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Dollarization and Economic Performance: What Do We Really Know?

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with comments by Luis Adalberto Aquino Cardona and by Hans Genberg

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Editorial

On April 15 - 16, 2002 a conference on "Monetary Union: Theory, EMU Experience, and Prospects for Latin America" was held at the University of Vienna. It was jointly organized by Eduard Hochreiter (OeNB), Klaus Schmidt-Hebbel (Banco Central de Chile) and Georg Winckler (Universität Wien). Academic economists and central bank researchers presented and discussed current research on the optimal design of a monetary union in the light of economic theory and EMU experience and assessed the prospects of monetary union in Latin America. A number of papers presented at this conference are being made available to a broader audience in the Working Paper series of the Oesterreichische Nationalbank and in the Central Bank of Chile Working Paper series. This volume contains the second of these papers. The first one was issued as OeNB Working Papers No. 64. In addition to the paper by Sebastian Edwards and I. Igal Magendzo the Working Paper also contains the contributions of the designated discussants Luis Adalberto Aquino Cardona and Hans Genberg.

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DOLLARIZATION AND ECONOMIC PERFORMANCE: WHAT DO WE REALLY KNOW?*

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ABSTRACT

In this paper we analyze the macroeconomic record of dollarized economies. In particular, we investigate whether, as its supporters' claim, dollarization is associated with lower inflation and faster growth. We analyze this issue by using a matching estimator technique developed in the training evaluation literature. Our findings suggest that inflation has been significantly lower in dollarized nations than in non-dollarized ones. We also find that dollarized nations have had a lower rate of economic growth than non-dollarized ones. Finally, we find that macroeconomic volatility is not significantly different across dollarized and non-dollarized economies. We conjecture that the lower rate of economic growth in dollarized countries is due, at least in part, to these countries' difficulties in accommodating external disturbances, such as major term of trade and capital flows shocks.

* This paper has been prepared for presentation at the conference on "Monetary Unions: Theory, EMU Experience and prospects for Latin America," organized by the University of Vienna, the Central Bank of Austria and the Central Bank of Chile. We have benefited from discussions with John Cochrane, Barry Eichengreen, Eduardo Engel and Ed Leamer. We thank Robert Barro and Andy Rose for helpful comments.

I. Introduction

The recurrence of currency crises in emerging countries has generated an intense debate on exchange rate policies. Pegged-but-adjustable exchange rate regimes have rapidly lost adepts, while hard pegs and freely floating rates have gained in popularity (See Summers 2000 and Fischer, 2001). A growing number of economists have gone as far as arguing that (many) emerging nations should completely give up their national currencies, and adopt an advanced nation's currency as legal tender. This policy proposal has come to be known by the general name of ***"dollarization."*** Recently, some emerging countries have, indeed, decided to officially dollarize their economies. In 2000, for example, and in the midst of a major crisis, Ecuador abolished its currency, the *Sucre*, and adopted the U.S. dollar. El Salvador adopted the dollar during 2001; and in May 2001, the dollar became legal tender in Guatemala.[1] In other countries, however, politicians have systematically refused to consider dollarization, even in the face of major and costly financial crises. This was the case, for instance, of Argentina during late 2001 and early 2002.

Supporters of dollarization have argued that countries that give up their currency will be unable to engage in monetary and macroeconomic mismanagement. Public finances will stay in balance, macroeconomic policy (or what is left of it) will be credible, and the external accounts will move within reasonable bounds. According to this view, dollarization will have two major positive effects on economic performance: First, inflation will be lower in dollarized than in non dollarized nations. Alesina and Barro (2001 p. 382), for instance, have argued that adopting another nation's currency "eliminates the inflation-bias problem of discretionary monetary policy." Second, countries that give up their currency will tend to grow faster than non-dollarized countries. This growth effect is supposed to take place through two channels: (a) dollarization will mean lower interest rates, higher investment, and faster growth (Dornbusch 2001). And (b), by eliminating exchange rate volatility, dollarization is

[1] By "officially dollarized" countries, we mean countries that use another nation's currency. This "other currency" needs not be the U.S. dollar, however. We have excluded countries that use a common supra-national currency, such as the Euro. On the selection of exchange rate regimes see, for example, Frankel (1999). On analytical aspects of dollarization see Calvo (2001) and Eichengreen and Haussman (1999). On currency unions see Frankel and Rose (1999).

suppose to encourage international trade and this, in turn, will result in faster growth. Rose (2000), and Rose and Van Wincoop (2001), among others, have emphasized this trade channel.[2] Other authors, however, have voiced skepticism regarding the alleged positive effects of dollarization on growth and overall macroeconomic performance. According to Eichengreen (2001) the evidence on the relationship between monetary regimes and growth is inconclusive, and does not support the claim that dollarization – or any exchange rate regime, for that matter – is an important determinant of growth.[3] The traditional view, on the other hand, is that in countries with a hard peg it is difficult to accommodate external shocks, including terms of trade and world interest rate disturbances. This, in turn, will be translated into greater instability and lower economic growth (Fischer 1976). And Frankel (1999) has argued that there is no unique recipe on exchange rate policy; while some countries will benefit from hard pegs, for other countries a floating regime will be more appropriate.

Surprisingly, until very recently there have been no formal empirical studies on the economic consequences of dollarization. In particular, international comparative studies on alternative exchange rate and monetary regimes have traditionally ignored dollarized countries. For instance, the comprehensive study on exchange rate regimes, growth, and inflation by Gosh et al (1995), does not include nations that do not have a currency of their own. Likewise, the IMF (1997) study on alternative exchange rate systems excludes dollarized countries, and the recent paper by Levy-Yeyeti and Sturzenegger (2001) on exchange rates and economic performance excludes nations that do not have a central bank. This lack of empirical evidence means that countries that are contemplating dollarization have very little information on how other countries have historically performed under this monetary regime. Most existing evidence on dollarization is based on the experience of Panama, a country that has used the US dollar as legal tender since 1904.[4] Rose and Engel (2000) provided an early empirical analysis

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[2] On analytical aspects of dollarization see Calvo (1999) and Eichengreen and Haussman (1999).

[3] Other authors that have been skeptical regarding the benefits of dollarization include Corbo, Velasco (2001) and Willet (2001). For a defense of dollarization see Hausmann (1999).

[4] Goldfjan and Olivares (2001) use econometrics to evaluate Panama's experience with dollarization. Moreno-Villalaz (1999) provides a detailed analysis of the Panamanian system. Bogetic (2000) describes several aspects of dollarization in a number of countries. As far as we know, Rose and Engel (2000) and Edwards (2001) are the first two papers to provide a statistical and econometric analysis of economic performance in dollarized countries and/or currency unions.

of economic performance in countries with no currency of their own. Their analysis, however, does not emphasize “dollarized” countries – that is countries that use an advanced nation’s currency --; instead it focuses mostly on currency unions, or countries whose common currency is *not* the currency of an advanced nation, but rather the union’s own currency. In fact, the Rose and Engel (2000) data set includes 26 countries that do not have a currency of their own, and have data on real GDP per capita. Of these 23 countries, only one – Panama -- corresponds to a strictly dollarized nation; the other 25 countries in the data set correspond to currency unions.

The purpose of this paper is to analyze the historical macroeconomic record of dollarized economies. More specifically, we are interested in investigating whether, as its supporters argue, dollarization is associated with superior macroeconomic performance, as measured by lower inflation, faster growth and lower growth volatility. Performing this type of international comparison, however, is not easy. The problem is how to define an appropriate “control” group with which to compare the dollarized nations. Since dollarization is not a “natural experiment,” using a broad control group of all non-dollarized emerging countries is likely to result in biased estimates. In this paper we tackle this issue by using a matching estimator technique developed in the training evaluation literature (Heckman et. al. 1997).

In this paper we concentrate on countries and territories that use an advanced nation’s currency, or countries that have a strictly dollarized system. That is, we exclude from the analysis territories and countries that join a monetary union that has a currency of its own (i.e. the East Caribbean Currency Area or the CFA area in Africa). The reason for focusing on strictly dollarized countries is rather simple: to a large extent the policy debate in the emerging world, and especially in Latin America, is whether these countries ought to adopt an "advanced" country's currency, as a way of achieving credibility. For Argentina, for instance, it is very different to delegate the running of monetary policy to the Federal Reserve, than delegating it to a MERCOSUR central bank that would be run by Brazilians and Argentines. Argentine politicians and economists rightly ask whether the latter would have any more credibility than their own embattled Central Bank.

