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Inflation Targeting in Latin America: Toward a Monetary Union?

“Convergence on regional monies is a no-brainer.” (Dornbusch 2001)

On 8 April 2010, one of the co-chairs of the World Economic Forum held in Cartagena, Colombia, proposed a monetary union for Latin America. The proposal was enthusiastically received by the audience and made it to the front page of *El Tiempo*, Colombia’s main newspaper. In an earlier episode in the 1990s, academics and policymakers gave serious consideration to the idea of dollarizing Latin American economies. The idea was extensively discussed at the International Monetary Fund (IMF), the Inter-American Development Bank (IDB), and even at the Federal Reserve and in the U.S. Congress (IMF 1999). In fact, Ecuador and El Salvador did give up their monetary autonomy in favor of the dollar.

Although proposals to form monetary unions emerge often in the Latin American context, little is known (quantitatively) about the costs and benefits of such a drastic change in the monetary regime. This paper fills part of that gap by analyzing some of the costs and benefits of a potential monetary union in the region and by comparing these with the costs and benefits of dollarization. I focus specifically on the inflation targeters in Latin America.

Since the early 1990s, a growing number of industrialized and developing economies have adopted inflation-targeting (IT) regimes operated by

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independent and more transparent central banks. Rose (2006) has labeled this a New International Monetary System—in his words, “Inflation Targeting is Bretton Woods, reversed.” In Latin America (LA), five of the main economies have adopted IT; these are Brazil, Chile, Colombia, Mexico, and Peru. These five countries collectively have a population of more than 380 million people, and make up 70 percent of the GDP of Latin America and the Caribbean (LAC). Close to three-quarters of the total trade of LAC takes place among these five countries. Since 2000 each has kept inflation in single digits, a notable achievement given LA’s inflation history over the last forty years.

Asking whether these countries would be better off adopting a common currency—that is, forming a Latin American Monetary Union (LAMU)—is natural in the context of the converging monetary strategies of these five nations. My response to this first question is yes. I also analyze economic pros and cons of the unilateral adoption of the U.S. dollar by each inflation targeter in LA.¹ I find that, with the exception of Brazil, these countries would be better off dollarizing than retaining monetary autonomy. My measurement of the costs and benefits of LAMU and dollarization takes into account increased volatility from giving up the use of monetary policy with countercyclical purposes and its resultant welfare losses; lost seigniorage revenue; gains in credibility; and gains in trade that, in turn, result in output gains.

Having found that both monetary union and dollarization make economic sense, I then ask which of the two strategies is preferable. The results are mixed. I conclude that LAMU should be preferred to dollarization in the cases of Chile, Peru, and Brazil. The opposite, however, is true for Mexico. For Colombia, the net benefits are similar for both common currency arrangements. Moreover, in general dollarization has an edge in countries that have either strong trade links with the United States or business cycles that strongly correlate with those of the United States.

In this paper I pursue a twofold strategy. On the one hand, I build a simple policy model that captures several costs and benefits for a group of IT countries considering forming a monetary union. Then, using the results from the model and from the large literature on monetary unions, I report estimates on the costs and benefits associated with LAMU and unilateral dollarization. The paper also makes a methodological contribution by proposing a way to

1. Panizza, Stein, and Talvi (2002) ask a similar question. However, their focus is on Central American countries.

compare some of the consequences of common currencies measurable in terms of GDP (for example, consequences via increased trade or the forgone seigniorage collection) with other traditionally more intangible consequences, such as the potential increase in volatility. I use self-reported satisfaction surveys to build country-specific indifference curves between volatility and growth; these help assess the relative importance of the increase in volatility brought about by the adoption of a common currency.

Though this paper only addresses the costs and benefits of monetary union and dollarization from an economic standpoint, the difficulties involved in building political support for a reform that gives up monetary autonomy are also worth mentioning. I believe that the political barriers confronting a multi-lateral Latin American monetary union would be much weaker than those faced by dollarization. “Argentina will adopt the dollar when the United States puts Eva Peron on the dollar bill” was a popular retort during the discussion about dollarization in Argentina in the late 1990s. The edge LAMU has vis-à-vis dollarization in this regard should be kept in mind, despite being beyond the scope of this paper.

The rest of the paper is organized as follows: The next section briefly describes the inflation targeting in Latin America and the dynamics of inflation in the countries with IT regimes. Next, the paper examines the theoretical model. The following section considers the empirical aspects, providing several quantifications, one at a time, for each of the costs and benefits of LAMU and dollarization, respectively. The subsequent section pools the empirical results together, while the final section concludes and offers further discussion.

Inflation Targeting in Latin America

From a theoretical standpoint, proponents of IT claim several benefits associated with this monetary policy framework (for example, Svensson 2010). These benefits include lowering inflation and inflation variability, solving the classic time inconsistency problem faced by central banks, and anchoring lower inflationary expectations, among others. At the empirical level, economists have also studied the impact of IT on macroeconomic aggregates, reaching disparate conclusions. Using a sample of industrialized nations, both Ball and Sheridan (2005) and Lin and Ye (2007) show that the recent disinflation and reduction in inflation volatility are not attributable to the adoption of IT. While Gonçalves and Salles (2008) and Lin and Ye (2009) find that IT did play a relevant role in driving down inflation and growth

volatility in emerging economies, these conclusions for emerging markets have been questioned by Ball (2010) and Brito and Bystedt (2010), who claim that the role of IT has been negligible.

Recently, five of the main economies in LA adopted inflation-targeting regimes. Figure 1 depicts the recent inflation history of these countries, along with respective inflation targets and long-run inflation goals.

Colombia, Chile, and Mexico all have long-run inflation targets set at 3 percent, while Peru's is set at 2 percent (starting in 2007). For all of these cases, the target is set with a ± 1 percent margin. Brazil has not officially announced its long-run goal, and its short-term targets are announced with a wider band than in the rest of the countries. This has allowed Brazil to exhibit inflation rates that fall within the target band, even in 2007 and 2008 when inflationary pressures caused inflation to deviate from targets in the remaining IT countries.

The Model

In evaluating the costs and benefits of joining a monetary union, I follow a modeling approach similar to the one proposed in Alesina and Grilli (1992). Unlike them, I explicitly incorporate the IT strategies that characterize the monetary policy framework of the countries under study. In my model, both the members of the potential union (under autonomy) and the union's central bank (under dollarization or LAMU) target inflation.

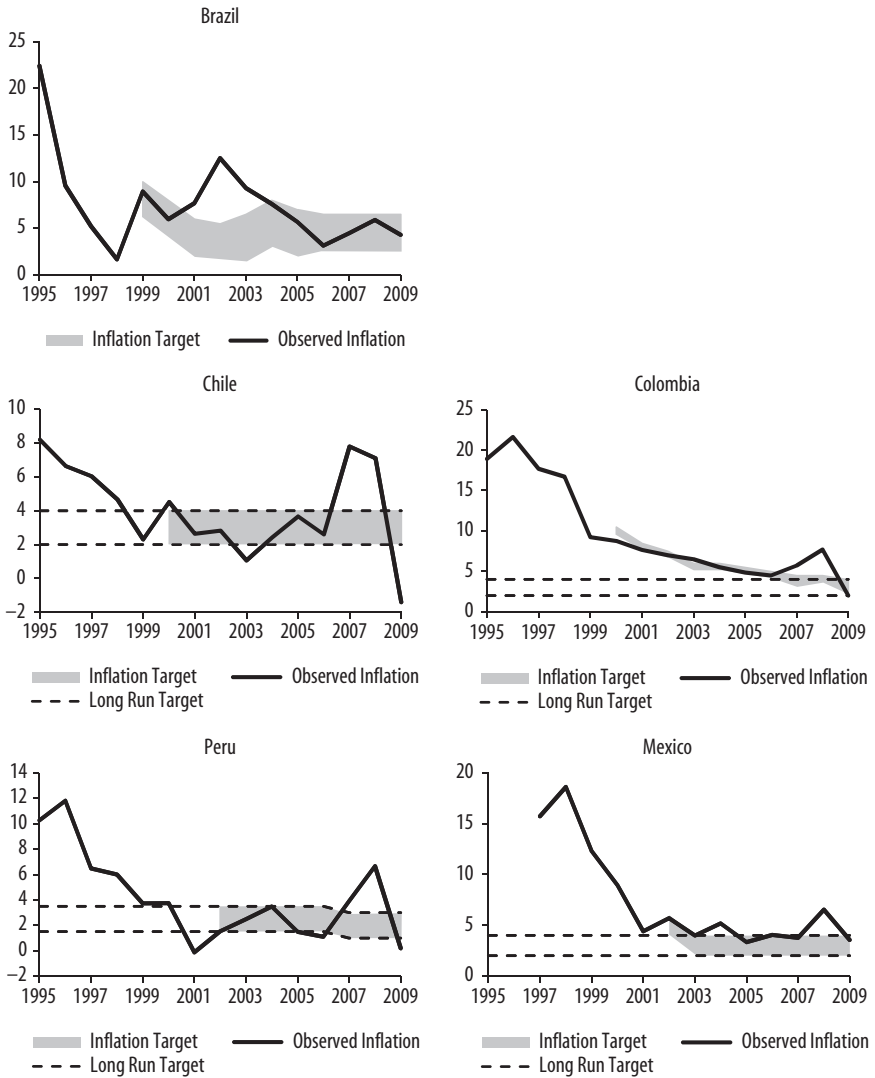
I first describe the problem of the union's central bank and analyze the welfare implications for individual countries joining the union. I then ask what happens if countries retain monetary autonomy. Finally, I analyze the convenience of giving up monetary autonomy by comparing welfare under these two scenarios.

UNION'S PROBLEM. Suppose there is a single Latin American central bank setting policy so as to minimize a loss function à la Barro-Gordon (1983)—that is, a function trading off unemployment and inflation in the union. In addition to the traditional Barro-Gordon elements, the Latin American central bank uses an inflation-targeting strategy. Thus the union's central bank minimizes

$$(1) \quad L_u = \frac{\lambda}{2} (U_u - \bar{U}_u)^2 + \frac{1}{2} (\pi_u - \pi^*)^2 + \frac{h}{2} (\pi_u - \pi_u^T)^2,$$

where λ represents the relative weight put on unemployment fluctuations; U_u represents the unemployment rate of the union; π_u is the union's inflation rate; π^* is the optimal inflation rate (which can be thought of as the *long-run* target);

FIGURE 1. Inflation and Inflation Targets in Latin American IT Countries, 1995–2009^a



Sources: Central banks of countries shown.

a. Brazil has not announced an official long-run target. Mexico's inflation rates in 1995 and 1996 were above 52 and 28 percent, respectively (not shown in the plot).

π_u^T is the bank's (short-run) inflation target; and h is the weight given by the central bank to the deviation of inflation from its target. \overline{U}_u is the unemployment target measured relative to the natural unemployment rate. That is, if the bank targets an unemployment rate below the natural rate, then $\overline{U}_u < 0$. The natural unemployment rate has been normalized to zero.

The union's central bank minimizes this expression by choosing π_u , subject to a Phillips curve given by

$$(2) \quad U_u = -(\pi_u - \pi_u^e) + \varepsilon,$$

where π_u^e represents expected inflation and ε is a supply shock. This is a standard expectations-augmented Phillips curve, where the natural rate of unemployment is again normalized to zero.

The solution to this problem, setting $h = 0$ (that is, without an inflation-targeting strategy), leads to the following inflation rate for the union:

$$(3) \quad \pi_u = -\lambda \overline{U}_u + \pi_u^* + \frac{\lambda}{1 + \lambda} \varepsilon.$$

The first term represents the well-known inflation bias (recall that $\overline{U}_u < 0$, as long as the central bank targets unemployment rates below the natural rate), which grows with the gap between the natural and target levels of unemployment and with the weight given by the central bank to unemployment relative to inflation stabilization. This is the traditional Barro-Gordon result, where the impossibility for the central bank to credibly commit to lower inflation rates generates persistent inflation above the optimal rate.

Under inflation targeting ($h \neq 0$), the inflation rate of the union will be

$$(4) \quad \pi_u = \frac{-\lambda}{1 + h} \overline{U}_u + \pi_u^* + \frac{h}{1 + h} \Theta + \frac{\lambda}{1 + \lambda + h} \varepsilon,$$

where $\Theta = \pi_u^T - \pi_u^*$. Several well-known results emerge. If $\Theta = 0$, that is, if the central bank targets the optimal long-run rate, the inflation bias will be smaller than if there were no inflation targeting (thus augmenting welfare). At the same time the reaction to supply shocks, ε , will diminish, thus exacerbating volatility (and negatively affecting welfare). This is technically analogous to Rogoff's (1985) conservative central banker problem, where the optimal h is positive. An inflation-targeting central bank increases welfare when $\Theta = 0$.

