On The Causes and Consequences of Currency Unions

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Abstract

Why do countries participate in currency unions or unilaterally adopt a foreign currency? I investigate the roles of geography, synchronization of economic shocks, cultural similarity, size, political integration and colonial heritage as determinants of monetary unions. The results motivate a selection model for common currency areas, which I then use to revisit the impact of currency-union membership on trade. I argue that previous studies that do not account for endogenous selection tend to produce estimates with a large positive bias. Correcting for selection, I find that the evidence for an enhancement effect of currency unions on trade is weaker than previously documented.

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1 Introduction

The map of world currencies is under revision. Twelve Western European countries have recently instituted the euro as their common currency. Sweden, Denmark and Britain have opted out, but they might join in the near future. Moreover, some Eastern European countries are likely to unilaterally adopt the euro as legal tender. Ecuador fully dollarized its economy; El Salvador and Guatemala legalized the use of the dollar and other governments in South and Central America are giving serious consideration to dollarization. Six West African states have agreed to create a new common currency in the region by the year 2003 and eleven members of the Southern African Development Community are debating whether to adopt the dollar or to create an independent monetary union possibly anchored to the South African rand.[1] This reshaping of the international monetary arrangement has reinvigorated the theoretical and empirical debate over the wisdom of currency unions.

The case for joining a currency union rests on two important benefits: one is the elimination of currency conversion costs and the disturbances in relative prices coming from nominal exchange rate fluctuations. The second is its potential to discipline policies, in particular to combat inflation, insofar as the anchor country (or the union's monetary authority) is better able to commit to monetary rules. Lower transaction costs and greater predictability encourage deeper integration in financial and non-financial markets.

The main argument against currency unions, from the perspective of a country member, is the loss of independence to tailor monetary policy to local needs. A currency union is

[1] The group of West African countries includes Ghana, Nigeria, Liberia, Sierra Leone, Gambia and Guinea. Initial participants in the Southern African monetary union will be South Africa, Botswana, Lesotho, Malawi, Mauritius, Mozambique, Namibia, Swaziland, Tanzania and Zimbabwe. Zambia is expected to confirm its membership. Angola, the Democratic Republic of Congo and Seychelles, also members of the Southern African Development Community, will not join the monetary union.

therefore relatively less costly for countries that feature high levels of labor mobility and high comovement of economic shocks vis-à-vis other countries in the union. Synchronization of shocks increases the consensus over the direction of monetary policy, whereas high mobility facilitates full employment, reducing the need for active policy. Additional costs of giving up a national currency include the loss of seignorage revenues and, arguably, the loss of a national symbol.

The quantitative importance of these cost-benefit considerations as determinants of currency unions has never been assessed. The first contribution of the current paper is a thorough study of the empirical determinants of existing currency unions, exploring the roles of geography, comovement of shocks, size, cultural similarity and colonial links, all in the context of a simple model of the currency union decision based on Mundell (1961) and Alesina and Barro (2001). The second contribution of this paper is to provide perhaps more reliable estimates of the effect of currency unions on trade. A number of recent papers estimated the effect of currency unions on international trade. Most notably, Rose (2000) and Frankel and Rose (2000) report that bilateral trade between two countries that use the same currency is, controlling for other effects, *over two-hundred-percent larger* than bilateral trade between countries that use different currencies. Frankel and Rose (2000) also report a significant effect of currency unions on income, mediated by trade.

The apparently large effect of currency unions on trade is puzzling and raises a number of concerns, some of which can be addressed by using the empirical selection model of currency union membership that I estimate.[2] Persson (2001) voices a critique based on the potential for self-selection in the decision to form a currency union. Among other distinctive features,

[2]The effect itself is puzzling because estimates of the impact of reduced exchange rate volatility on trade are small and fees on currency conversion are relatively low. (The argument that currency conversion costs are low may not apply to trade in capital, where the currency turnover is extremely high and hence small costs can translate into large disbursements.)

countries that have been engaged in currency unions during the past decades are typically small or poor. Examples are the fourteen countries of the CFA franc zone in Africa, the seven members of the Eastern Caribbean Currency Area and the unilaterally dollarized Panama, Puerto Rico and Bermuda.[3] Systematic differences in characteristics can distort OLS estimates when the effect of using the same currency differs across groups or when there are non-linearities in the trade relation that are ignored.

Besides the selection on observables problem, there are two other econometric concerns with the simple OLS estimates. One is an omitted variable problem (selection on unobservables). Compatibility in legal systems, cultural links, better infrastructure and tied bilateral transfers, for example, may increase the propensity to form a currency union as well as strengthen trade links between two countries. This correlation could lead to a positive bias in simple OLS estimates. Other variables, such as market concentration, may bias OLS estimates in the opposite direction: higher levels of monopoly distortion in the economy may lead to higher inflation rates under discretion and thereby increase the need to join a currency union as a commitment device to reduce inflation; on the other hand, higher mark-ups tend to deter trade. The second concern is caused by a simple problem caused by sample selection. Previous estimates of the currency union effect were based on a sample of countries with positive bilateral trade. Pairs of countries with zero trade flows were excluded from the sample to satisfy the log-specification of the gravity equation.