Before proceeding, it is useful to point out the ways in which our analysis differs from other related work in this general area. First, we use a "matching" methodology to define the appropriate control group. Second, we focus directly on the most important macroeconomic variables – real GDP growth, inflation and growth volatility. Other studies, in contrast, have analyzed performance in an indirect fashion, and have focused on ancillary variables such as the level of international trade and/or interest rates. For instance, Frankel and Rose (2002) have analyzed the way in which currency unions affect bilateral trade and, through this channel, economic growth.[5] Edwards (1999), and Powel and Sturzenegger (2000) have investigated the way in which the exchange rate/monetary regime affects interest rate behavior, and the cost of capital. And third, in the current paper we are particularly interested in estimating the actual magnitude of the "dollartization effect." That is we want to know, as precisely as possible, by how many percentage points countries under a certain regime have outperformed countries with an alternative regime. We believe that, by dealing with the "treatment bias" the matching methodology used in this paper is particularly appropriate for this purpose.

The results reported in this paper suggests quite strongly that inflation has been significantly lower in dollarized nations, than in non-dollarized ones. We also find that dollarized nations have had a lower rate of economic growth than non-dollarized ones. Statistically speaking, however, this result is not as strong as our finding on inflation differentials. Finally, we find that macroeconomic instability – measured by the degree of volatility of GDP growth – is not significantly different across dollarized and non-dollarized economies. We conjecture that the lower rate of economic growth in dollarized countries is due, at least in part, to these countries' difficulties in accommodating external disturbances, such as major term of trade and capital flows shocks. Unfortunately, the lack of data precluded us from investigating this issue formally. Preliminary results for the case of Panama reported in Edwards (2001) and Edwards and Levy-Yeyati (2002), however, provide some support for this view. The rest of the paper is organized as follows: In Section II we provide a preliminary analysis of

[5] See Klein (2002) for a discussion on dollarization and trade, including a comprehensive bibliography on the subject.

historical experiences with "dollarization." In Section III we present our empirical analysis using matching estimators. In Section IV we provide some concluding remarks.

II. Dollarization Experiences During 1970-1998

II.1 Historical Experiences

Countries that use a foreign currency as legal tender can be divided into two groups. The first one corresponds to *independent* nations, while the second group includes territories, colonies or regions within a national entity. Panama is an example of the first type of country, while Puerto Rico belongs to the second group. Table 1 contains a list of countries (Panel A) and territories (Panel B) that have had an official dollarized system at any time during the 1970-1998 period.[6] We have included information on population, and on the currency (or currencies) used as legal tender. As may be seen, the countries and territories that have had a dollarized monetary system are very small indeed. Many are city-states well integrated into their neighbors' economies – Monaco, Lichtestein, the Vatican and Andorra are good examples. Some of them are not only tiny, but also have an exciting and romantic origin. This is the case of Pitcairn Island, the place where a group of English mutineers and Tahitian women settled in 1790. Many of the dollarized economies are so small that they do not have data on basic economic indicators such as inflation or growth. We have been able to collect data on growth for 12 of the 13 independent countries, and for 3 of the territories. Inflation data are available for 9 of the independent countries and for the same 3 territories (See Table 1). This lack of readily available data may explain why most studies on currency unions have only included one or two strictly dollarized countries in the empirical analysis.

The largest dollarized countries in Panel A are Liberia and Panama. Only the latter, however, remains dollarized today; Liberia abandoned the system in the 1980s, when the government of President Samuel Doe decided to issue local currency as a way of avoiding the constraints imposed on policy by the dollarized system.[7] The largest

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[6] We follow the U.S. Congress' Joint Economic Committee, and concentrate on those territories that have a high degree of administrative autonomy. There are some borderline cases, however, that may generate some controversies.

[7] It is not easy to date unequivocally Liberia's abandonment of the dollarized system. In July 1974 the National Bank of Liberia (NBL) was opened. In 1982 the NBL began issuing five-dollar coins, and in

dollarized territory is Puerto Rico with little under 4 million people, and the smallest is Pitcairn Island with 50 people. In 1998 the median population in the independent dollarized countries' was 63,000 people; the median population in the territories was even smaller, at 19,000 people. Another characteristic of these economies is that they are extremely open. In most of them there are no controls on capital mobility or on any type of financial transactions. So much so, that in 2001 6 out of the 13 independent dollarized nations are in the OECD list of "Unfair Tax Havens," or countries whose lax financial regulations, according to the OECD, allow individuals and corporations to evade taxes. These fundamental characteristics of the dollarized economies – very small and extremely open – already suggest that using a broad control group of *all non-dollarized* countries, which are much larger and not as open, may indeed generate biased results.[8]

II.2 Comparative Analysis With an Unadjusted Control Group

In Table 2 we present, for the dollarized economies for which we have information, summary statistics on inflation, per capita GDP growth, and the standard deviation of growth. In order to put things in perspective we also present data on these three variables for an "unadjusted" control group that includes all countries with a currency of their own. This unadjusted control group contains 4,910 observations. In Column (C) we present data on mean and median differences between dollarized and non-dollarized countries for each of the three macroeconomic variables of interest. The numbers in parenteses are t-statistics for the significance of these differences. The test for the means differences is a standard t-statistic, while the medians differences test is a t-test obtained using a bootstrapping procedure. These results indicate that the difference in inflation means is very large and statistically significant; on average inflation in dollarized nations has been 55 percentage points lower than in non dollarized countries. The difference in inflation medians is still negative, much smaller (- 5 percentage points), and still statistically significant. The difference in GDP growth means is –0.7 percentage points, and statistically significant; the difference in medians is – 1.4 percentage points,

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1989 it began issuing five-dollar notes. On Liberia's dollarization experience see Barret (1995) and Berkeley (1993).

[8] The median population of all non-dollarized emerging nations is over 100 times larger than that of the dollarized economies.

and is also statistically significant. The results for growth volatility are mixed: while the difference in medians is statistically negative, the difference in means is not statistically different from zero. We also computed a non-parametric Kruskal-Wallis χ^2 tests on the equality of the distributions of the dollarized and non-dollarized groups. These tests indicate that the two groups had different distributions during the period under study. Using a slightly narrower control group comprised of emerging markets only did not alter the conclusions in Table 2.

As pointed out earlier, a potential limitation of these comparisons is that the control group may not be the appropriate one. If this is the case, the results presented in Table 2 may be subject to a "treatment bias."[9] In section III we deal with this issue in detail and we report new results obtained using a technique aimed at defining appropriate control groups.

III. Dollarization and Performance: A Matching Estimator Approach

III.1 Methodological Issues

Comparative macroeconomic analyses have traditionally relied on regression equations of the following type:

$$y_{jt} = \beta x_{jt} + \gamma D_{jt} + \varepsilon_{jt.} \tag{1}$$

Where y is the variable of interest –GDP growth, say--, x is a vector of controlling variables, D is the "event" or "treatment" dummy (dollarization, for example), and ε is an error term. In this setting, the analyst is interested in estimating parameter γ, which captures the effect of the "treatment" on the outcome variable y.[10] A potential problem with this approach, however, is that the "treatment" – the decision to dollarize, in our case -- may not be the result of a random experiment. If this is the case, the estimated conditional effect of the "treatment" on y, will be a biased estimator of the "true" effect. The reason for this is that some of the covariates (x) may affect the outcome (y) in a non-

[9] See Maddala (1983).

[10] In standard regression analysis the coefficient γ captures the mean effect of the "event" on y. It is perfectly possible, however, to estimate the effect of the event on the median (or any other quantile) of the

linear fashion. If this nonlinear term is excluded from the regression, we will face an "omitted variable" bias (see Maddala, 1983 and Heckman et. al. 2001, for details on the "treatment" bias).