If Θ is positive, that is, if the central bank targets an inflation rate above the long-run optimal rate, then the inflation-targeting strategy could diminish

welfare. In practice, this could happen in a scenario where the central bank disinflates using a gradualist strategy to bring inflation down to its long-run optimal rate. Finally, note that under strict inflation targeting, as proposed by Svensson (1997)—that is, if $h \rightarrow \infty$ —both the inflation bias and the reaction to supply shocks disappear.

THE WELFARE IMPLICATIONS OF MEMBERSHIP. To analyze welfare, and assuming the absence of a *political* union, each member country, j , should evaluate the outcomes of membership based on its own *social* loss function:

$$(5) \quad L_j = \frac{\lambda_j}{2} (U_j - \bar{U}_j)^2 + \frac{1}{2} (\pi_u - \pi^*)^2,$$

and a country-specific Phillips curve given by

$$(6) \quad U_j = -(\pi_u - \pi_u^e) + \varepsilon_j.$$

Each country in the union can have different preference parameters and unemployment rates and face idiosyncratic shocks; nevertheless, each country's inflation rate will be the same as that of the union.² The *society's* loss function does not include the inflation-targeting term; the latter is a policy strategy of the central bank, but not part of the social preferences. The expected loss of membership can be found by substituting equations 6 and 4 into 5, and taking expectations. The resulting equation is

$$(7) \quad EL_j^{mem} = \frac{\lambda_j}{2} \left[\left(\frac{\lambda}{1 + \lambda + h} \right)^2 \sigma_\varepsilon^2 + \sigma_{\varepsilon_j}^2 - \frac{2\lambda}{1 + \lambda + h} \sigma_{\varepsilon\varepsilon_j} + \bar{U}_j^2 \right] \\ + \frac{1}{2} \left[\left(\frac{\lambda}{1 + h} \right)^2 \bar{U}_u^2 + \left(\frac{h\Theta}{1 + h} \right)^2 - \frac{2\lambda h\Theta \bar{U}_u}{(1 + h)^2} + \left(\frac{\lambda}{1 + \lambda + h} \right)^2 \sigma_\varepsilon^2 \right],$$

where σ_ε^2 and $\sigma_{\varepsilon_j}^2$ are the respective variances of ε and ε_j , and $\sigma_{\varepsilon\varepsilon_j}$ is the covariance between ε and ε_j .

AUTARKY. If each country were to retain autonomy over its monetary policy, its monetary authority would minimize

$$(8) \quad L_j = \frac{\lambda_j}{2} (U_j - \bar{U}_j)^2 + \frac{1}{2} (\pi_j - \pi^*)^2 + \frac{h_j}{2} (\pi_j - \pi_j^T)^2,$$

2. Alesina and Grilli (1992) explore the case where $\pi_u \neq \pi_j$, in a model without IT.

subject to a Phillips curve as in equation 6, but with country-specific inflation rates. I allow for an idiosyncratic target—that is, π_j^T is not necessarily equal to π^T . Nevertheless, the optimal inflation rate (π^*) is assumed to be equal for the union and across the union's individual members. The problem and the solution are similar to those for the union. I omit the details.

THE WELFARE IMPLICATIONS OF AUTARKY. The expected loss when retaining monetary autonomy—obtained by replacing the solution to the problem in autarky into the country-specific social loss function—is

$$(9) \quad EL_j^{aut} = \frac{\lambda_j}{2} \left[\left(\frac{1+h_j}{1+\lambda_j+h_j} \right)^2 \sigma_{\varepsilon_j}^2 + \overline{U_j^2} \right] + \frac{1}{2} \left(\frac{\lambda_j}{1+h_j} \right)^2 \overline{U_j^2} \\ + \frac{1}{2} \left[\left(\frac{h_j \Theta_j}{1+h_j} \right)^2 - \frac{2\lambda_j h_j \Theta_j \overline{U_j}}{(1+h_j)^2} + \left(\frac{\lambda_j}{1+\lambda_j+h_j} \right)^2 \sigma_{\varepsilon_j}^2 \right],$$

where $\Theta_j = \pi_j^T - \pi^*$.

MEMBERSHIP VERSUS AUTARKY. The difference between the two loss functions represents the key expression for analyzing the costs and benefits of joining a union versus retaining monetary autonomy:

$$(10) \quad EL_j^{mem} - EL_j^{aut} = \frac{1}{2} \left[\left(\frac{\lambda}{1+h} \right)^2 \overline{U_u^2} - \left(\frac{\lambda_j}{1+h_j} \right)^2 \overline{U_j^2} \right] \\ + \frac{(1+\lambda_j)}{2} \left[\left(\frac{\lambda}{1+\lambda+h} \right)^2 \sigma_{\varepsilon}^2 - \left(\frac{\lambda_j}{1+\lambda_j+h_j} \right)^2 \sigma_{\varepsilon_j}^2 \right] \\ + \frac{1}{2} \left[-2\lambda_j \left(\frac{\lambda}{1+\lambda+h} \sigma_{\varepsilon_j} - \frac{\lambda_j}{1+\lambda_j+h_j} \right) \sigma_{\varepsilon_j}^2 \right] \\ + \frac{1}{2} \left[\left(\frac{h\Theta}{1+h} \right)^2 - \left(\frac{h_j \Theta_j}{1+h_j} \right)^2 - 2 \left(\frac{\lambda h \Theta \overline{U}}{(1+h)^2} \right) - \left(\frac{\lambda_j h_j \Theta_j \overline{U_j}}{(1+h_j)^2} \right) \right]$$

The differences in welfare between participating in a monetary union versus remaining autonomous come from two sources: preferences and shocks. I analyze each source one at a time, focusing on long-run scenarios, specifically those where the inflation target is equal to optimal inflation ($\Theta_j = \Theta = 0$). This

is the most relevant case given that the countries would agree to first achieve similar inflation rates (likely close to their long-run targets) before the union is implemented. Nevertheless, the short-run model, wherein targets and optimal inflation rates might differ, provides interesting insights with respect to the implementation of gradual disinflation. I develop these insights in the appendix.

Differences in Preferences

Let the shocks be identical across the economies—that is, $\varepsilon = \varepsilon_j$, so that $\sigma_\varepsilon^2 = \sigma_{\varepsilon_j}^2 = \sigma_{\varepsilon\varepsilon_j} = \sigma^2$. Moreover, the long-run assumption implies that $\Theta_j = \Theta = 0$. Equation 10 then collapses to

$$(11) \quad E\Delta L_j = \frac{1}{2} \left[\left(\frac{\lambda}{1+h} \right)^2 \overline{U}_u^2 - \left(\frac{\lambda_j}{1+h_j} \right) \overline{U}_j^2 \right] \\ + \frac{\sigma^2}{2} \left(\frac{\lambda}{1+\lambda+h} - \frac{\lambda_j}{1+\lambda_j+h_j} \right) \left(\frac{(1+\lambda_j)\lambda}{1+\lambda+h} - \lambda_j - \frac{\lambda_j h_j}{1+\lambda_j+h_j} \right),$$

where $E\Delta L_j \equiv EL_j^{mem} - EL_j^{aut}$.

A1. Let $\overline{U}_j \neq \overline{U}_u$, $\lambda_j = \lambda$, and $h_j = h$. $E\Delta L_j$ can then be written as

$$(12) \quad \frac{1}{2} \left(\frac{\lambda}{1+h} \right)^2 \left(\overline{U}_u^2 - \overline{U}_j^2 \right).$$

As long as $|\overline{U}_j| > |\overline{U}_u|$, the expression is negative; that is, a country with incentives toward high inflation will benefit from the monetary union. The credibility the monetary union bestows positively affects welfare. Under strict inflation targeting, the effect disappears as the inflation bias is removed, both for the union and for country j .

A2. Let $\lambda_j \neq \lambda$, $\overline{U}_j = \overline{U}_u$, and $h_j = h$. $E\Delta L_j$ can then be written as

$$(13) \quad \frac{1}{2} \left(\frac{\overline{U}_u}{1+h} \right)^2 \left(\lambda^2 - \lambda_j^2 \right) \\ + \frac{\sigma^2}{2} \left(\frac{\lambda}{1+\lambda+h} - \frac{\lambda_j}{1+\lambda_j+h} \right) \left(\frac{(1+\lambda_j)\lambda}{1+\lambda+h} - \lambda_j - \frac{\lambda_j h}{1+\lambda_j+h} \right).$$

The interpretation of the first term is traditional in the literature; the union is welfare enhancing as long as $\lambda < \lambda_j$. Again, the intuition is that the union confers credibility to a country that has greater incentives to inflate.

The second line is positive if $\lambda < \lambda_j$; that is, it favors maintaining an autonomous monetary policy. The whole expression is premultiplied by the variance of the shocks. The economic interpretation is simple: while the monetary union has fewer incentives to inflate when $\lambda < \lambda_j$, it will also react less strongly to supply shocks, thus reducing welfare.

A3. Let $h_j \neq h$, $\bar{U}_j = \bar{U}_u$, and $\lambda_j = \lambda$. $E\Delta L_j$ can then be written as

$$(14) \quad \frac{\lambda^2 \bar{U}_u^2}{2} \left(\frac{1}{(1+h)^2} - \frac{1}{(1+h_j)^2} \right) + \frac{\sigma^2 \lambda}{2} \left(\frac{1}{1+\lambda+h} - \frac{1}{1+\lambda+h_j} \right) \left(\frac{-h}{1+\lambda+h} - \frac{h_j}{1+\lambda+h_j} \right).$$

Consider the case where $h_j < h$. In other words, the union's central bank attaches a higher priority to the inflation target than country j . Correspondingly, the first term is negative. This is because the union reduces the inflation bias by focusing more strongly on the inflation target. The second line is positive. It is premultiplied by σ^2 and captures the fact that the union's bank does less to smooth activity variations—a negative impact on welfare due to joining the union.

Differences in Shocks

Let the objective functions be identical for all j economies ($\bar{U}_j = \bar{U}_u$, $\lambda_j = \lambda$, $h_j = h$, $\Theta_j = \Theta$), but allow for differences in shocks—that is, $\varepsilon \neq \varepsilon_j$. Equation 10 then collapses to

$$(15) \quad \frac{1}{2} \left(\frac{\lambda}{1+\lambda+h} \right)^2 \left((1+\lambda) (\sigma_\varepsilon^2 + \sigma_{\varepsilon_j}^2 - 2\rho\sigma_\varepsilon\sigma_{\varepsilon_j}) - 2h (2\rho\sigma_\varepsilon\sigma_{\varepsilon_j} - \sigma_{\varepsilon_j}^2) \right),$$

where ρ is the correlation coefficient between ε and ε_j .³

3. The expression does not depend on Θ . The welfare implications of the shocks are analogous over the long and short runs.

B1. Consider the case where shocks differ in size, but are nonetheless perfectly correlated—that is, $\rho = 1$. In that case, equation 15 is simply

$$(16) \quad \frac{1}{2} \left(\frac{\lambda}{1 + \lambda + h} \right)^2 \left((1 + \lambda)(\sigma_\varepsilon - \sigma_{\varepsilon_j})^2 + 2h(\sigma_{\varepsilon_j}^2 - \sigma_\varepsilon \sigma_{\varepsilon_j}) \right).$$

Note that $(\sigma_\varepsilon - \sigma_{\varepsilon_j})^2$ is always positive. This is the Alesina-Grilli result, whereby differences in output (unemployment) variances make entering the union less attractive. The intuition is that, relative to an autonomous bank, the monetary union would either understabilize or overstabilize.

The expression $(\sigma_{\varepsilon_j}^2 - \sigma_\varepsilon \sigma_{\varepsilon_j})$ is negative if $\sigma_\varepsilon > \sigma_{\varepsilon_j}$. In other words, if the variance of shocks under the union is higher than that for country j , joining the union will improve welfare in country j . Why is that? Note that the latter expression is premultiplied by h , the weight given to the inflation target. Recall, moreover, that countries targeting inflation react less strongly to supply shocks, a welfare-reducing feature of IT. Consequently, if $\sigma_\varepsilon > \sigma_{\varepsilon_j}$, the inflation-targeting union will react more strongly to the fully correlated shocks than the autonomous bank would. In this scenario, the negative implication of IT—namely, that it reacts less strongly to supply shocks—is mitigated from the perspective of country j . Note that if the variance of economic activity in country j is larger than that for the union, the opposite implication results.