[3]The CFA zone comprises two monetary groupings: the West African Economic and Monetary Union, formed by Benin, Burkina Faso, Cote d'Ivoire, Guinea-Bissau, Mali, Niger, Senegal and Togo, and the Central African Economic and Monetary Community. Each regional grouping issues its own CFA franc and, even though the two CFA francs are legal tender only in their respective regions, they maintain the same parity against the French franc and, since 1999, against the euro. Comoros pegs its currency, the Comorian franc, to the CFA franc; it has kept a fixed convertibility since the beginning of the CFA and is typically classified as a currency union member.

To overcome these difficulties, I use the empirical estimation of the determinants of currency unions to motivate a selection model for common currency areas. I then reexamine the impact of currency unions on international trade, after accounting for potential self-selectivity. To address the problem of zero-value entries for some years, I work with aggregate flows over five years.

Two results of this investigation stand out. First, excluding zero-valued entries tends to bias up OLS estimates. The effect falls from approximately 200% to 100% when average trade flows are used. The reason is that many members of currency unions are small countries that traded intermittently during the period under study. In the years they do trade, they outperform the predictions of the gravity equation (when flows are defined on a yearly basis). Thus, ignoring the information that they do not trade in some years generates an artificially large effect.[4]

Second, estimates of the impact of currency unions on trade fall when endogenous selection into currency union is taken into account. Point estimates indicate a trade-enhancement effect below 60%, although the numbers are not significantly different from zero. While point estimates are still sizeable, the general message here is that the impact of currency unions on trade might not be as robust as previous studies have reported.

The paper is organized as follows. Section 2 presents a theoretical framework that helps to motivate several empirical determinants of currency unions. Section 3 introduces the data and methodology. Section 4 studies the empirical determinants of currency unions. Section 5 revisits the effect of currency unions on trade. Section 6 summarizes and concludes.

[4]Notice that "zeros" are a problem at the bilateral level. (Total trade is typically positive for all countries.) A problem still remains with pairs of countries that never traded. While the inclusion of these pairs may counteract the results, they clearly call for a different theory that predicts zero-trade flows.

2 Theoretical Framework

The theory of optimal currency areas dates back to Mundell's 1961 paper, in which he describes a number of trade-offs involved in the decision to form a currency union. Alesina and Barro (2001) formalize these trade-offs in an analytical model and add new elements to Mundell's optimality criteria. To frame the empirical work, this section presents a simplified version of the model and summarizes the main forces at play.

2.1 Baseline Model

Competitive firms produce output using a varieties-type production function à la Spence (1976), Dixit and Stiglitz (1977). The output of firm i is given by:

$$Y_i = AL_i^{1-\alpha} \cdot \sum_{j=1}^{N^I+N^{II}} X_{ji}^{\alpha}, \tag{1}$$

where $A > 0$ is a productivity parameter, L_i is firm i's employment of labor, $0 < \alpha < 1$, X_{ji} is the amount of intermediate input of type j used by firm i, and N is the number of types of intermediates available. In the baseline model, there are two countries, where country I produces the intermediates $j = 1, ..., N^I$ and country II the intermediates $j = N^I + 1, ..., N^I + N^{II}$.[5] Intermediate inputs are differentiated goods and, to simplify the setting, there is no overlap in the range of goods produced by the two countries. A country that is larger in terms of number of products is assumed to be larger in the same proportion in terms of labor: $\frac{N^I}{L^I} = \frac{N^{II}}{L^{II}}$ and the ratios are normalized to 1. Within each economy, labor markets are perfectly competitive; however, there is no migration across borders.

There is free trade and no transaction costs for shipping goods within each country. The shipping of an intermediate good across country borders entails transaction costs, which are

[5] The model can be easily extended to include more than two countries.

assumed to feature an "iceberg" technology: for each unit of intermediate good shipped from country I to country II or the reverse, $1-b$ units arrive, with $0<b<1$.

Each firm maximizes profit, taking as given the real wage rate, W, and the price, p_j, of each type of intermediate good. (The prices are all measured in units of final product.) The first-order conditions for the choices of intermediate inputs are:

$$\begin{aligned} A\alpha L_i^{1-\alpha} X_{ji}^{\alpha-1} &= p_j,\ j=1,...,N^I, \\ A\alpha L_i^{1-\alpha} X_{ji}^{\alpha-1} &= (\frac{p_j}{1-b}),\ j=N^I+1,...,N^I+N^{II}. \end{aligned} \tag{2}$$

Every producer of final goods will use all N^I+N^{II} varieties of the intermediate inputs as long as all of the prices are finite and $b<1$.

Final output is a homogeneous good that can be used for consumption or to produce intermediate goods. To simplify matters, consumption goods are identical and their transportation entails no cost; hence, their prices are the same everywhere and are normalized to one.