One way of dealing with this problem is by using non-parametric methods, including the *matching estimators* technique developed in the training evaluation literature (see Blundell and Costa Dias, 2000).[11] This approach consists of using the available data to re-establish the conditions of a natural experiment. A general advantage of this non-parametric method is that no particular specification of the underlying model has to be assumed. We can restate the question at hand – what is the effect of dollarization on performance –in the following way:

(2) $$\Psi = E(y_1 - y_0/x, D=1).$$

Where y_1 is, say, per capita GDP growth in countries that receive the dollarization "treatment." y_0 is per capita GDP growth in those that have not received the treatment, and x are observable covariates. As before, D is a dummy variable that takes the value of one if the observation is subject to the treatment, and the value of zero otherwise. In words, equation (2) captures the mean effect of dollarization on the dollarized countries' performance. The analyst's problem, however, is that he does not have data to estimate $E(y_0/x,D=1)$, the "outcome" in dollarized countries, had they not dollarized[12]. Matching estimators use the existing data to construct an appropriate sample counterpart for the missing information. This is done by pairing each dollarized country with countries from the non-dollarized group (Blundell and Costa Dias 2000). If the sample is large enough, for each treated (dollarized) observation we can find, in principle, at least one untreated observation with exactly the same characteristics. Each of these properly selected untreated observations provides the required counterfactual for our comparative

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dependent variable. In the empirical results presented below we focus both on mean and median differences of the dependent variables.

[11] Lalonde (1986) is the classic paper on training evaluation.

[12] If we estimate the equation above using all non-treated observations the selection bias is given by:

$$B(x) = E(u_0 / x, D = 1) - E(u_0 / x, D = 0).$$

analysis.[13] The problem is that under most general conditions it is not possible to find an *exact* match between a treated and untreated observation. The matching estimator method focuses on estimating an average version of the parameter of interest[14]. That is, the matching estimator consists of obtaining the difference in outcome as an average of the differences with respect to "similar" -- rather than identical -- untreated outcomes. The matching estimator $\hat{M}$ can be written as[15]:

(3) $$\hat{M}(S) = \sum_{i \in T} w_i (y_i - \sum_{j \in C} W_{ij} y_j).$$

Where T and C are respectively the sets of treated and untreated countries, W_{ij} are weights attached to each untreated observation j that is "matched" with treated country *i*, and w_i are the weights that allow us to reconstruct the outcome distribution for the treated sample.

Rosenbaum and Rubin (1983) have shown that an efficient and simple way to perform this comparison is to rely on a *propensity score*, defined as the probability of participation or treatment: *P(x)=Prob(D=1/ x)*. In our case, this is the probability of a country being dollarized. This reduces a multi-dimensional problem to a one-dimensional problem, provided that we can estimate *P(x).* Instead of matching countries directly on all of their characteristics, we can compare countries with similar probability of dollarizing.

In this paper, and in order to explore the robustness of the results, we use two alternative methods for computing matching estimators. First, we use a *simple-average nearest neighbor* estimator. According to this method, for each treated observation, we

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[13] In order to guarantee that all treated agents have such a counterpart in the population (not necessarily in the sample) we also need to assume that $0 < \Pr ob(D = 1/x) < 1$.

[14] This averaged version is given by:

$$M(S) = \frac{\int_S E(y_1 - y_0 / x, D = 1) dF(x / D = 1)}{\int_S dF(x / D = 1)},$$

where S is a subset of the support of *x* given *D*=1.

select a pre-determined number of untreated nearest neighbor(s). The nearest neighbors of a particular treated observation *i* are defined as those untreated observations that have the smallest difference in propensity score with respect to *i*. If we choose to use *nn* nearest neighbors, we set $W_{ij} = \frac{1}{nn}$ for the observations that have been selected; for other observations we set W_{ij} =0. We applied the above method to both one nearest neighbor and five nearest neighbors. The second method consists of using *local linear regressions* to identify each matching observation (Fan 1993).

III.2 Results

In this section we present the basic results from the computation of matching estimators for inflation, growth and growth volatility for the period 1970-1998. The section is organized as follows: we first present the results from a probit model of dollarization, which we use to compute the propensity scores. We then report the results obtained from the calculation of matching estimators proper.

Propensity Scores

We used a 199-country unbalanced panel data set to estimate a random-effect probit model on the probability of a country being dollarized at a particular point in time[16]. The dependent variable takes a value of one if country j is dollarized in year k. Although many of the dollarized economies do not collect extensive data, we were able to obtain information on a number of covariates that capture geographical, economic and political characteristics of the countries in the sample. The following independent variables were used in the probit estimation: (a) Initial GDP, taken as a measure of the country's economic size. (b) Population measured in millions of people, as an alternative index of size. (c) An indicator that measures the degree of openness of the economy. For the majority of countries and years we used the Sachs and Warner (1995) openness index, that takes a value of one if the country in question is open to international trade, and zero otherwise. We used data from a variety of sources to supplement the Sachs-Warner index

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[15] See Blundell and Costa Dias (2000). Persson (2001) has used matching estimators in a study of monetary unions and trade

[16] We will use the term "country" to refer both to independent nations as well as to territories. On propensity scores see, for example, Drake (1993) and Rosenbaum and Rubin (1983).

for those countries and years not covered in their sample.[17] (d) A dummy variable that takes the value of one if the country in question is an island. (e) A dummy variable that takes the value of one if the country has a common boarder with a nation whose currency is defined by the IMF as a "convertible currency." (f) A variable that measures the country's geographical location, as captured by its latitude. And (g), a dummy variable that takes the value of one if the economy in question is an independent nation.[18] The data set covers 1970 through 1998, and has a total of 5,290 observations, of which 386 correspond to dollarized economies. The results obtained are summarized in Table 3, and provide useful information on the probability of a country being dollarized. For example, according to these results smaller, non-independent economies are more likely to be dollarized. Also, more open economies that have a common border with a country with a convertible currency have a higher probability of being dollarized. As may be seen, the fit is quite satisfactory, with the pseudo R^2 exceeding 0.43. The estimated probabilities of being dollarized obtained from this equation were used to define the matching observations in the computation of alternative matching estimators[19].

Nearest Neighbor Matching Estimators

We computed nearest neighbor estimators *"with replacement"* and *"without replacement."* In the *"with replacement"* case an observation for an untreated country may be selected as the nearest neighbor for several dollarized countries. In the *"without replacement"* case each untreated country observation may be the nearest neighbor to only one dollarized country in a particular year. This option requires more data points but reduces the risk of using too few comparison countries. In terms of number of neighbors, we considered both "one nearest neighbor" as well as "five nearest neighbors." In total, then, we use four "adjusted" control groups:

- One nearest neighbor, with replacement;

[17] See the original Sachs-Werner (1995) article for a specific list of requirements for a country to qualify as "open."

[18] Unfortunately, only three of the dollarized economies have data on other variables of interest, including terms of trade, investment, the fiscal balance, and interest rates.

[19] As an alternative method, for each dollarized country we restricted the matching observations to correspond to the same non-dollarized country for every year in the sample. In order to do this, the propensity scores were re-calculated from a cross-country probit regression for 1970. The results obtained from these country-to-country matching estimators are very similar to those reported in Table 6 and are not reported due to space considerations. They are available on request.

- One nearest neighbor, without replacement;
- Five nearest neighbors, with replacement;
- Five nearest neighbors, without replacement.

In Table 4 we summarize some key data for the "adjusted" control groups constructed using the propensity scores methodology. For comparison purposes we also present data on the dollarized economies, and on all non-dollarized economies – the latter group is the "unadjusted" control group used in the previous section. Simple inspection reveals that the new adjusted control groups have a greater degree of similarity with the dollarized nations, than the original unadjusted control group. For example, the new control groups include economies that are smaller, more open and have a higher initial income per capita than the average for the unadjusted sample. This table also reflects the fact that the "adjusted" control groups have a significantly smaller number of observations (or "controls") than the unadjusted control group made of all non-dollarized economies.

The results from the matching estimators are presented in Table 5. For each variable of interest –inflation, growth, and volatility -- we report data on (a) the number of countries and number of observations in the control group; (b) The *"mean difference,"* calculated as the mean of the differences, for each variable, of the dollarized economies and the corresponding non-dollarized control group. And (c) the *"median difference,"* calculated as the median of the differences of the dollarized economies and the corresponding non-dollarized control group. For both the mean and the median difference we present, in parentheses, a t-statistic for their statistical significance. As in Table 2 the test for the mean difference is a standard t-statistic, while that for the difference in median was calculated using a bootstrapping procedure. Finally, and for comparison purposes, we report again the means and medians differences obtained when the unadjusted control group of all dollarized countries is used. We refer to these differences as "unadjusted comparisons."