B2. Consider $\sigma_\varepsilon = \sigma_{\varepsilon_j} = \sigma$, but with $\rho \neq 1$. In that case, equation 15 is simply

$$(17) \quad \frac{\lambda^2}{1 + \lambda + h} \sigma^2 (1 - \rho).$$

The less correlated the shocks, the less incentive there is to join the union. In the extreme case, where $\rho = -1$, the union's central bank would implement expansionary policies even though contractions were needed in country j . Nevertheless, note that the expression is mitigated by the presence of h , the weight given to the inflation target. As an IT regime reacts less strongly to economic activity fluctuations, the reaction of the IT union's bank to shocks that are not fully correlated does less harm from the perspective of country j than it might otherwise.

The following is a summing up: (1) Countries with incentives to adopt high inflation or with central banks that attach a lower priority to inflation targets than the union's will benefit from the monetary union via a smaller inflation bias. (2) A union with fewer incentives to allow inflation to go up will also

react less to supply shocks, a welfare-diminishing feature of unions. (3) The latter effect is mitigated if the variance of shocks for the union is of greater magnitude than that for the specific country. (4) A country benefits the most from the union if the cycles of the union and the member country are highly correlated and shocks are similar in size.

LAMU, Autonomy, or Dollarization? A First Look at the Data

This section provides several quantifications, *one at a time*, of each of the costs and benefits of LAMU (or dollarization) identified in the model. It also provides quantifications of a couple of relevant aspects left out of the model. The next section combines most of these empirical results.

While the model features several elements for evaluating the convenience of joining a monetary union, it leaves out several relevant considerations. For instance, the literature highlights that the reduction in transaction costs—resulting from joining a union—increases trade and could have an impact on GDP in the long run. Moreover, if the union is a unilateral policy (that is, a dollarization), member countries give up their present and future seigniorage collection. Both of these effects are estimated and discussed later in this section. There are other relevant elements left out in the model. For instance, LAMU may be a pivotal element in LA's economic integration process; however, this does not suggest that the monetary union should precede other relevant aspects of the integration process such as labor mobility and trade agreements. The economic benefits are part of a larger story, one where the long-run political gains of laying the building blocks of a Latin American nation might outweigh economic considerations.⁴ These aspects should be part of any future discussion regarding a monetary union, but are beyond the objectives of this paper. I offer two additional caveats: I evaluate the costs and benefits of LAMU as though it would occur only among the current inflation targeters in LA. Nevertheless, if the process turns out to be successful, it is conceivable that other countries in the region will want to join, as happened with the euro. Finally, when analyzing dollarization, the results should be read as the consequence of each country dollarizing unilaterally, not as if all the inflation targeters were simultaneously adopting the dollar.

I subdivide the rest of this section into three parts: the first deals with volatility and credibility; the second quantifies the seigniorage forgone if

4. See, for instance, Krugman (1990) for a similar discussion about the European Union.

countries dollarize; and the third analyzes the trade effects. Later, in the following section, I propose a methodology for quantifying the net impact of several of these effects.

Volatility and Credibility

According to the model, one undesirable characteristic of unions is that they potentially exacerbate economic volatility. The model suggests that this side effect is attenuated if the business cycles are highly correlated, or if the country has a smaller variance of shocks relative to the union. The model also suggests that countries with incentives to allow for higher inflation benefit more from a union. I apply these ideas to the data to see which countries would benefit more relative to others; where appropriate, I state whether union or dollarization would be more convenient.

(1) CREDIBILITY. I use two proxies for incentives to inflate under autonomy. One is the actual behavior of inflation during the recent past. The other consists of measures of central bank independence (CBI) taken from Jácome and Vázquez (2005); the GMT index (Grilli and others, 1991), ranging from 0 to 15, with 15 indicating maximum independence; and the Cukierman (1992) and modified Cukierman indexes, ranging from 0 to 1, with 1 representing the highest degree of independence (see the appendix for details).

To summarize the information contained in the two proxies, I build a credibility index representing the average of an inflation index and the modified Cukierman index—the preferred CBI index according to Jácome and Vázquez (2005). The inflation index is constructed as follows: $(\pi_{\max} - \pi_i)/(\pi_{\max} - \pi_{\min})$, where π_{\max} is the highest average inflation rate for the period 2000 to 2007 within LA; π_{\min} is the lowest inflation in the region for the same period; and π_i is the average inflation rate for country i for the same period. Thus the country with the smallest inflation rate in LA will have an *inflation* index of 1, while the country with the largest inflation rate in LA will have an index of 0. To construct the *credibility* index, I average this outcome with the modified Cukierman index. The closer the number is to 1, the better the respective country's credibility, and the fewer the gains to be expected from joining a monetary union or from dollarizing. (Note that dollarization and LAMU cannot be compared to one another from the perspective of credibility unless I make specific assumptions about the credibility changes that each monetary arrangement would bestow. I do not do that in this paper.)

The results are reported in table 1. From the credibility perspective, Brazil and Colombia would benefit the most from a union, while Chile and Peru

TABLE 1. Central Bank Independence, Inflation, and Credibility

	Central bank independence indexes ^a			Average inflation 2000–07 (percent)	Credibility index
	GMT	Cukierman index	Modified Cukierman		
Brazil	10.0	0.47	0.50	7.16	0.61
Chile	14.0	0.84	0.85	3.27	0.89
Colombia	10.0	0.78	0.83	5.95	0.81
Mexico	13.0	0.75	0.81	4.34	0.84
Peru	13.0	0.86	0.86	1.99	0.93
Average IT in LAC	12.0	0.74	0.77	4.54	0.81
Average non-IT in LAC ^b	10.6	0.71	0.69	9.53	0.64

Source: Authors calculations based on CPI data from the IFS (IMF, International Financial Statistics).

a. Jácome and Vásquez (2005).

b. Countries included are Argentina, Bolivia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Nicaragua, Paraguay, Uruguay, and Venezuela.

would benefit the least. Moreover, IT countries in LA exhibit lower inflation rates and higher CBI indexes—and thus better credibility indexes—compared to non-IT countries in the region. In this sense, IT countries in LA have less to gain in terms of credibility than other countries in the region using alternative monetary regimes.

An interesting paradox emerges when comparing these facts with those in Europe before the monetary union. While the largest economy in Europe—Germany—was also the one with a highly credible central bank, in LA the largest economy—Brazil—has the least credible central bank among the IT countries. The consequences of this fact are twofold. On the one hand, the inflation bias might actually increase if some countries with credible central banks give up monetary autonomy in favor of a central bank with higher incentives to inflate. Nevertheless, if the union is going to take place in the future, members will agree on inflation convergence before the union and on common inflation targets after the adoption of a common currency. Such an agreement would alleviate concerns regarding the potential increase in the inflation bias in the more credible countries. On the other hand, a leading country of the union that is not an inflation hawk also has an upside for the rest of the countries. The imperfect synchronization of the business cycle is less of a problem for the small members of the union if the leading country is not an inflation hawk.

(II) CORRELATION. The model suggests that countries would like to have business cycles that correlate as much as possible with those of the union.

I begin by reporting the correlation of the GDP growth rates of each IT nation in LA with those of the union (common GDP of the five IT countries in LA) and of the United States.⁵ Specifically, figure 2 plots ten-year rolling correlations of growth rates and shows that correlations of individual countries with a potential LAMU are considerably higher than corresponding correlations with the United States. The only exception is Mexico, where the correlation with the United States is similar to that with the union. NAFTA likely plays a large role in explaining this outcome. In any case, by 2007 the average growth correlation for the five IT countries in LA with a potential union reached 0.72, while that with the United States was only 0.02. On the correlation front, the advantage of LAMU over dollarization is large.

The comparison across IT countries shows that Brazil has the highest correlations with LAMU. This is not surprising given that Brazil is the largest economy in the region and therefore plays a large role in driving the joint business cycles of the five inflation targeters in LA. In this sense, it plays a role similar to Germany's within the euro area.

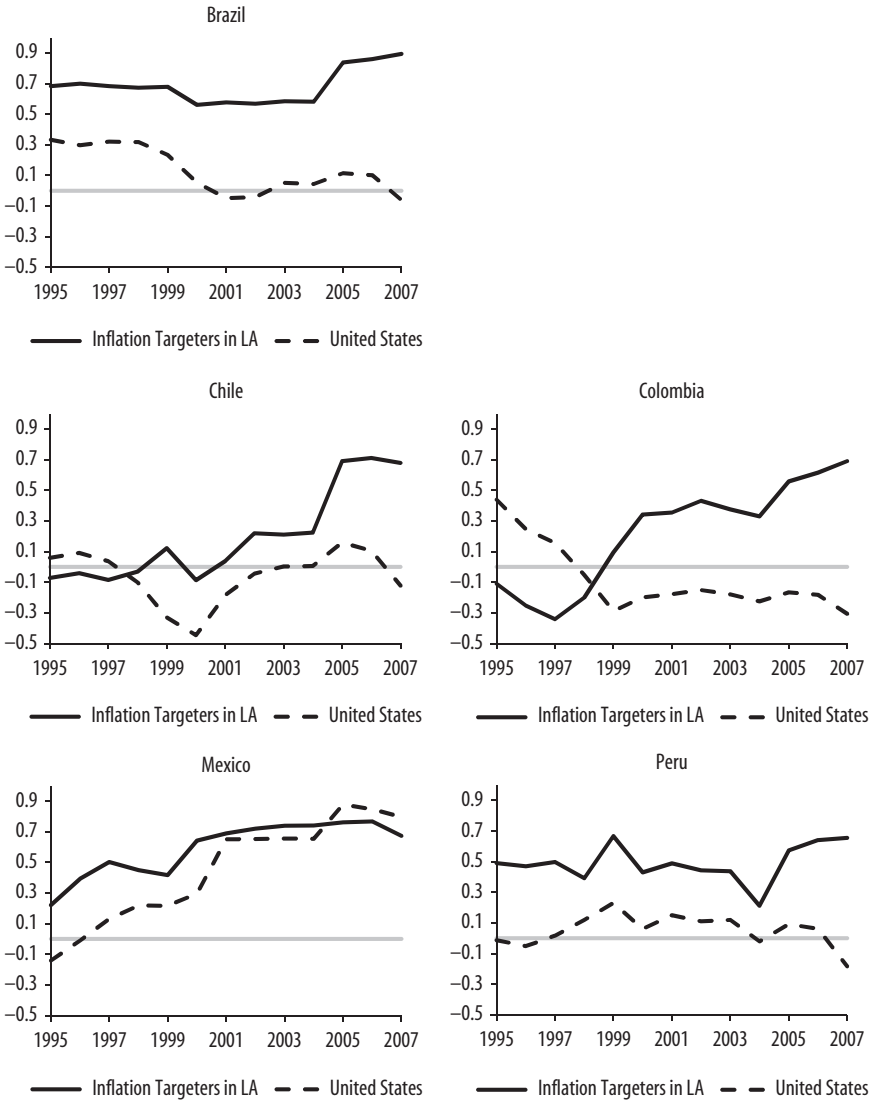
(iii) **STANDARD DEVIATION OF THE SHOCKS.** Alesina-Grilli's model calls for shocks as similar as possible in size. My model, assuming IT, stresses that having a standard deviation of shocks below the union's favors joining the union. In figure 3, I report the ten-year rolling standard deviation ratios of the growth rate for country j relative to the LAMU or the United States, minus 1. One would like this statistic to be as close to zero as possible (the Alesina-Grilli argument) or negative (the additional effect due to IT). Interestingly, for all of the countries analyzed, the ratio for the union is always below the ratio for the United States. Here LAMU also seems preferable to unilateral dollarization.

A Business Cycle Index

To put results (ii) and (iii) in perspective, I build an ad hoc business cycle index defined as $(\sigma_j/\sigma - 1) + (1 - \rho_j)$, where σ_j/σ is the relative standard deviation and ρ_j is the growth correlation. My model suggests that the first term should be small or even negative for the union to be beneficial, while the second term should be as close to zero as possible. The evolution of the index over time for each IT country in my sample is reported in figure 4.

