligible in comparison to U.S. currency. High inflation is certainly not a problem in Panamá. The average annual inflation rate from 1981 to 1990 was 1.8 percent. By comparison, the average annual inflation rate in the United States from 1981 to 1990 was 4.7 percent. (Data from *International Financial Statistics*.)

10 Liberia had the same dollar-based monetary system as Panamá until the mid-1980's. At that time, political upheaval and budget deficits led the government to issue large amount of five-dollar coins (and then, in 1989, five-dollar notes). As a result, U.S. banknotes have disappeared from circulation and the Liberian dollar has become the medium of exchange. (Since 1985, the Liberian dollar has been traded, at a discount with respect to the U.S. dollar in the parallel market.) Liberia thus provides a fascinating modern-day application of Gresham's law.

11 Actually, domestic debt may serve as a way of reneging on full dollarization. This would happen if, say, the government paid wages and salaries with its own paper, forcing it to become a medium of exchange.

12 See Frenkel (1982) for a discussion of the "discipline" argument in the context of fixed versus flexible exchange rates. Canzoneri and Diba (1991) examine whether currency substitution imposes inflation "discipline" in the context of the EMS.

13 Calvo and Végh (1990b, 1990c) study the effectiveness of interest rate policy –modeled as paying interest on money– in fighting high inflation. Sustainability issues related to such policies are discussed in Calvo (1992) (see also Fernández (1991)). Dornbusch and Reynoso (1989) are equally skeptical of high interest rates as a substitute for fiscal correction. Based on the Brazilian case, they argue that the steady accumulation of public debt that pays high interest rates leads to a situation in which the entire public debt is matched by interest-bearing, checkable deposits. Eventually, the government will be unable to roll over its debt, and a funding crisis will arise. See also Dornbusch, Sturzenegger and Wolf (1990).

14 The banking system becomes vulnerable essentially when there is a mismatching of assets and liabilities in terms of currency or maturity. In the euromarkets, the extent to which banks can have a net imbalance in foreign currency terms has been subject to review by the supervisory authorities.

15 See also Girton and Roper (1981). Further elaboration of Kareken and Wallace's (1981) result can be found in Manuelli and Peck (1990) and King, Wallace, and Weber (1992).

16 An example may help to clarify the central issue. Suppose the U.S. government erased the number "10" from the 10-dollar bills, and let the market determine the price of the ex-10-dollar bills (i.e., their exchange rate) against all the other dollar bills. A moment's reflection shows that, given an exchange rate, total money supply is determined which, in turn, determines the price level. But if such exchange rate doubles, the price level will increase to a new equilibrium. Hence, the exchange rate and the price level are totally undetermined –the system has no nominal anchor.

17 If there is lack of credibility, an early deceleration of inflation is more likely under exchange-rate-based stabilization, because the exchange rate "anchors" the price of traded goods.

18 Of course, the sustainability of fixed exchange rates depends on the level of available reserves. This is an issue that falls outside the scope of this paper. However, it is worth mentioning that, if the stabilization program is sound, and does not require substantial depletion of international reserves, fixed rates could be sustained by a "stabilization fund" like that recently granted to Poland and other previously centrally-planned economies.

19 Since the stock of foreign currency circulating in an economy is difficult to measure, there is no alternative but to rely on dollarization ratios (the proportion of M2 denominated in foreign currency). This discussion assumes that hysteresis in these dollarization ratios is a good indicator of hysteresis in currency substitution, which is far from clear (see the discussion in Section VI on asset substitution versus currency substitution).

20 They base their conclusions on a data set consisting of the record of informal loans in the Cochabamba region of Bolivia. The pattern of dollarization is measured by the currency of denomination of informal loans.

21 See also Barro (1978).

22 Liviatan (1981) assumed that the utility function is separable between consumption and liquidity services.

23 Specifically, the elasticity of substitution between the two currencies is higher than the elasticity of substitution between consumption and liquidity services.

24 The traditional results could be obtained even in the presence of a "pure" bond and flexible prices if, say, idiosyncratic shocks to foreign assets were introduced. Then, foreign currency would be hold also for portfolio considerations, as in the traditional formulations.

25 It is worth noting that some inflation instability may actually be desirable. Calvo and Guidotti (1992) show an example in which it is optimal to cover the unanticipated part of government expenditure through seignorage, even when the latter policy may create large inflation volatility.