Our results may be summarized as follows: First, for every one of the matching indicators both the mean and median difference in inflation are negative and significantly different from zero. This indicates that the dollarized economies have had significantly lower yearly rate of inflation than the non-dollarized countries. According to these

results, however, the mean difference in inflation is much *smaller* that what the simple, uncorrected comparisons would suggest. Indeed, while according to the results reported in Table 2 the "unadjusted means difference" in inflation is –55 percentage points per year, the mean difference obtained using matching estimators range from -3.5 to -5.7 percentage points per year. These differences are partially due to the fact that, while the unadjusted control group includes hyperinflation episodes, the "matching" control groups exclude hyperinflation. But, as the results for "median differences" in Table 2 indicate, hyperinflation is not the only reason.[20] Indeed, our matching results indicate that the median difference in inflation between non-dollarized and dollarized countries ranges from 1.92% to 4.45% per year. These median differences reported in Table 5 are significantly smaller than the 5.2% difference in medians obtained when the non-adjusted control group of non-dollarizers was used (Table 2).

Second, for every one of the matching indicators the GDP per capita growth differences – both for means and medians -- are negative. And they are significantly negative in seven out of the eight matching estimators reported in Table 5; the only exception is for the mean difference using one nearest neighbor. Overall we interpret these results as providing fairly strong evidence that, once appropriate control groups are defined, the dollarized economies have tended to experience lower GDP per capita growth than the non-dollarized ones. This conclusion is, in fact, supported by the local linear regression results reported below. In terms of magnitudes, the results from the matching analysis indicate that dollarized countries' underperformed no-dollarized countries by a wider margin than what simple comparisons suggest. The (statistically significant) mean differences in GDP per capita growth in Table 5 range from –1.56% per year to –1.12% per year; the unadjusted mean difference in Table 2 is only –0.69%. The median differences in GDP per capita growth in Table 5 range from –1.53% per year to –1.01% per year; the unadjusted mean difference in Table 2 is –1.41%.

And third, statistically speaking, the matching results reported in Table 5 indicate there are no differences (either in the means or medians) in volatility in dollarized and non-dollarized economies. This contrast with the results obtained from the raw

[20] By using medians we make sure that outliers do not drive our results.

comparisons, which suggested that volatility was significantly higher in the dollarized nations (see Panel C in Table 2).

III.3 Extensions: Local Linear Regressions

The results reported in Table 5 were obtained using an average nearest neighbor approach. An alternative method for computing matching estimators consists of using local linear regressions (LLR), a non-parametric technique similar to traditional kernel regression[21]. When using local linear regressions, the weights in equation (3) are given by:

$$(4) \qquad W_{ij} = \frac{K_{ij}\sum_{k\in C} K_{ik}(P_K - P_i)^2 - \left(K_{ij}(P_j - P_i)\right)\left(\sum_{k\in C} K_{ik}(P_K - P_i)\right)}{\sum_{j\in C} K_{ij}\sum_{k\in C} K_{ik}(P_K - P_i)^2 - \left(\sum_{k\in C} K_{ik}(P_K - P_i)\right)^2},$$

where $K_{ij} = K(\frac{P_i - P_j}{h_n})$ and $P_i = P(x_i)$. And, as before, *P(x)=Prob(D=1/ x)*, is the propensity score, defined as the probability of participation or treatment.

An alternative, but equivalent, way of implementing LLR is the following: For each treated observation we run a weighted least square regression of the outcomes on the differences of the propensity scores. The intercept from this weighted regression is a good estimate of $E(y_{0i} / x_i), D = 1)$ -- see Fan (1992, 1993). The weights can be chosen using any standard Kernel function and selecting an adequate bandwidth. LLR can be interpreted as solving the following problem:

$$\min_{a,b} \sum \left(y_{0j} - a - b(P(x_j) - P(x_i))\right)^2 K\left(\frac{P(x_j) - P(x_i)}{h_n}\right),$$

where *a* and *b* are parameters, *j* indexes untreated observations and *i* refers to treated observations. The results obtained when this LLR matching method was used confirmed

those presented in Table 5. What is particularly important in terms of this paper, is that these estimates indicate that GDP per capita growth has indeed been significantly lower in the dollarized countries than in the non-dollarized ones. The estimated means difference in GDP growth per capita using the LLR is –1.16, with a t-statistic of –5.34. The estimated difference in medians is –1.32 with a t-statistic of –8.31.

IV. Concluding Remarks

In the aftermath of the currency crises of the 1990s some economists have argued that the emerging economies should give up their domestic currencies, and adopt an advanced nation's currency as legal tender. Interestingly, there have been no systematic comparative studies on the performance of countries that, indeed, officially use another nations' currency. Most of the literature on the subject has been based on case studies of Panama. This lack of empirical analyses has resulted in policy debates that, until now, have been based on conjectures and not on hard historical evidence.

The purpose of this paper has been to analyze, from a comparative perspective, economic performance in "dollarized" economies. We have argued that the main difficulty in performing this type of comparison refers to defining the correct "control group" with which to compare the performance of the dollarized countries. In this paper we tackled this issue by using the "matching estimators" technique developed in the training evaluation literature. We found that the matching estimators technique yield somewhat different results than raw comparisons using a large control group of all non-dollarized countries. More specifically, we found that dollarized countries have had a significantly lower rate of inflation than non-dollarized ones. The mean difference ranged from 3.4% to 5.7% per year. We also found that dollarized countries have had a statistically lower rate of GDP per capita growth than non-dollarized ones. Both the mean and median growth differences are approximately 1% per year. Finally, we found that there has been no statistical difference in macroeconomic volatility between dollarized and non-dollarized economies.

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[21] This estimator improves on kernel regression in two ways: a) the bias of the LLR estimator does not depend on the design density of the data (i.e. on the density f(P(x)); and b) the order of convergence is the same at the boundry points as at the interior points. For details see Fan (1992, 1993).

The results reported here do not imply that dollarization is an inferior monetary arrangement for all countries. Indeed, our results only refer to an historical comparison of the performance of economies that have had an official dollarized regime. As data from more recent experiences with “dollarization” become available, it will be possible to gain further insights into the performance of countries that adopt this monetary regime. In particular, the recent cases of Ecuador, El Salvador and Guatemala will provide information on how mid-size economies fare under this regime.

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Table 1

Dollarized countries and territories:
Experiences and data availability

PANEL A: Independent Countries

Country	Population	Currency	Data Availability Growth	Data Availability Inflation
Andorra	73,000	France, Spain	1971-1998	-
Kiribati (1980)	82,000	Australia†	1971-1998	1983-1997
Liberia	2,900,000	USA	1971-1981	1971-1981
Liechtenstein	31,000	Switzerland	1971-1998	1971-1997
Marshall Inds. (1987)	61,000	USA	1971-1998	1982-1997
Micronesia	130,000	USA	1971-1998	1987-1998
Monaco	32,000	France	1971-1998	-
Nauru	10,000	Australia	1971-1998	1989-1998[a]
Palau (1995)	17,000	USA	1971-1998	-
Panama	2,700,000	USA	1971-1998	1971-1997
San Marino	26,000	Italy†	1971-1998	1985-1998
Tuvalu (1979)	11,000	Australia†	1971-1998	1983-1998
Vatican City	900	Italy	-	-

PANEL B: Non-Independent Territories

Country	Population	Currency Used	Data Availability Growth	Data Availability Inflation
American Samoa	65,000	USA	-	
Cocos Islands	600	Australia	-	
Cook Island	20,200	New Zealand	1971-1998	1983-1998
Greenland	60,000	Denmark	1987-1997	1971-1998
Guam	150,000	USA	-	
Niue	2,000	New Zealand	-	
Norfolk Islands	1,900	Australia	-	
N. Mariana Inds.	70,000	USA	-	
Pitcairn Island	50	New Zealand, USA	-	
Puerto Rico	3,880,000	USA	1971-1998	1974-1998
Saint Helena	7,000	UK	-	
Tokelau	1,500	New Zealand	-	
Turks & Caicos	17,000	USA	-	
UK Virgin Inds.	19,000	USA	-	
US Virgin Inds.	120,000	USA	-	

Sources: Bogetic (2000), CIA Fact Book, U.S. Congress Joint Economic Committee, October, 2001 and The Statesman's Yearbook. Other recently dollarized countries and territories include East Timor (US dollar), Ecuador (US dollar), El Salvador (US dollar) and Kosovo (German mark).

[a] Consumer Price Index for Nauru is not available for the years 1994-1996.

† Also own coins in circulation.