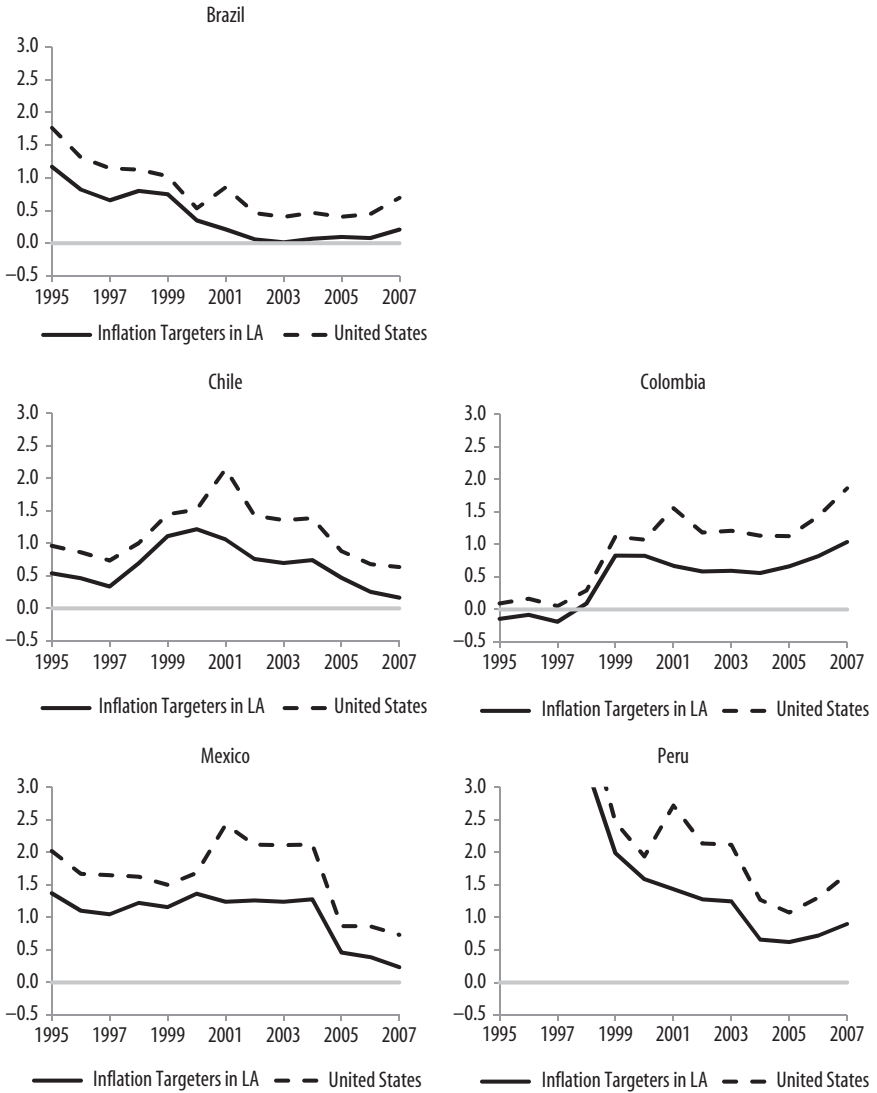
5. The model was expressed in terms of unemployment, but analogous results are obtained if the loss function and the Phillips curve are expressed in terms of output. I use output given that unemployment statistics are not comparable across LAC countries.

FIGURE 2. Correlation between Growth Rates (Ten-Year Rolling Correlation of Growth Rates)



Source: Author's calculations based on GDP data from the World Development Indicators (WDI).

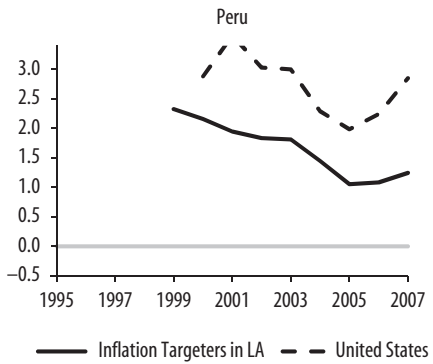
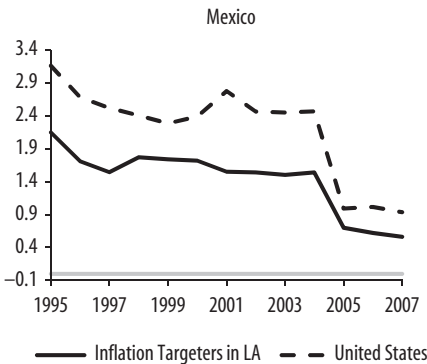
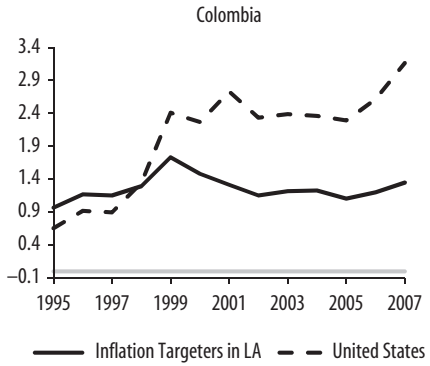
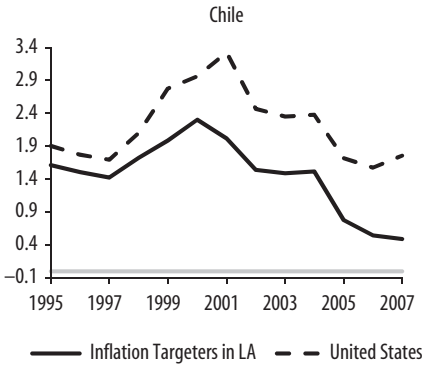
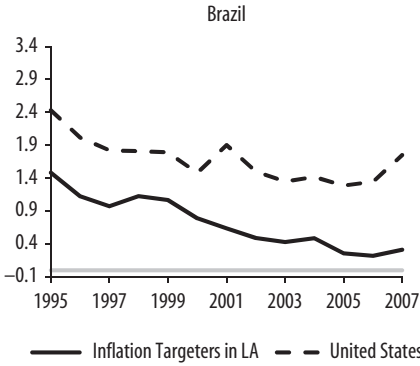
FIGURE 3. Standard Deviation Ratio -1 (Ten-Year Rolling Standard Deviation Ratio -1)^a



Source: Author's calculations based on GDP data from WDI.

a. Peru's standard deviation ratios (-1) before 1999 were above 3 (not shown in the plot).

FIGURE 4. Business Cycle Index, 1995–2007



Source: Author's calculations based on GDP data from WDI.

The results show that, based on this ad hoc business cycle index, LAMU is preferable: volatility would increase more under dollarization than under LAMU. The differences between the two lines are large in all cases except for Mexico. Even though this index is completely ad hoc, I doubt that—with the exception of the Mexican case—the adoption of an alternative model for averaging the two business cycle dimensions would change the main conclusion. In this category as well, LAMU is better than dollarization. Later, in the next section, I further develop the measurement of costs associated with the potential exacerbation of volatility from relinquishing monetary autonomy.

Seigniorage

If the five inflation targeters in LA were to form a monetary union, they would likely agree on a formal sharing rule for the stream of seigniorage revenue. Conversely, if any of them were to dollarize, it is unlikely that the United States would agree to discuss a seigniorage-sharing rule. Thus in a cost-benefit analysis of union versus dollarization, it is important to assess the size of present and future seigniorage revenues that would be lost when choosing to dollarize. In calculating these costs, I closely follow the framework proposed by Schmitt-Grohé and Uribe (1999).

Let B_0 be the monetary base, denominated in dollars, at time 0 of the country dollarizing. Suppose that all foreign reserves are held in U.S. Treasury bills, yielding a constant nominal interest rate, i^* . At the time that the country implements dollarization, it sells B_0 of its foreign reserves to the United States in exchange for dollar bills, which it then uses to buy the entire monetary base. The loss of reserves equals B_0 , such that the amount of seigniorage income forgone in period 0 is i^*B_0 .

For $t > 0$, the demand for monetary assets grows over time because of both inflation (π) and domestic real growth (g); for simplicity's sake, these are assumed constant. Furthermore, I assume a unitary income elasticity of real money balances, so that domestic dollar holdings for any period $t \geq 0$ will be $D_t = [(1 + g)(1 + \pi)]^t B_0$. Finally, citing Schmitt-Grohé and Uribe (1999), "Under dollarization the way in which the increase in the domestic country's money holdings, $D_t - D_{t-1}$, is brought about is through transfers of real resources from the domestic economy to the U.S. government in exchange for U.S. dollars. The U.S. government in turn can earn interest on these real resources. . . . The stream of income earned by the U.S. government in each

TABLE 2. Present Discounted Value of Seigniorage Income Forgone as a Percentage of PDV of GDP, 2007

	Baseline		Sensitivity analysis	
	$i^*=4, r=5, g=4$		$i^*=2$	$i^*=6$
	(1)	(2)	(3)	
Brazil	0.39	0.19	0.58	
Chile	0.41	0.21	0.62	
Colombia	0.36	0.18	0.54	
Mexico	0.20	0.10	0.30	
Peru	0.53	0.27	0.80	
Average	0.38	0.19	0.57	

Source: Author's calculations.

*Statistically significant at the 10 percent level.

period $t \geq 0$ is given by i^*D_t .⁶ Thus the present discounted value (PDV) of seigniorage income lost (earned by the United States) is

$$S = \sum_{t=0}^{\infty} \left(\frac{1}{1+i} \right)^t i^* [(1+g)(1+\pi)]^t B_0.$$

If $r > g$ and $(1+i) = (1+r)(1+\pi)$, S converges to $i^*B_0 \frac{(1+r)}{r-g}$.⁶ Under column 1 in table 2, I report estimates of seigniorage income forgone as of 2007 as a percentage of the PDV of GDP of each of the IT countries for baseline values of i^* , r , and g of 4, 5, and 4 percent, respectively.⁷ The results suggest that the seigniorage forgone as a percentage of the PDV of GDP is large—it ranges from 0.2 percent to as high as 0.53 percent. Under columns 2 and 3, I report the results using alternative values of i^* .

The Trade Effect

In a very influential paper, Rose (2000) estimates that belonging to a currency union triples trade with other union members. This surprising result has sparked

6. $r > g$ is a standard steady-state condition in optimizing growth models. If $g > r$, S goes to infinity.

7. The 4 percent on i^* matches the average interest rate earned by the Banco de la República de Colombia on foreign exchange reserve holdings over the period 2004–08. As for g and r , in this case their values are irrelevant as they cancel out when S is reported as a percentage of the PDV of GDP. Nevertheless, these baseline values will become relevant in other parts of the paper.

a lot of research, with skeptical economists seeking arguments that would shrink the effects estimated by Rose. (For an excellent summary of the related literature, see Baldwin [2006].) Nevertheless, even those skeptical of Rose's results—Baldwin among them—estimate the effect of currency unions on trade to be very large. In describing the effect of the euro adoption on trade in “Euroland,” Baldwin claims “the number is between 5 and 10 percent to date. Most of the evidence suggests that this number may grow as time passes, maybe even doubling.” In other words, even a critic of Rose's results finds it plausible that a currency union could increase trade by at least a factor of 1.1. Rose and Stanley (2005) in their meta-analysis of thirty-four studies on the subject conclude that currency unions increase bilateral trade by between 30 and 90 percent.

In another paper, Frankel and Rose (2002) estimate the effect of common currencies on long-run income (via trade). They find that a 1 percent increase in the ratio of trade to GDP increases GDP per capita by one-third of a percent over the long run. Other authors, for example Rodriguez and Rodrik (2001), offer more skeptical views regarding the potential impact of trade on GDP.

I evaluate the benefits of a union among the five inflation targeters via increased trade, and indirectly via increases in long-run GDP, and contrast them with respective unilateral dollarization by each. I estimate the impact of currency unions on trade under two alternative scenarios. First, I look at a pessimistic scenario, where trade “only” increases by a factor of 1.1, consistent with Baldwin's view and roughly coinciding with Rose and Stanley's lower bound. Then, I examine a more optimistic outcome—though still conservative when compared with Rose's original results—where the common currency increases trade by a factor of 1.9, consistent with Rose and Stanley's upper bound. I then use two additional figures to estimate the effect of increased trade on long-run GDP for each of these scenarios: on the one hand, a pass-through of one-third; Frankel and Rose's results, on the other hand, a pass-through of one-sixth, closer to skeptical views such as those of Rodriguez and Rodrik. Table 3 reports the results. Columns 1 to 3 report the actual data for the five inflation targeters in LA. It is notable how trade has gained importance as a percentage of GDP. From an average of 27 percent in 1990, it reached 46 percent by 2007.