26 While the use of the word "optimal" carries a normative connotation, one could also interpret these public finance results in terms of positive analysis; that is, as providing an explanation as to why governments engage in inflationary finance. Other explanations include the presence of collection costs (Aizenman (1987) and Végh (1989c)) and untaxable sectors (Canzoneri and Rogers (1990), Mourmouras (1991) and Mourmouras and Tijerina (1992)).

27 Note that the Diamond and Mirlees (1971) proposition –which states that it is not optimal to tax intermediate inputs in order for productive efficiency to be achieved– does not hold in Végh (1989a), in spite of the fact that money acts as an intermediate good. The reason, as argued by Guidotti and Végh (1990), is that, when transactions costs depend positively on consumption and negatively on real money balances, consumption acts both as a final and an intermediate good, thus rendering invalid the application of the Diamond and Mirlees (1971) proposition, except under special cases.

28 Imperfect substitutability has been modeled in various ways. The most common is probably to include both monies in the utility function (see, among many others, Liviatan (1981), Calvo (1985), Végh (1988), and Rogers (1990)). Alternative approaches include modeling currency substitution in a Baumol-Tobin context (see Poloz (1984) and Guidotti (1989)); assuming that both monies reduce transactions costs or shopping time (see Thomas (1985) and Végh (1989a, b)); and using a "liquidity-in-advance" constraint (see Calvo and Végh (1990a) and Rojas (1990)).

29 The econometric evidence for Latin American countries, in particular, is extensive. On Argentina, see Canto and Nickelsburg (1987), Fasano-Filho (1987), and Ramírez-Rojas (1985). On Bolivia, see Clements and Schwartz (1992), Melvin (1988), Melvin and Afcha (1989), Melvin and Ladman (1991), Melvin and Fenske (1992, this issue), and Savastano (1992, this issue). On Brazil, see Calomiris and Domowitz (1989). On Ecuador, see Canto and Nickelsburg (1987). On México, see Melvin (1988), Ortiz (1983a, b) and Savastano (1992, this issue). On Perú, see Rojas-Suárez (1992, this issue) and Savastano (1992, this issue). On Uruguay, see Ramírez-Rojas (1985) and Savastano (1992, this issue). On Venezuela, see Canto and Nickelsburg (1987) and Márquez (1987). In addition, El-Erian (1988) studies the case of Egypt and the Yemen Arab Republic, and Agénor and Khan (1992) study dollarization in ten developing countries (Bangladesh, Brazil, Ecuador, Indonesia, Malaysia, México, Morocco, Nigeria, Pakistán, and Philippines). Stanczak (1989) describes the Polish experience.

30 An exception to the use of foreign-currency deposits is found in Melvin and Fenske (1992, this issue). They use data on loans denominated in both domestic and foreign currency to test a model of lender behavior.

31 Since these accounts have basically a required reserve ratio of 100 percent, they can be viewed as foreign currency deposits.

32 See also Cuddington (1989).

33 See Melvin and Afcha (1989) for an attempt to estimate the stock of American dollars circulating in Bolivia.

34 The specification in (1) assumes that both nominal interest rates are known a priori. Otherwise, expected values and covariances between the marginal utility of consumption and nominal returns would enter equation (1).

[35] As emphasized by Thomas (1985), portfolio considerations are irrelevant for currency substitution in the presence of perfect capital mobility, because foreign *currency* holdings are independent of asset composition. Increases in the demand for foreign *currency* will be financed by foreign borrowing without altering the share of foreign-currency-denominated assets in the consumer's portfolio.

[36] This is the standard assumption in currency substitution models. However, if foreign currency were used more heavily for a subset of goods (i.e., big-ticket items), then relative expenditure shares would enter equation (1) (see Sturzenegger (1991)).

[37] Alternatively, if interest rate parity holds (i.e., $i = i^* + \varepsilon$), then equation (2) follows directly from equation (1).

[38] Note that these results are consistent with the idea, discussed above, that demands for M2 may be capturing asset substitution rather than currency substitution.

[39] See also Arrau and De Gregorio (1991).

[40] In Argentina, GARCH statistics are significant for the parallel exchange rate but not for the inflation rate.

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