TABLE 2

Inflation, Growth and Volatility in Dollarized and Non-Dollarized Economies (Unadjusted Control Group)

	(A) Dollarized Countries[a]	(B) Non-dollarized Countries[b]	(C) Difference * (A) – (B)
		A. Inflation	
Mean	4.30	59.42	-55.11 (-11.34)
Median	3.80	9.00	5.20 (-13.31)
		B. Per capita GDP growth	
Mean	0.58	1.26	-0.69 (-1.96)
Median	0.44	1.85	-1.41 (-4.73)
		C. Volatility of Growth	
Mean	6.45	5.58	0.87 (0.99)
Median	5.72	4.85	0.87 (2.77)

[a]: Number of observations is 386.
[b]: Number of observations is 4,910.
*: Number in parentheses are t-statistics

TABLE 3

Probit Estimate of Propensity Score

	Coef.	Std. Err.	z	P>z
GDP_0	1.14	5.53	0.21	0.837
POP	-4.31	3.81	-11.30	0.000
BORDER	0.87	0.10	8.60	0.000
ISLAND	-1.10	0.09	-1.18	0.237
LATITUDE	-2.94	0.30	-9.86	0.000
OPEN	1.65	0.10	16.30	0.000
INDEP	-0.44	0.08	-5.38	0.000
Constant	-0.38	0.12	-3.20	0.001
Number of obs	5290			
LR chi2(7)	1,192.17			
Prob > chi2	0.000			
Log likelihood	-785.92			
Pseudo R2	0.43			

Note: Dependant variable is 1 if a country uses a foreign currency during that year. For a description of the independent variables see the text.

TABLE 4

DOLLARIZED AND NON-DOLLARIZED COUNTRIES: DESCRIPTIVE STATISTICS*

	Population (millions)		Initial GDP (US dollars)		Openness (0 to 1 index)		Latitude (0 to 1 index)		Indep.	Comm Border	Island	Number of countries	Number of Observations
Group	**Mean**	**Med**	**Mean**	**Med**	**Mean**	**Med**	**Mean**	**Med**	**%**	**%**	**%**		
a. Dollarized Countries													
All	0.457	0.030	7,594	2,928	0.53	1.00	0.25	0.10	67	33	60	15	386
b. Non-Dollarized Countries													
All	26.630	5.113	3,968	1,638	0.22	0.00	0.28	0.23	92	18	26	184	4,910
M1R	0.976	0.671	7,636	1,816	0.36	0.00	0.15	0.14	100	20	58	29	386
M1N	0.281	0.589	7,518	4,206	0.46	0.23	0.18	0.18	69	26	73	35	386
M5R	0.872	0.365	7,194	2,254	0.35	0.00	0.17	0.18	79	25	67	40	1,930
M5N	1.213	0.483	5,349	1,848	0.23	0.00	0.23	0.19	81	17	55	79	1,930

*: M1R refers to one nearest neighbor, with replacement. M1N refers to one nearest neighbor, without replacement. M5R refers to five nearest neighbors, with replacement. M5N refers to five nearest neighbors, without replacement.

TABLE 5

Matching Estimators:
Inflation, GDP per Capita Growth and Volatility*

	Number of Control Countries	Number of Control Observations	Mean Difference	Median Difference
		A. Inflation		
M1R	22	197	-3.53 (-5.68)	-3.15 (-4.00)
M1N	28	197	-3.39 (-5.01)	-1.92 (-2.82)
M5R	31	985	-3.89 (-9.03)	-4.45 (-9.89)
M5N	53	985	-5.68 (-5.98)	-4.42 (-8.41)
		B. GDP per capita growth		
M1R	29	386	-0.28 (-0.47)	-1.05 (-3.03)
M1N	35	386	-1.56 (-2.78)	-1.53 (-3.88)
M5R	40	1,930	-1.12 (-2.48)	-1.01 (-3.34)
M5N	79	1,930	-1.19 (-2.78)	-1.30 (-2.71)
		C.Volatility of Growth		
M1R	12	386	0.86 (0.63)	0.42 (0.24)
M1N	16	386	0.62 (0.40)	1.29 (0.51)
M5R	71	1930	0.72 (0.74)	1.59 (0.86)
M5N[a]	-	-	-	-

***:** M1R refers to one nearest neighbor, with replacement. M1N refers to one nearest neighbor, without replacement. M5R refers to five nearest neighbors, with replacement. M5N refers to five nearest neighbors, without replacement. Numbers in parentheses are t-statistics.

[a]: Not computed because the number of observations was too small.

Discussion

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Introduction.

The goal of this paper by Edwards and Magendzo (E-M hereafter) is to determine how dollarization of an economy affects its macroeconomic performance, particularly its inflation rate, its real growth rate, and the variability of its real growth rate. The motivation is understandable: if we can identify clear differences in macroeconomic performance due to the choice of exchange rate regime, we will be in a better position to make recommendations to countries that are contemplating changes in their current arrangement.

The E-M paper is valuable first of all because it contains a careful description of those economies that have actually dollarized.[1] A perusal of Table 1 shows that these economies for the most part represent a quite particular set of countries or territories. Many of them are extremely small, and they tend to be very open to international trade. As we shall see, this complicates both testing for differences in performance between dollarized and not dollarized economies and drawing conclusions about the effects of dollarization in countries with quite different characteristics.

In order for the particular characteristics of their sample not to bias the comparisons of macroeconomic performance, E-M make use of a matching estimator technique that is intended to ensure that dollarized countries are compared with 'similar' non dollarized countries. Ideally we would like to match each dollarized economy with another country that is identical in all respects except that it was not dollarized during the sample period. Any difference in macroeconomic performance between them would thus be due to the 'dollarization treatment'.[2] Of course, the matching will never be perfect, and I will argue that this is a reason why the conclusions of the empirical comparisons must be interpreted with extreme care.

On the basis of their comparisons of dollarized and 'similar' non-dollarized countries E-M conclude that the former have had significantly lower inflation and lower real economic growth, but that there is no significant difference in the variability of the real growth rate.

In the following I first discuss what economic theory has to say about the relationship between exchange rate regime and macroeconomic performance. Thereafter I take up some issues related to the empirical methodology adopted by E-M, before I conclude with some more general remarks.

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[1] The term dollarized is used in a generic sense to mean having adopted another country's money as your own legal tender. It does not necessarily mean that this currency is the United States dollar. Indeed countries in the sample have adopted the Swiss Franc, the French Franc, the Italian Lira, and the Australian dollar in addition to the US dollar.

[2] The term 'treatment' reflects the frequent use of this empirical methodology in the evaluation of medical treatments.

To anticipate the main thrust of my argument, I believe it is unlikely that we will ever be able to say categorically that dollarization will in general lower (or raise) inflation or lower (raise) economic growth. As the literature on the choice of exchange rate regime has told us, the macroeconomic consequences of a particular exchange rate system depends on the structure of the economy and on the shocks it is subject to. Unless we can control for these factors in our empirical tests, calculated differences between dollarized and not dollarized countries will not necessarily be due to the choice of exchange rate regime as such but could be due to differences in economic structure or the economic environment. As the literature on optimum currency areas have shown, the factors we need to control for are numerous and often hard to measure, so it is likely that some important ones will be left out. Although the matching estimator technique used by E-M does attempt to identify an appropriate control group, it falls short, in my opinion, of controlling for relevant factors determining macroeconomic outcomes. This is partly due to the extremely limited sample of dollarized countries that the authors can base their analysis on, but I believe it is also inherent in the type of comparisons that E-M carry out.

What does theory tell us about the macroeconomic consequences of different exchange rate regimes?

Inflation

It is not unreasonable to presume that different exchange rate regimes, and therefore different monetary standards, can have an impact on the inflation performance of a country. For example, it is well known that when the central bank is subject to political pressures to reduce unemployment below what is feasible in the long run, an inflation bias may characterize the equilibrium under a flexible exchange rate system. If it is possible to fix the exchange rate credibly to a low-inflation country, the inflation bias can be eliminated. Adopting the currency of a low-inflation country is of course an extreme version of such a change in monetary standard.

On the other hand it is quite possible for a country to have its own money, a floating exchange rate and an independent central bank that is successfully following a strict inflation targeting strategy. Switzerland is a good example. For such a country it is not clear that giving up its currency for the dollar or the Euro will lead to a better inflation performance.