Columns 4 through 6 report the estimated impact of dollarization both on trade and GDP per capita. Columns 4 through 6 are each broken down into two subcolumns. For each, the figures on the left hand report the findings for the pessimistic scenario in terms of the impact of a common currency on trade; and the ones on the right hand, those for the optimistic cases. For instance, the number for Brazil in 1990 under the left subcolumn 4 is

T A B L E 3 . Union versus Dollarization: Effects on Trade, 1990–2007

Country	Effects (% of GDP) of dollarization									
	Trade (% of GDP) (1)	% of trade with the US (2)	% of trade with other ITs in LA (3)	On GDP			Effects (% of GDP) of LAMU			
				On trade (4)	Pass-through = 1/6 (5)	Pass-through = 1/3 (6)	On trade (7)	Pass-through = 1/6 (8)	Pass-through = 1/3 (9)	
Brazil	1990	12	23	4	[3 5]	[0 1]	[1 2]	[1 1]	[0 0]	[0 0]
	2000	18	24	6	[5 8]	[1 1]	[2 3]	[1 2]	[0 0]	[0 1]
	2007	21	16	7	[4 6]	[1 1]	[1 2]	[2 3]	[0 0]	[1 1]
Chile	1990	49	18	10	[10 17]	[2 3]	[3 6]	[6 10]	[1 2]	[2 3]
	2000	46	18	14	[9 16]	[2 3]	[3 5]	[7 12]	[1 2]	[2 4]
	2007	66	14	15	[11 18]	[2 3]	[4 6]	[11 18]	[2 3]	[4 6]
Colombia	1990	31	40	7	[14 24]	[2 4]	[5 8]	[2 4]	[0 1]	[1 1]
	2000	30	42	10	[14 24]	[2 4]	[5 8]	[3 6]	[1 1]	[1 2]
	2007	37	31	14	[12 21]	[2 4]	[4 7]	[6 10]	[1 2]	[2 3]
Mexico	1990	21	69	2	[16 28]	[3 5]	[5 9]	[0 1]	[0 0]	[0 0]
	2000	59	81	1	[52 90]	[9 15]	[17 30]	[1 2]	[0 0]	[0 1]
	2007	62	66	3	[45 77]	[7 13]	[15 26]	[2 3]	[0 1]	[1 1]
Peru	1990	23	25	13	[6 11]	[1 2]	[2 4]	[3 5]	[1 1]	[1 2]
	2000	27	26	15	[8 13]	[1 2]	[3 4]	[5 8]	[1 1]	[2 3]
	2007	44	19	17	[9 16]	[2 3]	[3 5]	[8 14]	[1 2]	[3 5]
Average	1990	27	35	7	[10 17]	[2 3]	[3 6]	[2 4]	[0 1]	[1 1]
Average	2000	36	38	9	[17 30]	[3 5]	[6 10]	[3 6]	[1 1]	[1 2]
Average	2007	46	29	11	[16 28]	[3 5]	[5 9]	[6 10]	[1 2]	[2 3]

Source of columns 1, 2, and 3: Author's calculations based on trade data from United Nations Commodity Trade Statistics Database (UN COMTRADE) and GDP data from WDI. Columns 4 through 9: author's calculations. Left column in brackets assumes that the common currency increases trade by 10 percent. Right column assumes that the common currency increases trade by 90 percent.

obtained by multiplying the numbers under columns 1 and 2 times 1.1 (that is, column [1] \times column [2] \times 1.1). The number under the left subcolumn 6 is simply a third of the number in the left subcolumn 4; that is, a 1 percent increase in overall trade raises GDP by one third of a percent. Columns 7 through 9 report the same information as columns 4 through 6 for a union among the inflation targeters in LA.

On average, trade would rise by between 16 and 28 percent under dollarization. As a consequence, the impact on GDP per capita would be a 3 to 9 percent boost over twenty years.⁸ The same statistics for LAMU indicate that trade would gain between 6 and 10 percentage points while GDP per capita would increase by 1 to 3 percent. As noted by Frankel and Rose, the effects are large even by conservative estimates.

For dollarization, Mexico is the country that would benefit the most; its large trade with the United States makes the benefits of the transactions-cost reduction more relevant. In the long run, its output would increase by up to 26 percent. The country that would gain the least with dollarization is Brazil, with a 2 percent boost on its long-run GDP under the more optimistic scenario. This is because Brazil has a very large economy with a smaller size of trade relative to the other IT nations in LA. For LAMU, Chile and Peru would benefit the most in trade. Their long-run GDPs would rise by up to 6 and 5 percent, respectively.

An alternative way of grasping the size of these effects—one that will prove useful later when all of the elements are considered together—is to calculate the present discounted value of the *additional* GDP due to the trade effect. Let us call x the percentage impact on long-run GDP estimated under columns 5, 6, 8, and 9 in table 3. The present discounted value of the *additional* GDP due to the trade effect (assuming that the trade effects on GDP only occur twenty years after the monetary union is put in place) can thus be written as

$$\begin{aligned}
 (18) \quad PDV(Y^T) &= \sum_{t=20}^{\infty} \left(\frac{1}{1+r} \right)^t Y_0 (1+g)^t x \\
 &= Y_0 x \left(\frac{1+g}{1+r} \right)^{20} \frac{1+r}{r-g}, \text{ if } r > g,
 \end{aligned}$$

8. The results from Frankel and Rose (2002) should be interpreted this way—that is, once the impact on trade settles in, it takes twenty years for the estimated impact on GDP to take hold.

TABLE 4. Present Discounted Value of Trade Effect on GDP Expressed as Percentage of PDV of GDP, 2007, if Effect Occurs from Year 20 Onward

	LAMU						
	Baseline: $r = 5\%$, $g = 4\%$			Sensitivity: $x = \text{mean}(x)$, $g = 4\%$		Sensitivity: $x = \text{mean}(x)$, $r = 5\%$	
	$x = \text{mean}(x)$	$x = \text{low}(x)$	$x = \text{high}(x)$	$r = 4.5\%$	$r = 6\%$	$g = 2\%$	$g = 4.5\%$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Brazil	0.5	0.2	0.8	0.5	0.4	0.3	0.5
Chile	3.0	1.5	5.0	3.3	2.5	2.0	3.3
Colombia	1.6	0.8	2.7	1.8	1.3	1.1	1.8
Mexico	0.6	0.3	0.9	0.6	0.5	0.4	0.6
Peru	2.3	1.1	3.9	2.5	1.9	1.5	2.5
Average	1.6	0.8	2.7	1.7	1.3	1.1	1.7
	Dollarization						
Brazil	1.0	0.5	1.8	1.1	0.9	0.7	1.1
Chile	3.0	1.4	5.0	3.3	2.5	2.0	3.3
Colombia	3.5	1.7	5.9	3.8	2.9	2.3	3.8
Mexico	12.6	6.2	21.3	13.9	10.4	8.5	13.9
Peru	2.6	1.3	4.3	2.8	2.1	1.7	2.8
Average	4.5	2.2	7.6	5.0	3.7	3.1	5.0

Source: Author calculations.

where r is the real interest rate, Y_0 is the real GDP for period 0, and g is the growth rate of output. In table 4, I report the estimates for equation 18, as a percentage of the PDV of GDP (as in table 2). In the baseline cases, I use the same baseline values for r and g as in the seigniorage estimates reported earlier, 5 and 4 percent, respectively. As for x , I define $\text{low}(x)$ as the pessimistic case—a combination of low trade effect of 10 percent with a low pass-through of one-sixth; $\text{mean}(x)$ is defined as a combination of 50 percent and a pass-through of one-fourth; while $\text{high}(x)$ uses 90 percent and one-third for the currency effect and the pass-through, respectively. These results are reported under columns 1 through 3. Under columns 4 through 7, I explore the sensitivity of the results by estimating the expression for alternative values of r and g .

The results show that the effect is very large. First, take the case of LAMU. Even under the pessimistic scenario in terms of the impact of a common currency on trade and GDP ($\text{low}(x)$), and considering the country that benefits the least (with the lowest ratio of trade with other LAMU countries—Brazil), the result suggests that the benefit is 0.2 percent relative to the present discounted

value of GDP. The figures are above 20 percent in the case of dollarization in Mexico.

LAMU, Dollarization, or Autonomy?

The previous section dealt with the three main areas that would be affected by the adoption of a common currency—business cycles, seigniorage, and trade. In this section, I take steps toward compiling the evidence—that is, I discuss the relative importance of these areas⁹ and look at certain policy implications that emerge.

I first discuss whether inflation targeters in Latin America should retain monetary autonomy or form a common currency, and conclude that each would be better off in a monetary union. I then tackle the case of dollarization versus autonomy, concluding again that giving up monetary autonomy is the preferred strategy except in Brazil, if the trade effects are assumed to be small. Finally, I deal with the case of unilateral dollarization versus LAMU. Here, the results are mixed. For reasonable calibrations, LAMU is strictly preferred for Chile, Peru, and Brazil, while dollarization is the preferred strategy for Mexico; the results are ambiguous for Colombia.

Autonomy or LAMU?

Embarking on a LAMU—compared to retaining monetary autonomy—entails one large benefit: the impact on trade and GDP, which was discussed in the previous section. There should be no losses in seigniorage, provided that the union agreement includes a seigniorage-sharing rule. In fact, if the union is successful and the currency becomes important, foreigners could start hoarding the currency; that is, there could be a positive impact on seigniorage. In this paper, I do not estimate this effect. Thus the reported benefits of LAMU should be interpreted as a lower bound of the actual effects. On the downside, the adoption of a common currency can exacerbate the volatility of economic activity. How costly is volatility in terms of its impact on welfare?

This question has been actively debated in the literature, especially since Lucas (1987) claimed that business cycle fluctuations have a negligible impact

9. The previous section also discussed credibility aspects. Nevertheless, as mentioned, this paper makes no assumptions about the level of credibility that dollarization would bestow compared to LAMU. Thus the credibility category is not included in this section.

on welfare. More recently, Wolfers (2003) has used subjective well-being data from developed nations to show that unemployment volatility has a negative and relatively large impact on well-being. Here, I use an empirical strategy inspired by Wolfers's contribution to estimate whether the observed volatility in economic activity had any impact on the self-reported well-being statistics for the five IT nations in LA. Later, based on these results, I propose a methodology for answering the following question: Is the potential increase in volatility (due to giving up monetary autonomy) large enough to overcome the benefits of trade with LAMU?

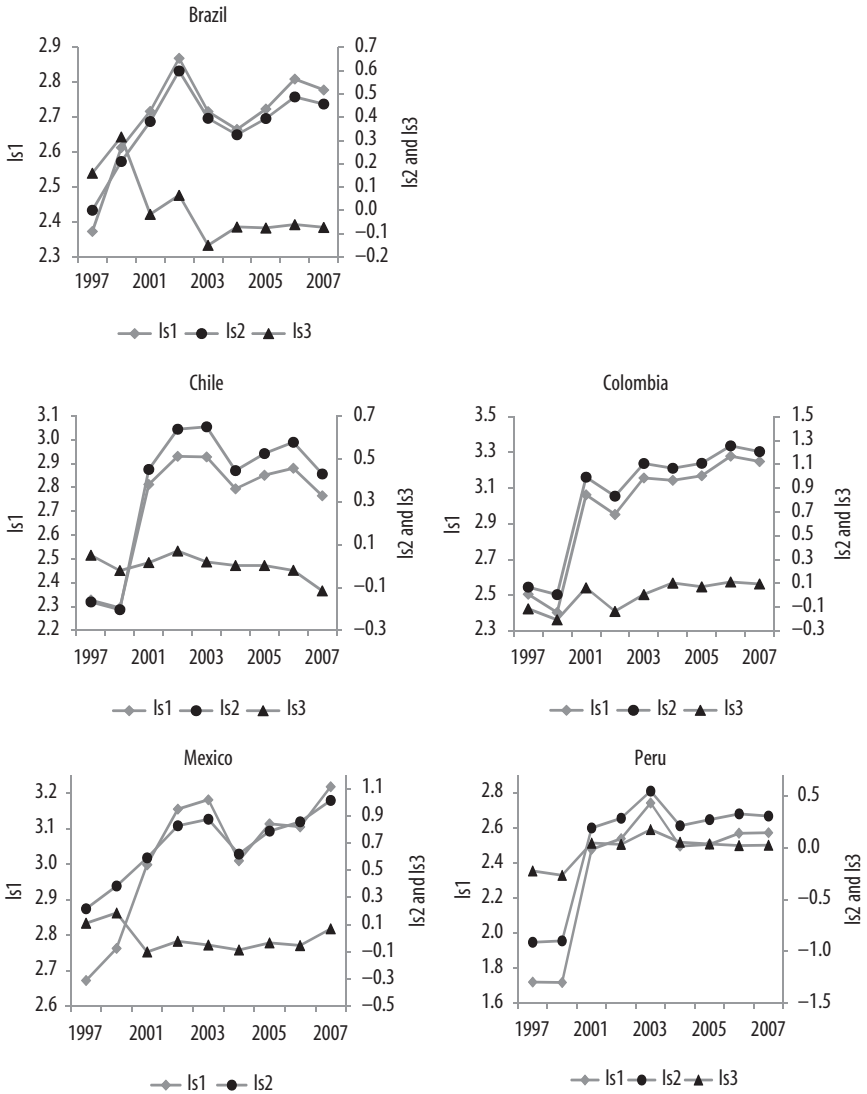
I use data from Latinobarómetro, an annual survey that has been given in a number of Latin American nations since 1995. The specific question I am interested in is the following: *In general terms, would you say that you are satisfied with your life? Would you say that you are very satisfied, fairly satisfied, not very satisfied, or not at all satisfied?* This question was asked in the years 1997 and 2000 through 2007.¹⁰ I focus on the surveys performed in the five IT nations in LA. The dataset covers nine years and five countries—forty-five country-years—and contains 52,650 valid responses. I build three alternative Life Satisfaction (LS) measures for country c at year t .