Evaluating the consequences of dollarization hence requires identifying the counterfactual monetary regime. In a cross-section study this amounts to finding a control group that has the monetary regime the dollarized country would have had if it had possessed its own currency. In terms of the matching estimator methodology, this argument seems to suggest that countries should be matched on criteria such as the determinants of the size of the inflation bias or the degree of independence of the central bank. This strikes me as a very difficult task in the best of situations, and next to impossible given the sample of dollarized countries that we have to work with.

Real growth

If money is neutral, we should not expect any relationship between monetary policy and long-term economic growth. To be sure, neutrality arguments typically refer to comparisons of the effects of differences in inflation rates on real variables, and not the consequences of giving up the one's money altogether. Dollarization therefore introduces potential effects that have not

been treated in the monetary neutrality literature. Nevertheless one might expect that any such effect will be quantitatively small.

The so-called Tobin-Mundell effect suggests that a country with a higher inflation rate should have a lower real interest rate and therefore higher investment and growth. Whatever the theoretical merits of this argument, empirical evidence suggests that when inflation increases into double digits, growth is negatively affected. The usual reasons given for such results is that high inflation is typically also quite variable and unpredictable, both of which are harmful for economic growth. So I do not think that this is where one should look for effects of dollarization.

Proponents of monetary union often refer to various types of efficiency gains from the use of a common currency, reduction in transaction costs and greater transparency of prices being the most prominent. In turn these efficiency gains are expected to increase competition in the economy. Increased competition furthermore can be expected to have an effect on the level of output and, if it is imbedded in an endogenous growth model, on the growth rate itself. Although most observers would agree with the principle of these arguments, it is often argued that they are quantitatively relatively modest.

A second argument linking dollarization with growth is that the removal of currency risk lowers interest rates which stimulates investment and growth. This link has been questioned on the grounds that the removal of currency risk may not lead to a corresponding reduction in total risk but simply its transformation into credit risk. Hence the growth effect from this channel will be correspondingly attenuated.

Finally, it has been suggested that use of a common currency will lead to a deeper integration of financial markets, which in turn opens up diversification opportunities for investors. For firms this translates into a lower cost of capital and hence greater investment. The quantitative importance of this channel remains uncertain, however.

It is hard to find arguments, which imply that adopting a common currency should have a negative impact on the level or growth rate of GNP. E-M refer approvingly to a paper by Stanley Fischer who argues that a country with a fixed exchange rate, and a fortiori one that has dollarized, will find it difficult to adjust to asymmetric shocks, and will therefore suffer greater variability of employment and output than countries with a flexible exchange rate. Greater variability of output is then assumed to reduce economic growth. Leaving aside the possibility that financial markets themselves may be the origin of shocks, which would not materialize in a common currency environment (see below), this argument does not provide a rationalization of the empirical results in the paper. The reason is that these results show no difference in the degree of volatility of real output between dollarized and non-dollarized countries. Hence we seem to have a result (dollarized countries have lower growth) that cannot easily be rationalized on theoretical grounds.

Output variability

Whether and how the choice of exchange rate system influences output stability has been debated ever since the fixed versus flexible exchange rate question was first raised. While it is uncontroversial that exchange rate adjustments can be helpful when an economy is subjected to asymmetric demand shocks, it should be remembered that fixing the exchange rate may be

optimal when shocks originate in other markets. This is simply an application to an open economy context of Poole's arguments regarding fixing the interest rate versus fixing the money supply. It is crucial to take into account the source of disturbances in order to draw conclusions.

One may argue that a floating exchange rate permits an active monetary policy on the part of the central bank, which can therefore stabilize domestic output for any type of disturbance. In this case it would serve no purpose to tie the hands of the central bank with a fixed exchange rate or an official dollarization. To the extent, however, that the effects of monetary policy are materialized with long and variable lags, it is not a foregone conclusion that an active monetary policy is in actual fact always stabilizing. Furthermore, if not having an independent money actually eliminates certain types of shocks, it may well be that giving up monetary sovereignty could bring less output variability.

The upshot of these arguments is that the 'normal' volatility of output in an economy depends on the size and source of shocks to the economy, on the competence of the central bank, and on the structure of the economy. Identifying the marginal effect of dollarization on stability would require controlling for these factors, a difficult task indeed.

Empirical Methodology

E-M show convincingly that if we judge the performance of dollarized countries against that of <u>all</u> non-dollarized countries, we are comparing groups of countries which are very different on many criteria (see their Table 4). They go on to suggest that under these circumstances it may be inappropriate to use a conventional linear regression methodology to test for differences between them. Hence they argue for the non-parametric matching estimator approach as a better alternative.

Basically the approach consists of choosing a control group that is 'similar' to the treated (dollarized) group of countries, and to compare the economic performance only against this restricted sample. 'Similarity' is determined by an auxiliary regression that is intended to identify those variables that predict whether a country has chosen to dollarize or not.

I will argue that while the matching estimator methodology does solve certain problems associated with heterogeneous samples, it may not adequate control for all factors that determine inflation, growth, and variability of the economies in the sample. Hence I would like to see more robustness tests as well as more information about the control group in order to evaluate the empirical results.

Linear regression vs. matching estimator methodology

To appreciate the potential usefulness of the matching estimator methodology, consider the following simple example. The variable of interest y (e.g. growth) is linearly related to a set of variables x as well as to a dollarization indicator D and an error term u. We have data on y, x and D for a cross-section of countries.

$$y = \alpha x + \gamma D + u \qquad (1)$$

Provided the usual assumptions regarding the error term are fulfilled, a cross-section regression will provide an unbiased estimate of γ, the effect of dollarization on y.

Consider now the matching estimator approach. It consists of including in the sample of non-dollarized countries only those that are similar to the dollarized counties. I will take this to mean that we will choose as a control group only those countries that have identical values of x as the dollarized countries.[3] If a subscript 1 refers to the dollarized countries and a 2 to the control group, I can write

$$y_1 = \alpha x_1 + \gamma + u_1$$
$$y_2 = \alpha x_2 + u_2$$

To find an estimate of γ we now take the difference between the mean of y_1 and the mean of y_2.

$$\text{Mean}(y_1 - y_2) = \text{Mean}[\alpha(x_1 - x_2) + (u_1 - u_2) + \gamma] = \gamma$$

This procedure provides an unbiased estimate since we have chosen x_2 such that $(x_1 - x_2) = 0$, and since we are averaging over several observations such that $\text{Mean}(u_1 - u_2) = 0$

Suppose now that the relationship between y and x contains a non-linear term $\alpha_2 f(x)$ in addition to the linear term in equation (1).

$$y = \alpha_1 x + \alpha_2 f(x) + \gamma D + u \qquad (2)$$

A linear regression approach would be subject to an omitted-variable problem, and if this omitted variable [f(x)] is correlated with D, the estimate of γ will be biased.

The matching estimator approach would however still be appropriate. Using the notation introduced above we now have

$$y_1 = \alpha_1 x_1 + \alpha_2 f(x_1) + \gamma + u_1$$
$$y_2 = \alpha_1 x_2 + \alpha_2 f(x_2) + u_2$$

and the matching estimator of γ will be obtained from

$$\text{Mean}(y_2 - y_2) = \text{Mean}\{\alpha_1(x_1 - x_2) + \alpha_2[f(x_1) - f(x_2)] + \gamma\} = \gamma$$

since we still have $(x_1 - x_2) = [f(x_1) - f(x_2)] = 0$ and $\text{Mean}(u_1 - u_2) = 0$.

Hence we matching estimator succeeds where the OLS estimator fails.

But there is never any free lunch! Suppose y is influenced by a variable z that has not been used as a matching criterion in the choice of the control group. Excluding the non-linear terms for simplicity, we now have

[3] Clearly it is in general impossible to find countries that have strictly identical values of the x variables, particularly if x is high-dimensional and if the total number of countries we can chose from is limited. E-M explain clearly the algorithm they use to chose the control group.

$$y = \alpha x + \beta z + \gamma D + u \qquad (3)$$

The linear regression framework would correctly estimate γ provided we control for all the other relevant determinants of y.
In the matching estimator setup we would have

$$y_1 = \alpha x_1 + \beta z_1 + \gamma + u_1$$
$$y_2 = \alpha x_2 + \beta z_2 + u_2$$

and the estimator of γ would be calculated from

$$\text{Mean}(y_2 - y_2) = \text{Mean}[\alpha(x_1 - x_2) + \beta(z_1 - z_2) + \gamma] = \text{Mean}[\beta(z_1 - z_2)] + \gamma$$

If the mean of $z_1 - z_2$ is not equal to zero the matching estimator of the effect of dollarization will be biased. This is likely to occur if the z is a predictor of dollarization but has been left out of the auxiliary regression.