- (i) *LS1*: Following Di Tella, MacCulloch, and Oswald (2001) and Wolfers (2003), the life satisfaction questions are coded as the following: 1 = not at all satisfied; 2 = not very satisfied; 3 = fairly satisfied; and 4 = very satisfied. The simple average across individuals for any country c for any year t gives the first country-year life satisfaction measure.
- (ii) *LS2*: Following Wolfers (2003), I run an ordered probit regression on individual characteristics and a full set of dummy variables for each country for each year. *LS2* is the corresponding country-year fixed effect in the ordered probit.
- (iii) *LS3*: Following Di Tella, MacCulloch, and Oswald (2001), I run an ordinary least squares (OLS) regression of *LS1* on micro controls and country and year fixed effects.¹¹ The average error for each country in each year—that is, the part of *LS* not explained by individual characteristics—is *LS3*. The three *LS* measures over time are depicted in figure 5.

10. In 2002 a similar question appeared: *In general, would you say that you are very happy, fairly happy, not very happy or not at all happy?* Wolfers (2003) reports that the answers to these questions are highly correlated in the Eurobarometer data. We assume that the same is true in the LAC case.

11. The first stage results are not reported, but are available from the author upon request.

FIGURE 5. Life Satisfaction over Time



Source: Author's calculations based on data from Latinobarómetro.

TABLE 5. Determinants of Life Satisfaction^a

	<i>LS1</i>	<i>LS2</i>	<i>LS3</i>
Inflation	-0.009 (0.006)	-0.016 (0.011)	-0.010 (0.007)
Growth	0.048 (0.033)	0.084 (0.051)	0.062* (0.036)
Growth squared	-0.001 (0.003)	-0.003 (0.005)	-0.002 (0.004)
Constant	2.190*** (0.140)	-0.360 (0.270)	-0.085 (0.180)
R squared	0.92	0.91	0.26
Number of observations	45	45	45
Joint significance (<i>p</i> values) of growth-related variables	0.045**	0.038**	0.027**

Source: Author's calculations.

*Statistically significant at the 10 percent level.

**Statistically significant at the 5 percent level.

***Statistically significant at the 1 percent level.

a. Robust standard errors in parentheses. Regressions include year and country dummies.

I then examine whether volatility in economic activity undermines well-being. To do this, I estimate the convexity in preferences over growth. Specifically, I regress *LS* measures against contemporaneous inflation, growth, and a quadratic term for growth. The regressions include a full set of dummy variables for each country and each year. The results are reported in table 5.¹²

Consistent with the results obtained by Di Tella, MacCulloch, and Oswald (2001) and Wolfers (2003) for developed nations, inflation exhibits the expected negative sign in all cases. Nevertheless, it is not significant. The low statistical relevance is explained by the small sample used here, where I focus solely on the IT nations in the region. In De Roux and Hofstetter (2011) similar regressions (although without growth-related variables) are shown to exhibit the same negative coefficient for inflation but along with high statistical significance. In regressions not reported, I included a quadratic term for inflation, but it is not significant either; again a result consistent with that in Wolfers (2003).

Moreover, increases in growth rates go hand in hand with increases in self-reported satisfaction levels, although with marginally decreasing effects.

12. The specification in table 5 only makes sense if there are no negative growth rates. In our sample, there is one negative growth rate, but the absolute value of the number is the smallest figure in the sample. Dropping this observation does not alter the conclusions.

That is, the negative sign on the squared term implies that the growth rate may at some point have a negative effect on LS . Nevertheless, this occurs only at unreasonably high growth rates (13 percent and above). The individual coefficient for the growth term is once significant at the 10 percent level. In all cases, the growth terms are jointly statistically relevant at the 5 percent level.

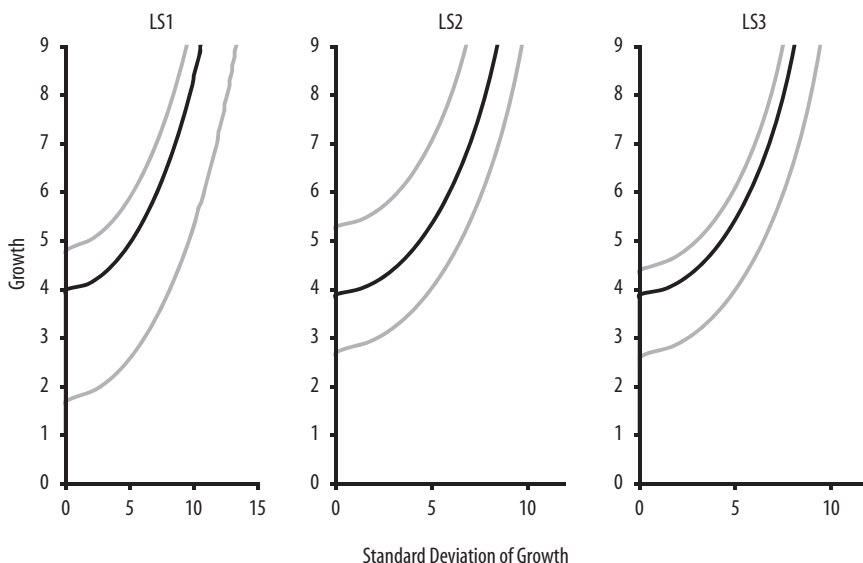
One important issue, which should be stated here, is that while this paper reports estimates with three alternative measures of LS , the second and third are the preferred ones. The reason is that contrary to $LS1$, they control for the micro characteristics of those being surveyed. Thus when discussing results, where discrepancies appear among the three measures, I favor the outcomes of $LS2$ and $LS3$.

The results in table 5 can be expressed in terms of the mean of inflation and the mean and variance of growth. In particular, abstracting from the constants and the error term, and defining g as the output growth rate and \bar{x} as the mean of x , the expected value of LS can be written as

$$\begin{aligned} E(LS) &= E[a\pi + cg + dg^2] \\ &= aE\pi + d[Eg^2 - (Eg)^2] + d(Eg)^2 + cEg \\ &= a\bar{\pi} + d\text{Var}(g) + (d\bar{g} + c)\bar{g}. \end{aligned}$$

This allows us to estimate indifference curves; that is, relationships between output volatility and growth that leave LS unaltered. In figure 6, I plot indifference curves based on the results from table 5. The shape of the indifference curve implies that as volatility goes up, agents need to be compensated with increasingly higher growth rates in order to leave LS unaltered.

How much and for how long would average volatility increase with the adoption of a monetary union? Even though there is no clear answer in the literature to this question, economists have argued that as trade among members increases and their policies converge, there are forces associated with the monetary union that should attenuate increases in volatility over time. Indeed, Frankel and Rose (1997) show that the synchronization of business cycles increases with trade links; consequently, a monetary union will ex post yield more tightly correlated business cycles. Moreover, convergence in monetary and fiscal policies has recently been shown to have a quantitative impact on business cycle synchronization comparable to the trade effect (Inklaar, Jong-A-Pin, and de Haan 2008). While the recent world financial crisis has severely affected certain European countries—and some economists

FIGURE 6. Indifference Curves³

Source: Author's calculations.

a. The lines in the middle pass through the sample mean of growth and standard deviation of growth.

have blamed lack of synchronization for this outcome—new evidence confirms that the business cycle synchronization has increased over time, especially after the introduction of the single currency (for example, Afonso and Sequeira 2010). Thus even though economists are unsure how large the increase in volatility (from giving up the currency) would be, the evidence suggests that it should dissipate over time. Having said that and allowing for a permanent increase in volatility, I present results after monetary autonomy is relinquished.

As explained earlier, the indifference curves are a means for approaching the following question: Is the impact of an increase in volatility potentially large enough to overcome the benefits via trade of LAMU? To answer this question, I use the following counterfactual: What increase in volatility is needed to offset the benefits via trade of LAMU? Here are the detailed steps for implementing an empirical strategy aimed at answering the question.

On the one hand, I estimate the present discounted value of GDP, inclusive of the effect of trade. In the baseline I focus on the case where trade increases

GDP twenty years after a common currency is adopted. The present discounted value of GDP if LAMU is adopted in period 0, inclusive of the benefits of trade, can be written as

$$PDV(Y^{Tr}) = \sum_{t=0}^{19} \left(\frac{1}{1+r} \right)^t Y_0 (1+g)^t + \sum_{t=20}^{\infty} \left(\frac{1}{1+r} \right)^t Y_0 (1+g)^t (1+x).$$

I then ask what increase in growth (later converted to an equivalent increase in volatility via indifference curves) is needed to match these benefits. In the baseline I assume that an increase in volatility occurs as soon as a common currency is adopted and lasts for twenty years. The expression I am interested in is

$$PDV(Y^{\sigma}) = \sum_{t=0}^{19} \left(\frac{1}{1+r} \right)^t Y_0 (1+g+\varepsilon)^t + \sum_{t=20}^{\infty} \left(\frac{1}{1+r} \right)^t Y_0 (1+g)^t,$$

where ε is the additional growth (again, later converted to additional volatility) needed to match the benefits of trade. I estimate ε numerically. Note that for each country, I have specific x 's and thus specific ε 's.

Having country-specific ε 's, I use the indifference curves to calculate the implied increase in volatility for each country needed to offset the benefits of a common currency via trade.¹³ The indifference curves are also country-specific in the sense that each passes through the respective growth and standard deviation means. Table 6 reports the ε 's and respective implied increases in volatility.

For the baseline case, the average ε is 1 percent, and the implied volatility increase (averaged across the *LS* estimations) is 141 percent—a large figure. To put it in perspective, Blanchard and Simon (2001) document that the variability of quarterly growth in real output in the United States (as measured by its standard deviation) declined by half since the mid-1980s. A similar phenomenon occurred in many countries around the world in a process that has been dubbed the Great Moderation. If such a striking process was able to

13. In comparing $PDV(Y^{\sigma})$ and $PDV(Y^{Tr})$, I use the baseline value for g , 4 percent. Later, estimating the increase in volatility, I use country-specific indifference curves—the ones that cross through the average growth and standard deviation of each country. Robustness checks, not reported here, show that none of the conclusions in the section are altered if we try alternative values for g in the first step of the estimation of the volatility increase.

TABLE 6. LAMU: Volatility Increase Needed to Offset Trade Gains
Percent

	ϵ	<i>Implied increase in volatility</i>			<i>Average</i>
		<i>LS1</i>	<i>LS2</i>	<i>LS3</i>	
<i>Baseline</i>					
Brazil	0.29	108	82	78	89
Chile	1.75	383	294	281	319
Colombia	0.98	167	126	120	138
Mexico	0.36	64	47	45	52
Peru	1.37	136	97	92	108
Average	1.0	171.4	129.3	123.1	141.3
<i>x = low(x)</i>					
Brazil	0.14	62	46	44	51
Chile	0.90	259	198	189	215
Colombia	0.49	103	77	73	84
Mexico	0.18	36	26	25	29
Peru	0.70	84	59	56	66
Average	0.5	108.8	81.3	77.2	89.1
<i>Volatility increase lasts thirty years; trade effect after thirty years</i>					
Brazil	0.12	55	41	39	45
Chile	0.77	234	178	170	194
Colombia	0.42	92	68	65	75
Mexico	0.15	31	23	21	25
Peru	0.59	74	52	49	59
Average	0.4	97.4	72.5	68.9	79.6
<i>Volatility increase lasts one hundred years; trade effect after twenty years</i>					
Brazil	0.02	10	7	7	8
Chile	0.12	61	44	41	49
Colombia	0.06	19	13	12	15
Mexico	0.02	5	4	4	4
Peru	0.09	15	10	9	11
Average	0.1	21.9	15.5	14.6	17.4

Source: Author's calculations.

cut volatility by half over three decades, then increasing volatility by almost 150 percent through the monetary union—with the relatively high correlation of business cycles identified earlier—seems implausible. In other words, it seems unrealistic to expect such a large increase in volatility to be caused by the absence of an autonomous monetary authority. Thus I conclude that under the baseline scenario, the positive effect of trade is of a greater magnitude than the negative impact of volatility.