The conclusion from this discussion is that the matching estimator methodology has an advantage over simple OLS if non-linearities are important in the explanations of macroeconomic performance. Such non-linearities create an omitted variable problem in the regression framework. But the matching estimator methodology does to eliminate the omitted variable problem altogether, however, it simply moves it from the equation predicting y to the equation predicting D. In general it is therefore not possible to determine whether this is an improvement.

Additional empirical issues

a. Small sample problems.
When the control group has to be chosen according to many criteria, I suspect that we need a very large sample indeed in order to satisfactorily eliminate differences between the dollarized countries and the control group. In view of the limited number of countries we have at our disposal, I suspect that the matching is not perfect. It would therefore be useful to carry out robustness tests by, for example, experimenting with additional variables in the auxiliary regressions or estimating the γ parameter using regression techniques.

b. Simultaneity.
Dollarizing a country is a different 'treatment' than giving a patient a drug as opposed to a placebo. A dollarized country has chosen this course of action, which raises the possibility that there is a systematic relationship running from macroeconomic performance to the choice of exchange rate regime rather than the other way around. In principle this simultaneity problem can be handled in the regression framework provided we can identify the two relationships. I suspect it is less evident how to deal with the causality issue within the matching estimator approach.

c. The nature of the control group.
Given that the countries in the control group are supposed to be 'similar' to the dollarized countries, one might suspect that they have also chosen a 'similar' exchange rate regime. If so it is possible that the comparison is made between dollarized countries and countries on a

fixed exchange rate, for example. If that is actually the outcome of the selection of the 'nearest neighbor(s)', then the interpretation of the results will of course have to be quite different from a case where the nearest neighbor has a floating exchange rate. For this reason it would be useful if the paper contained some information on the actual members of the control group.

d. Controlling for determinants of growth and variability.
In the paper, countries are matched according to criteria that predict dollarization. These are not necessarily the same as those that we would put into cross-country growth regressions or cross-country regressions predicting macroeconomic volatility. It would be interesting to test whether controlling for factors like educational attainment or financial market development could explain some of the differences between dollarized countries and the control group, and if it did whether the estimate of the effect of dollarization is affected.

Conclusions

The paper by Edwards and Magendzo is valuable because it brings together a lot of information about dollarized countries and because it introduces a relatively new (for macroeconomists) statistical technique to deal with heterogeneous cross-sections of countries. Due to the particularity of the sample that they have to work with, however, I do not believe that we can draw many conclusions about the effects of dollarization. Let me explain with some specific examples.

Taken literally, the results of E-M would imply that if the dollarized countries had chosen to create their own currency and therefore their own monetary institutions and their own monetary policy, they would have had a higher inflation rate and a higher real growth rate. Applied to many countries in the sample this thought experiment does not make much sense. Take Tuvalu, population 11'000. I for one have a hard time imagining how that economy would operate with its own money and its own central bank. More generally some three quarters of the observations on dollarization that we have to work with come from countries that have a population of less that fifty thousand. I doubt that these countries are viable currency areas, and therefore whether it is sensible to ask what the absence of dollarization would have done to their macroeconomic performance

Another example is Switzerland. Although it may not even be part of the control group in the E-M paper, it would be nice if a study of this type would have something to say about the likely consequences about Switzerland unilaterally adopting the Euro. Again taken literally, the estimates would imply that the inflation rate in Switzerland would fall from the current 2 percent level into negative territory, i.e. below the average in Euroland, if it adopted the Euro. In view of the historical trend-like real appreciation of the Swiss Franc, most observers in that country have argued that adoption of the Euro would actually increase inflation in Switzerland. There is clearly something missing in the E-M methodology.

Theory suggests that the macroeconomic consequences of choice of exchange rate regime depend on a wide variety of structural and institutional factors as well as on the economic environment (shocks) that the economy evolves in. In view of the small and very peculiar sample of dollarized countries, I therefore see very little hope that we will be able to settle the question asked in this paper by cross country comparisons. Case studies of 'real countries' strike me as a

more promising avenue. Unfortunately, currently this reduces the sample drastically, basically to Panama and perhaps Puerto Rico. All economists interested in this subject are eagerly waiting for news from El Salvador and Equador to produce some more evidence on the effects of dollarization.

Luis Adalberto Aquino Cardona

Central Reserve Bank of El Salvador

Good Morning, Ladies and Gentlemen.

First of all, I want to thank to the organizers of this event for the invitation to the conference on "Monetary Union Theory: EMU experience and Prospects for Latin America", and also for the excellent organization of the event.

In this occasion, I will comment the paper on "Dollarization and Economic Performance: What Do We really Know?, prepared by Sebastian Edwards and I. Igal Magendzo.

The recent financial crises in Asia, Russia, and its effects on other countries, as the case of Argentina in South America, reopened the discussion on the perspective of the exchange rate regimes in the region.

The subject of "dollarization" has generated a strong theoretical debate in the last years in Latin America between economist who support this adjustment in the exchange rate regime and those who are in favor of flexible exchange regimes.

My commentaries focus on three aspects of the paper of the authors, related to:

- Historical evidence
- The economic consequences of dollarization
- The results of the Monetary Integration in El Salvador at the year of its application.

Among the benefits that are attributed to the dollarization, we can emphasize:

i) Institutional stability;
ii) It contributes to the fiscal discipline;
iii) It strengthen the credibility of the macroeconomic policy;
iv) Sustainable external accounts;
v) Low inflation rate;
vi) Exchange rate stability;
vii) Lower interest rates;
viii) Higher investment;

ix) Higher economic growth and lower product volatileness;

x) It promotes the external trade.

However, some authors stand by that there are no robust evidence on the relation between exchange rate regimes and economic growth. In this topic, they argue that a dollarized economy has difficulty to accommodate external shocks (trade-off, interest rates) and, on the contrary, it could generate greater volatileness and lower economic growth. They also indicate that there is no a unique prescription on exchange rate policy. The theoretical arguments indicated by both groups run into the limitation of not having sufficient empirical evidence as the study demonstrates.

Historical Evidence

As it is indicated by Edwards and Magendzo, there is no much empirical evidence on the economic performance on dollarized economies, and it limits the accomplishment of a deep analysis on the subject and therefore, it reduces the reach of the conclusions of the study. The historical review of "independent nations, small economies, territories, colonies or regions" that work with a dollarized system make difficult the empirical and comparative analysis between groups of countries.

The indicated points are important for those countries of the region that have considered the dollarization as a possible option of economic policy since many questions have raised and they do not have conclusive answers.

The oldest experience that is known is the one of Panama, which adopted the US dollar from principles of the last century. But the characteristics of that economy are very different of the ones from the rest of Latin American countries. On the other hand, Ecuador dollarized its economy in the middle of a deep economic crisis.

In the other extreme, it is the case of El Salvador, a country that shows macroeconomic stability, which is product of one decade of deep economic reforms. In that stable economic context, it was approved the “Law of Monetary Integration” at the end of the year 2000 which came into effect in January 1st of 2001. Through this Law, it was adopted the dollar as legal tender currency and the unit of account for the financial system.

Considering the available information and the strong limitations of data, I consider that the authors have made a great effort in their investigation in order to provide a first study of empirical evidence. Nevertheless, the results of their investigation should not be generalized to countries like El Salvador, which shows very different characteristics from those of the sample of countries included in the study.

Economic consequences of the Dollarization

The study focuses on analyzing the economic performance of the dollarized countries, through three key variable:

- Low inflation,
- Growth of the GDP per capita
- Volatileness of the GDP

The methodology of the study is interesting because it applies techniques to define a suitable control group between dollarized and non-dollarized countries; it eliminates the bias in the estimation.

Unadjusted control	May not be group appropiate one
Regression analysis	Biased estimator of the “true” effect of dollarization
Matching estimators “adjusted control group”	Technique have a greater degree of similirity with the dollarized nations
Probit Model	Non-independent economies and more open economies are more likely to be dollarized

The "dollarization effect " is defined by the authors as "what percentage of countries under a certain exchange rate regime have a better performance than countries with alternative regimes”.

On the matter, the equation that defines the performance of the GDP is defined as a linear function, of the following form:

(1) $y_{j\,t} = \beta\, x_{j\,t} + \gamma D_{j\,t} + \varepsilon_{j\,t}$

(2) $\psi = E(y_1 - y_0/x, D=1)$

The question is what would happen if the previous function is not of the linear form and therefore, the explanatory variable of the effect dollarization "D" disappears of the equation.

Through a Probit Model they found that Non-independent economies and more open economies that have a common border with a country with a convertible currency have a higher probability of being dollarized.

Through the use of **Matching Estimators Technique**, the authors found the following results:

Variable	Supports	Edwards, Igal
Inflation rate	Lower in dollarized countries	Lower in dollarized countries
GDP percapita growth	Faster growth	Lower in dollarized countries
Growth volatility	Lower in dollarized countries	There are no differences statistic in volatility

Monetary Integration In El Salvador: one year later

El Salvador is a country that during the decade of the 90´s it implemented a deep economic reform and laid the basis for the macroeconomic stability, which we enjoy today. We publish our information – economic statistics and financial statistics in the Web site of the Central bank and, since 1997 we subscribed to the Special Standards of Data Dissemination (SSDD) of the International Monetary Fund (IMF). El Salvador is a medium size economy with very different characteristics from those of the sample countries included in the study.

Before the Law of Monetary Integration, El Salvador was characterized by being a country with macroeconomic stability:

- Low Deficit of Current Account

- Low and stable inflation
- Stability in the exchange rate
- Sustainable Growth of exports
- High accumulation of NIR
- Real exchange rate on equilibrium
- Strong Financial System
- Low External Debt

Commercially, our country is integrated with the United States and it is located in the area of influence of the dollar:

- Trade with USA: X- 63.1%, M- 51.7%
- Central America and Panama: X% 26.5 M%18
- Total : 90% y 70%
- Family Remittances: US$1,751 millions in 2000
- Migration: More than 1.5 millions of salvadoreans living abroad

At one year of the application of the Law of Monetary Integration, we have observed positive results that could contribute to enrich the discussion about this type of monetary regime:

Drop of Interest rates:

- 500 base points against month before LIM was announced
- 460 base points respect to december 2000, and
- more of 700 bp respect to march 2000
- 770 base points against rates´ peak
- No effect discernible over inflation
- 100% of Deposits in US$
- 100% de ATMs, Credit Cards in US$
- Around of 66.6% of circulating currency is US$

NIVEL DE TASAS

	DP30	DP60	DP90	DP120	DP150	DP180	DP360	PREST1 año	PREST>1 año
Dic-00	7.26	7.13	6.92	6.72	6.80	7.10	7.03	12.21	13.65
Mar-01	6.36	6.25	6.15	6.09	6.21	6.43	6.67	10.60	11.63
Jun-01	5.72	5.59	5.44	5.31	5.57	5.73	6.07	9.63	11.39
Sep-01	5.14	5.07	4.80	4.92	4.79	5.21	5.48	8.82	9.97
Dic-01	3.65	3.57	3.61	3.60	3.41	3.89	4.18	7.83	9.10
Mar-02	3.09	3.01	3.05	3.15	2.99	3.41	3.56	7.29	9.01

REDUCCIONES ANUALES

	DP30	DP60	DP90	DP120	DP150	DP180	DP360	PREST1 año	PREST>1 año
Dic-00	-3.44	-3.54	-3.46	-2.81	-2.33	-3.55	-2.47	-2.88	-2.27
Mar-01	-3.91	-4.04	-4.12	-4.20	-3.69	-2.80	-2.27	-4.52	-5.00
Jun-01	-3.81	-3.78	-3.87	-3.41	-3.44	-4.14	-4.13	-4.45	-4.03
Sep-01	-3.68	-3.66	-3.88	-3.49	-3.33	-3.78	-4.19	-5.30	-5.59
Dic-01	-3.61	-3.56	-3.31	-3.12	-3.39	-3.21	-2.85	-4.38	-4.55
Mar-02	-3.27	-3.24	-3.10	-2.94	-3.22	-3.02	-3.11	-3.31	-2.62
Resp mzo 00	-7.18	-7.28	-7.22	-7.14	-6.91	-5.82	-5.38	-7.83	-7.62

REDUCCIONES ACUMULADAS RESPECTO A MARZO 2000

	DP30	DP60	DP90	DP120	DP150	DP180	DP360	PREST1 año	PREST>1 año
Mar-01	-3.91	-4.04	-4.12	-4.20	-3.69	-2.80	-2.27	-4.52	-5.00
Jun-01	-4.55	-4.70	-4.83	-4.98	-4.33	-3.50	-2.87	-5.49	-5.24
Sep-01	-5.13	-5.22	-5.47	-5.37	-5.11	-4.02	-3.46	-6.30	-6.66
Dic-01	-6.62	-6.72	-6.66	-6.69	-6.49	-5.34	-4.76	-7.29	-7.53
Mar-02	-7.18	-7.28	-7.22	-7.14	-6.91	-5.82	-5.38	-7.83	-7.62

We maintain the degree of investment in Sovereign Risk and recently we placed US$500 million Eurobonos at 30 years term and at a rate of yield of 8.25% annual. The spread was of 265 base points, similar to the one of Mexico.

The inflation rate continues being very low (1.4% annual) and the financial conditions of the country have improved significantly. The exchange rate risk was eliminated, the cost of making businesses in the country diminished and it is observed a relatively important flow of direct foreign investment to the country.

El Salvador received private transferences during 2001 on familiar remittances by US$1,910.5 million, growing 9.1% and they are equivalent to 14% of the GDP.

With the effect of the Free Trade Agreement with Mexico, the country has gotten an elevated growth in the exports, 87.8% annual in 2001. Recently, it came into effect the Trade Agreement with Dominican Republic, and Chile. It is also in progress the agreement with Panama, Canada and the United States. With the European Union it was managed to obtain a possible agreement on economic association in a medium term, that includes a Free Trade

Agreement with Central America. These new opportunities will stimulate the commercial flow of the country.

It is convenient to indicate that the effects of the Law on real variables as production and employment require of a greater time to be observed.

It is necessary to remember that at the beginning of the 2001, El Salvador was struck by two strong earthquakes. The damages considered by ECLAC oscillated near 16% of the GDP.

At this time, the Government executes an investment plan in reconstruction and it has required additional financing to cover this investment. Due to this, temporarily, the fiscal deficit reached 3.7% of the 2001´s GDP (of which, 1.4% of the GDP correspond to reconstruction) and it tends to diminish, being considered that in the year 2002 it will reach the 3.3% of the GDP (of which 1.8% of the GDP corresponds to reconstruction).

The international settings were characterized by a fall of prices of raw materials (coffee) and a raise in prices of petroleum; the economic recession and the events of September 11th in the United States affected the economic performance of the world.

The rate of growth of the GDP was 1.8% in 2001, higher to the average of Latin America countries and it is estimated that the GDP will grow 3% during 2002.

The results of El Salvador during the first year point that:

1) The inflation rate is one of lowest of Latin America;
2) The interest rates diminished significantly, when it was eliminated the exchange rate and because of the performance of the international interest rates;
3) The GDP grew above the average of Latin America in spite of the difficult international surroundings and the impact of two strong earthquakes at the beginning of the 2001. On this matter, it was made a comparative analysis about the economic performance of El Salvador with a sample of 16 countries that have undergone natural disasters during the last the 20 years. The economic indicators corresponded to one year before, during the events and one year after the events (natural disasters: earthquakes or hurricanes). It was found that the macroeconomic position of El Salvador was much more solid than the countries of the sample and that that condition of strength, allowed El Salvador to face on a better way the impact of earthquakes. Even one year after the events, El Salvador registers better economic indicators than the rest of countries.

Finally

The introduction of US$ as a legal tender currency is a logical step for the country

- It is a measurement taken in an integral reform frame and inside of a clear vision of integrating the country with the world
- It is a premeditated, planned and executed fact from a strong macroeconomic position
- It lets to consolidate the benefits of a decided compromise with the macroeconomic and financial stability and to transform it in something tangible for the population
- In the context of the recent earthquake, exchange stability and lower interest rates are a strong support for the reconstruction.

Thank you very much.

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1) vergriffen (out of print)
2) In abgeänderter Form erschienen in Berichte und Studien Nr. 4/1990, S 74 ff
3) In abgeänderter Form erschienen in Berichte und Studien Nr. 4/1991, S 44 ff
4) In abgeänderter Form erschienen in Berichte und Studien Nr. 3/1991, S 39 ff
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