In the same table, I perform a couple of robustness checks. In the second panel, I report results assuming that the trade effect takes its lowest value. In the third, I also check the outcomes if the trade effect only takes place thirty years later and the volatility increase lasts thirty years. On average, both cases suggest that the average implied volatility increase—between 80 and 90 percent—still needs to be very large to offset gains on the trade front. The country with the smallest implied increase in volatility is Mexico. Nonetheless, the implied average increase is about 25 to 30 percent. Since, after Brazil, Mexico is the largest economy in Latin America, the joint business cycle of the five IT nations and the policy decisions of LAMU's central bank would be highly dependent on the Mexican cycle. Thus it is unlikely that the union would increase Mexican volatility by this figure.

Finally, in the fourth panel, I explore the consequences of a permanent increase in volatility (proxied by one hundred years). In that case, the conclusions are less evident, with the exception of Chile, where the common currency still has a clear edge. In the other countries, a not too large but nevertheless permanent increase in volatility can offset the trade gains. The discussion here becomes empirical: Does a common currency increase the volatility of output forever?

As discussed above, the evidence from Europe suggests that the synchronization of the cycles increases after the adoption of a single currency. In Latin America, there is also evidence that a permanent increase in volatility is an extreme assumption. This evidence comes from the “natural experiment” of Panama and Colombia. The former separated from Colombia in 1903 and has since been a dollarized economy. A comparison of the output volatility between Colombia (with its own currency) and Panama (without monetary autonomy) suggests that the volatility increase did not last for a century. Indeed, the standard deviation of GDP growth (relative to the mean GDP growth) for the period 1993–2008 (that is, starting ninety years after the separation) is 0.62 in Panama and 0.80 in Colombia. The same statistics one hundred years after separation (period 2003–08) are 0.30 and 0.31, respectively. To say the least, it is not at all obvious that giving up monetary autonomy leaves

permanent scars on output volatility.¹⁴ Having said that, it is still informative for policymakers to be aware of the implications of this scenario, shown in the fourth panel.

To sum up, the results suggest that the potential increase in volatility that each member country might face when forming a monetary union does not have a first-order impact on well-being—at least not relative to the positive impact of trade unless one assumes that output volatility goes up forever. Otherwise the results suggest that LAMU is preferable to monetary autonomy.

Dollarization or Autonomy?

To study the convenience of dollarizing, I use the same methodology as in the previous subsection. There are two differences, however: if a country dollarizes, it will face both a loss of seigniorage and potentially greater volatility exacerbation. As for the loss of seigniorage, I subtract the present discounted value of lost seigniorage from net trade. I then ask what increase in volatility would offset the gains in trade resulting from dollarizing, net of the lost seigniorage. The results are reported in table 7 for the same baseline case and using the same robustness checks as in table 6.

In the baseline case, the predicted increases in volatility (when they are temporary) needed to offset the gains derived from trade net of lost seigniorage are very large. Even though (with the exception of Mexico) we should expect greater volatility exacerbation when dollarizing than when joining LAMU, the numbers reported in the top panel in table 7 are too large to be expected. On average, volatility should grow by a factor of almost 3, an implausible figure. The robustness checks—focusing on the cases when the increase in volatility is not permanent—still suggest very large figures, with the exception of Brazil, where trade effects are in the pessimistic range. Indeed, Brazil, in the second panel of table 7, would have to see the volatility of GDP increase by 30 percent in order to offset the net gains derived from trade. This is a plausible figure. Thus the conclusion is that giving up monetary autonomy, this time in favor of the dollar, makes economic sense for all countries except Brazil.

If the increase in volatility is permanent (last panel), dollarization still has the edge in Chile and Mexico but no longer in Brazil, Colombia, and Peru.

14. Goldfajn and Olivares (2001) claim that dollarization did increase GDP growth volatility in Panama. However, their estimates are mainly driven by the high volatility of the late 1980s (the conflict with the United States). Moreover, they do not compare Panama with Colombia.

TABLE 7. Dollarization: Volatility Increase Needed to Offset Trade Gains (Net of Seigniorage Losses)
Percent

	<i>Implied increase in volatility</i>				<i>Average</i>
	ϵ	<i>LS1</i>	<i>LS2</i>	<i>LS3</i>	
<i>Baseline</i>					
Brazil	0.4	138	106	102	115
Chile	1.5	354	271	259	295
Colombia	1.8	245	187	178	203
Mexico	5.7	378	283	269	310
Peru	1.2	126	90	85	100
<i>Average</i>	2.1	248.1	187.6	178.5	204.7
<i>x = low(x)</i>					
Brazil	0.1	37	27	26	30
Chile	0.6	211	160	152	174
Colombia	0.8	148	112	106	122
Mexico	3.2	282	217	207	235
Peru	0.5	60	42	39	47
<i>Average</i>	1.0	147.8	111.6	106.2	121.8
<i>Volatility increase lasts thirty years; trade effect after thirty years</i>					
Brazil	0.2	70	52	50	57
Chile	0.7	211	160	153	175
Colombia	0.8	143	108	103	118
Mexico	2.7	254	196	187	212
Peru	0.5	67	47	44	52
<i>Average</i>	1.0	149.0	112.6	107.2	122.9
<i>Volatility increase lasts one hundred years; trade effect after twenty years</i>					
Brazil	0.0	14	10	9	11
Chile	0.1	54	38	36	43
Colombia	0.1	33	24	22	27
Mexico	0.4	75	56	54	62
Peru	0.1	13	9	8	10
<i>Average</i>	0.2	37.9	27.5	26.0	30.5

Source: Author's calculations.

TABLE 8. Impact of Common Currency: Trade Effects of Dollarization; Trade Effects of LAMU; Seigniorage Forgone under Dollarization, with Trade Effects Taking Place from Year Twenty Onward^a

	$i^* = 4\%, r = 5\%, g = 4\%$			$x = \text{mean}(x),$ $r = 5\%, g = 4\%$		$x = \text{mean}(x),$ $i^* = 4\%, g = 4\%$		$x = \text{mean}(x),$ $i^* = 4\%, r = 5\%$	
	$x = \text{mean}(x)$	$x = \text{low}(x)$	$x = \text{high}(x)$	$i^* = 2$	$i^* = 6$	$r = 4.5$	$r = 6$	$g = 2$	$g = 4.5$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Brazil	0.2	-0.1	0.6	0.4	-0.3	0.3	0.1	0.0	0.3
Chile	-0.4	-0.4	-0.4	-0.2	-0.6	-0.4	-0.4	-0.4	-0.4
Colombia	1.5	0.5	2.8	1.7	0.4	1.7	1.2	0.9	1.7
Mexico	11.8	5.7	20.1	11.9	5.6	13.0	9.8	8.0	13.0
Peru	-0.3	-0.4	-0.1	0.0	-0.7	-0.2	-0.3	-0.3	-0.2
Average	2.6	1.1	4.6	2.8	0.9	2.9	2.1	1.6	2.9

Source: Author's calculations.

* Statistically significant at the 10 percent level.

a. Effects reported are percentage of PDV of GDP, 2007.

The same caveats discussed earlier regarding the low likelihood that a country will see its volatility increase forever apply in this case.

Dollarization or LAMU?

Given the large share of trade with the United States, the benefits via trade of dollarizing are greater than those of LAMU for all countries except Chile. On the downside, dollarizing implies a loss of seigniorage and a potentially greater exacerbation of volatility. Here, I take a look at the relative importance of these effects under alternative scenarios. I begin with trade and seigniorage, and later turn to volatility issues.

In table 8, I report the PDV of the trade effect from dollarizing on GDP, net of the same effect if the country in question adopts LAMU. From this *net* trade effect, I subtract the seigniorage forgone if a country dollarizes. Again the present discounted value is measured as a percentage of the PDV of GDP in 2007. If the numbers in the table are positive, dollarization is preferred to LAMU (in terms of trade gains net of seigniorage). The opposite is true if the numbers are negative.

Under the baseline case, Chile and Peru show negative numbers. For the rest of the countries, the benefits of dollarization are greater than those of LAMU if only trade and seigniorage are taken into account. Comparing across columns of table 8, the positive-negative split changes in Brazil when either

the trade effects are low or when the seigniorage loss picks up. Colombia and Mexico are the only cases where, when trade and seigniorage are the sole concerns when comparing LAMU and dollarization, the latter consistently appears as the preferred strategy. This is mostly because Colombia and Mexico have the highest proportion of trade with the United States.

To sum up, with only trade and seigniorage taken into consideration, I have two cases where LAMU is always the preferred strategy (Chile and Peru); two cases where dollarization seems more appropriate (Colombia and Mexico); and one case where there is no clear-cut favorite (Brazil).

Would these conclusions change if I were to consider the effects of volatility? For the Mexican case, the answer is clearly no. On the one hand, one should not expect significantly different increases in Mexican volatility when comparing dollarization with LAMU (see figure 4). On the other hand, the *net* gains via trade of dollarizing, even after taking into account seigniorage losses, are very large. No reasonable change in volatility could offset those gains.

As for Chile and Peru, even without considering volatility, LAMU is the preferred strategy. Since the increase in volatility would be worse under dollarization than under LAMU, this makes LAMU even more attractive vis-à-vis dollarization.

As for Brazil, while in table 8 a few negative signs show up—that is, LAMU is preferable to dollarization—most columns show positive signs. What average increase in volatility is needed to offset the advantage of dollarization under the two *worst* scenarios from the point of view of LAMU (columns 3 and 4)? Using the indifference curve strategy outlined above, the answer is a 28 and a 24 percent average increase in volatility, respectively.¹⁵ Given that Brazil is the main driver of the business cycle of LAMU, and that its correlation with the United States is very low, the relative increase in volatility is plausible. This and the fact that negative numbers show up in table 8 (without taking into account volatility factors) lead us to conclude that, for reasonable calibrations, the large gains on the trade front under dollarization are surpassed by the sum of the trade gains under LAMU, plus the seigniorage forgone and the relative volatility increase under dollarization.

As for Colombia, to counter the relative advantage of dollarization in the baseline case in table 8, an average increase in volatility of 42 percent would be required. Even though Colombia has a low business cycle synchronization with the United States, a 42 percent increase in volatility seems too large to be

15. That is, vis-à-vis a zero threshold increase in volatility in the case of LAMU.

reasonably expected. Nevertheless, if I focus on the average of the two lowest figures for Colombia in table 8 and calculate the increase in volatility that would counter it, the answer is 13 percent. Such an increase in volatility if Colombia were to dollarize—considering the low synchronization of its business cycle with the United States—seems plausible. I conclude that even though dollarization seems to have the edge in most calibrations for Colombia, there are plausible combinations where the choice is a close call.

Thus there are three countries, Chile, Peru, and Brazil, where LAMU seems a better alternative; one case where LAMU and dollarization are close to equal, Colombia; and one case where dollarization is clearly preferable, Mexico. In all cases, a common currency strategy, be it dollarization (except in Brazil) or LAMU, is preferable to monetary autonomy. As Dornbusch (2001) once stated, “Convergence on regional monies is a no-brainer.”

Concluding Remarks

The policy lessons that emerge from this paper are clear: IT nations in Latin America should consider more seriously before giving up monetary autonomy. The fact that the paper focuses exclusively on IT nations in the region is not a coincidence; a successful monetary union needs converging monetary institutions, both in terms of goals and strategies. From the point of view of trade, a monetary union between Argentina and Brazil or between Colombia and Venezuela would make sense. Nevertheless, the monetary institutions, strategies, and goals of Venezuela and Argentina are very distant from the IT framework that Colombia and Brazil share. That is why non-IT countries are not considered in this paper.

There are a few caveats that should be considered when interpreting the results. The conclusions are based on the assumption that increases in volatility caused by countries ceding their monetary autonomy are not permanent. They can be long lived (say thirty or forty years), and conclusions would be the same. However, if the volatility increase is permanent (say a hundred years), giving up monetary autonomy becomes more costly. Nevertheless, the evidence to date suggests that such long-lived volatility increases are unlikely.

An issue that the literature on currency unions has not explored (and this paper is not an exception) is the potential impact of volatility on income *levels*. Indeed, there is some evidence that profound recessions might leave permanent scars on economic activity and unemployment. For instance, Abiad and others

(2009) and Cerra and Saxena (2008) show that economic activity might never recover the precrisis trend following financial crises. If a currency union exacerbates volatility, the occurrence of sharp recessions is more likely. Thus the union could increase the likelihood of an event that would leave permanent scars on the *levels* of economic activity or even unemployment (see Ball, 2009; and Ball, De Roux, and Hofstetter 2011 for a discussion on hysteresis in unemployment in OECD countries and in Latin America, respectively). This calls for interesting new theoretical research in the Optimal Currency Area (OCA) literature. This second generation of OCA research will have to incorporate some of the lessons that start to emerge from the recent European experience, including the possibility that the volatility increase might leave scars on economic activity levels for extended periods of time. These elements are not included in this paper.

Another topic this paper has not considered concerns the political barriers confronting the relinquishing of monetary autonomy. National currency is part of national identity. Even if there were no debate regarding the economic benefits of abandoning it, there would always be public opinion resistant to monetary unions. If a consensus among policymakers emerges regarding the economic benefits of a LAMU, a careful strategy aimed at explaining the cost-benefit analysis to the public should be planned. The European experience has shown that this is not an easy task. As mentioned in the introduction, overcoming resistance to giving up monetary autonomy in favor of a new Latin American currency seems more plausible than in favor of adopting the dollar. In many sectors of the region, anti-Americanism remains strong and often appears as a useful political tool.

Along with addressing political barriers, it should be clear that a currency union among Latin American countries requires many complementary reforms. For instance, the trade integration process should be completed. There has been considerable progress over the last two decades in this area—and recently, Mexico, Peru, Chile, and Colombia have accelerated trade integration—but the process is not yet over. The private sector has also taken some steps in that direction. For instance, in 2011 the stock exchanges of Colombia and Peru merged, forming the largest stock market in LAC in terms of the number of equities traded. On the other hand, the region has not actively addressed the issues related to labor mobility.

The recent crisis in Europe has taught us that difficult political economy issues are present not only before the formation of the union, but persist and actually flourish thereafter, particularly during crisis periods. The muscle of certain members to force others to comply with fiscal goals; the reluctance

of some well-behaved members (as in the example of Germany) to provide financial assistance to others who did not comply with the agreements (for example, Greece); the role of financial regulation; and the supervision of statistics across members are topics that should be evaluated by countries thinking seriously about giving up monetary autonomy.

Additional research on currency unions is certainly needed. There are several areas this paper has not explored, where knowledge is still weak. For instance, this paper has not addressed two important issues regarding currency unions—labor mobility and flexibility, and the role played by fiscal rules. Both topics are part of the first generation of the OCA literature and remain important. There are other topics that I have not addressed that should be part of the second generation of OCA papers. They include the persistence of the volatility increase, the role of hysteresis, financial regulation, and statistical supervision, among others. I hope this paper will spark interest among economists on the important topic of monetary unions so that, in the near future, the robustness of the policy implications of this paper can be more fully assessed.

Appendix. Differences in Preferences: The Short-Run

Let the shocks be identical across the economies, that is, $\varepsilon = \varepsilon\varepsilon_j$; so that $\sigma_\varepsilon^2 = \sigma_{\varepsilon_j}^2 = \sigma_{\varepsilon\varepsilon_j} = \sigma^2$. Here I do *not* assume that $\Theta_j = \Theta = 0$; the goal is to explore the role of Θ_j and Θ in determining the welfare implications of joining a union. Then, $E\Delta L_j$ can be written as

$$(19) \quad E\Delta L_j = (11) + \frac{1}{2} \left[\left(\frac{h\Theta}{1+h} \right)^2 - \left(\frac{h_j\Theta_j}{1+h_j} \right)^2 - 2 \left(\frac{\lambda h \Theta \bar{U}_u}{(1+h)^2} \right) - \left(\frac{\lambda_j h_j \Theta_j \bar{U}_j}{(1+h_j)^2} \right) \right],$$

where the sign of the new line depends on the relative size of the other parameters in the model. I explore differences in each of them, one at a time.

A1. Let $\bar{U}_j \neq \bar{U}_u$, $\lambda_j = \lambda$, $h_j = h$, and $\Theta_j = \Theta$. Then $E\Delta L_j$ can be written as

$$(20) \quad (12) - \frac{\lambda h \Theta}{(1+h)^2} (\bar{U}_u - \bar{U}_j).$$

The new term is negative if $|\overline{U}_j| > |\overline{U}_u|$, and if $\Theta > 0$. That is, if the inflation target is above the optimal rate and country j has more ambitious unemployment goals, joining a monetary union will further increase welfare for j . The credibility the monetary union bestows has a higher impact on welfare when the union occurs among inflation targeters.

A2. Let $\lambda_j \neq \lambda$, $\overline{U}_j = \overline{U}_u$, $h_j = h$, and $\Theta_j = \Theta$. Then $E\Delta L_j$ can be written as

$$(21) \quad (13) - \frac{h\Theta\overline{U}_u}{(1+h)^2}(\lambda - \lambda_j).$$

The new term is again negative as long as $\Theta > 0$ and $\lambda < \lambda_j$. The interpretation is analogous to the previous case.

A3. Let $h_j \neq h$, $\overline{U}_j = \overline{U}_u$, $\lambda_j = \lambda$, and $\Theta_j = \Theta$. Then $E\Delta L_j$ can be written as

$$(22) \quad (14) + \frac{\Theta^2}{2} \left(\left(\frac{h}{1+h} \right)^2 - \left(\frac{h_j}{1+h_j} \right)^2 \right) - \Theta\lambda\overline{U}_u \left(\frac{h}{(1+h)^2} - \frac{h_j}{(1+h_j)^2} \right).$$

For interpretation purposes, I consider the case where $h_j < h$; namely, a scenario where the union's central bank attaches a higher priority to the achievement of the inflation target. The two new terms are positive as long as $\Theta > 0$. The message they convey is intuitively clear: if the union's central bank attaches a greater weight to the inflation target, and the latter is above the optimal rate, then joining the union decreases welfare.

A4. Let $\Theta_j \neq \Theta$, $\lambda_j = \lambda$, $\overline{U}_j = \overline{U}_u$, and $h_j = h$. Then $E\Delta L_j$ can be written as

$$(23) \quad \frac{1}{2} \left(\frac{h}{1+h} \right)^2 (\Theta^2 - \Theta_j^2) - \frac{2h\lambda\overline{U}_u}{(1+h)^2} (\Theta - \Theta_j).$$

The expression says that the higher Θ_j with respect to Θ , the greater the gains of joining the union. By joining the union, country j adheres to a central bank that targets an inflation rate closer to the optimal, reducing the bias generated by the discrepancy between the target and the optimal rate. In this scenario, joining the union will unambiguously be welfare improving.

About the Indexes of Central Bank Independence (CBI)¹

The GMT index comes from the work of Grilli, Masciandaro, and Tabellini (1991). GMT observes fifteen criteria, each one with a score of zero or one. The overall index is obtained by addition. A higher score indicates higher CBI. In this index, political independence is defined in terms of central bank responsibilities, procedures for appointing central bank government bodies, and the level of government control over monetary instruments. Economic independence is defined in terms of restrictions to finance fiscal deficits and the role of the central bank in banking supervision.

The Cukierman index is based on sixteen criteria of political and economic independence. The index uses a continuous scale from zero to one. The overall index is obtained using a weighted average of the individual criteria. Political independence is based on the characteristics of the appointment and dismissal of the central bank's governor and the independence for policy formulation. In terms of economic independence, a central bank is better rated if the provisions for monetization of the fiscal deficit are restrictive. In addition, the index is higher if there is a legal mandate to focus on price stability.

The modified Cukierman index (MCI) changes some of the sixteen criteria considered by the Cukierman index. MCI maintains the four general classification criteria of the Cukierman index but adds a new category for central bank accountability. There are four main changes in the index: (1) MCI assesses characteristics of the appointment and dismissal of the entire board of directors of the central bank. (2) MCI includes the CBI in terms of exchange rate policy. (3) MCI includes central bank faculties as governing lender of last resort as well as provisions that secure central bank financial autonomy. For example, MCI rewards the existence of limits on central bank involvement in banking crises. (4) MCI adds criteria for accountability. For example, MCI rewards legal provisions that force central banks to report their policy targets and achievements on a regular basis. Also, a better MCI is obtained if the central bank financial statements are published regularly.

1. This part is based on the description provided in Jácome and Vázquez (2005).

Comment

Laurence Ball: Marc Hofstetter has performed a skillful and innovative analysis of a major policy question: Should Latin American countries retain independent monetary policy, form a currency union, or dollarize? Hofstetter uses technically advanced methods to measure the costs and benefits of a regime change in comparable units, using survey evidence on the determinants of life satisfaction. The paper reaches the provocative conclusion that both a currency union and dollarization would increase economic welfare in Latin America. While I admire Hofstetter's technical accomplishment, I disagree with his conclusions. I think a currency union is probably a bad idea for Latin America, and dollarization is *definitely* a bad idea. I held these views before I read Hofstetter's paper and have not changed my mind. First I discuss my prior opposition to dollarization and currency union, and then I give reasons I am not persuaded by the paper.

The history of the last twenty years shows that a hard currency peg—either dollarization or a currency board—is a dangerous policy. The emerging market economies that have adopted hard pegs have typically experienced periods of strong capital inflows that ended in a sudden stop. This capital flight has produced severe slumps because the economies have lacked the shock absorber of depreciation. We can determine the costs of a hard peg by comparing the effects of capital flight on countries with pegs and on neighboring countries with flexible exchange rates. As documented in Ball (2010), Hong Kong, with a currency board, was hit much harder than its neighbors during the East Asian financial crisis of 1997–98. Argentina, among all its South American neighbors, was the country hit hardest by the Tequila crisis of 1994 (with the exception of Mexico, where the crisis originated). The Baltic countries and Bulgaria suffered more than other countries in Eastern Europe during the world financial crisis of 2008–09. Hofstetter's position in the paper is ironic, given that he is one researcher who has documented the costs of hard pegs, as borne out in Ball, De Roux, and Hofstetter (2011), which finds that inflexible exchange

rates contribute to large, persistent increases in unemployment in Argentina, Panama, and Paraguay.

A common currency is not as obviously dangerous as dollarization. A regional currency union can allow its currency to depreciate if capital flight hits the region, dampening the effect on output. Hong Kong would have suffered less in 1997–98 if it had used an Asian currency, which would have depreciated, rather than pegging to the dollar. Argentina and Panama would have suffered less from capital flight if they had used a Latin American currency. Yet we have learned a lesson from the current Greek crisis: a sudden stop can occur for one country even within a currency union. When that happens, the country's plight is the same as under a hard peg. Greece's lack of competitiveness has produced steadily rising unemployment—rates of 11 percent in mid-2010 and 16 percent in mid-2011. Greece badly needs a devaluation against the currencies of other European countries, which is impossible as long as it retains the euro. A monetary union in Latin America could push one of its members to become the next Greece. Thus the history of hard pegs and currency unions makes me a skeptical reader of Hofstetter's paper.

Still, Hofstetter offers estimates of the costs and benefits of these regimes and finds that the benefits are higher. Why aren't these calculations persuasive? The answer is that, in my view, the estimates both overstate the benefits and understate the costs. The primary benefit of dollarization or a currency board is an increase in trade among the countries that share a currency. Thus a key parameter for Hofstetter's cost-benefit analysis is the proportion by which a common currency increases trade. As Hofstetter discusses, research on the euro suggests that it has increased intra-European trade by something on the order of 10 percent. This European precedent is the most reliable guide to the effects of new Latin American currencies. Some researchers find larger effects of common currencies, but their estimates are based on the less relevant experiences of tiny countries. Hofstetter argues that dollarization has substantial benefits even if we assume 10 percent for the trade effect. However, I believe there is an error in his calculations. In table 3, to estimate the effect on trade, he multiplies current trade with the United States by 1.1. He should multiply instead by 0.1, which gives the increase in trade resulting from dollarization, while multiplying by 1.1 gives total trade with the United States after dollarization. Hence if I am correct, all the benefits of dollarization in table 3 should be divided by 11 ($[1.1]/[0.1]$), and this adjustment makes the benefits very small.

A similar point applies to the costs of dollarization or currency union. My main concern is an issue that Hofstetter points out in his conclusion. The

paper's estimates of costs assume that a monetary regime can influence the variability of output but not its average level. In effect, Hofstetter assumes that any output loss that dollarization or currency union causes in one period is balanced by higher output in another period. If this assumption is wrong, the costs of a regime are likely to be much higher than Hofstetter estimates. In reality, it appears that hard pegs and currency unions cause output and employment losses that do not come with offsetting gains. In Argentina, over the decade from 1991 to 2001, the combination of capital flight and a hard peg raised unemployment by 12 percentage points—from 6 to 18 percent. Obviously an offsetting decrease in unemployment would be impossible: regardless of the monetary regime, no shock could push unemployment from 6 to -6 percent.

Summing up: Hofstetter has taken a promising first step in quantifying the costs and benefits of alternative monetary regimes. For the results to be plausible, however, he must address the problem with measuring trade effects that I have highlighted, and account for the effects of policies on average output and employment. These modifications of Hofstetter's analysis are likely to yield more negative results about dollarization and currency unions.

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