Prices of intermediates depend on the extent of monopoly power: if there is only one potential producer in each sector, the constant-elasticity demand function implied by the Spence-Dixit-Stiglitz formulation determines the monopoly price of each intermediate good to be $1/\alpha$. More generally, other forms of imperfect competition will lead to a marked-up price $p_j=\mu_j$, with $1<\mu_j<1/\alpha$. Substitution into equation (2) determines the quantities of intermediates j demanded by firm i in country I :

$$\begin{aligned} X_{ji} &= (A\alpha/\mu^I)^{1/(1-\alpha)} \cdot L_i,\ j=1,...,N^I, \\ X_{ji} &= [(A\alpha/\mu^{II})\cdot(1-b)]^{1/(1-\alpha)} \cdot L_i,\ j=N^I+1,...,N^I+N^{II}. \end{aligned} \tag{3}$$

Aggregating over firms leads to the level of aggregate output in country I:

$$Y^I = A^{1/(1-\alpha)}\alpha^{\alpha/(1-\alpha)} L^I \left[\left(\frac{1}{\mu^I}\right)^{\alpha/(1-\alpha)} N^I + \left(\frac{1-b}{\mu^{II}}\right)^{\alpha/(1-\alpha)} N^{II} \right] \tag{4}$$

From the perspective of incentives to use the intermediate inputs, markup pricing ($\mu^{II} > 1$) and trading costs ($b > 0$) have similar and reinforcing effects. The value of these imported goods, gross of trading costs, is determined by multiplying the quantity of intermediates by $\mu^{II}/(1-b)$:

$$\begin{aligned} & \text{Value of intermediates imported by } I \\ = \; & (A\alpha)^{1/(1-\alpha)} \left(\frac{1-b}{\mu^{II}}\right)^{\alpha/(1-\alpha)} N^I N^{II} \end{aligned} \tag{5}$$

An expression analogous to the second part of equation (3) determines the quantity of country I's intermediates used by final-goods producers in country II. The corresponding value of the exports of intermediate goods from country I to country II can be calculated, after multiplication by $\mu^I/(1-b)$, as

$$\begin{aligned} & \text{Value of intermediates exported by } I \\ = \; & (A\alpha)^{1/(1-\alpha)} \left(\frac{1-b}{\mu^{I}}\right)^{\alpha/(1-\alpha)} N^I N^{II} \end{aligned} \tag{6}$$

2.2 Empirical Implications

The model predicts that higher trading costs, b, reduce the overall volume of trade. Empirically, the parameter b might relate to distance, other measures of transport costs, tariff and non-tariff barriers, costs of currency conversion, costs associated to exchange rate uncertainty and, more generally, differences in culture, language, legal systems, etc.

Sharing a common currency lowers the cost parameter b, and insofar as this reduction is important, it should lead to a higher volume of trade. The extent of trade-enhancement caused by lower conversion costs will depend, however, on other trading costs and on the elasticity of substitution between goods. More precisely if b is the sum of all trading costs,

the gain on trade coming from sharing a common currency will be proportional to:

$$\frac{\partial VTrade}{\partial b} \sim (1-b)^{\frac{2\alpha-1}{1-\alpha}} \tag{7}$$

If $\alpha > 1/2$, the trade gain caused by a reduction in currency conversion costs will have a larger effect when other trading costs are smaller. The intuition is that when goods are relatively close substitutes, lowering b will save on the trading costs incurred (which are more important when trade volumes are large). If $\alpha < 1/2$, the trade gain derived from lowering conversion costs will be increasing in other trading costs. In this case, when trading costs are large, trade in the margin has a large value and a reduction in b will have a high impact on trade, largely reinforced by the fact goods are poor substitutes.

In a multi-country multi-currency setting, if goods are close substitutes, a country will be more prone to form a monetary union with natural trading partners (i.e., countries for which trade volumes are large due to low trading costs).[6] The opposite will be true if goods are poor substitutes. The general message here is that trading costs affect the selection of common-currency partners and, thus, should be included in the econometric model of currency unions.

The total volume of trade is proportional to the product of the number of varieties, $N^I N^{II}$. Empirically, the number of varieties might be proxied by the level of per capita GDP, as it relates to the level of technological development of a country and other measures of size (e.g. population and geographical area). Notice that the "gravity force" present in the

[6] The underlying assumption is that countries seek to maximize consumption flows; in the model, consumption is increasing in the volume of trade. If markups are equal for the two countries $\mu^I = \mu^{II} = \mu$, the resulting formula for per capita consumption in country I reduces to:

$$C^I = A^{\frac{1}{1-\alpha}} \alpha^{\frac{\alpha}{1-\alpha}} (1/\mu)^{\frac{1}{1-\alpha}} N^I (\mu - \alpha) \left[N^I + (1-b)^{\frac{\alpha}{1-\alpha}} (\mu^I - 1) N^{II} \right]$$

trade equation is also reflected on the selection of common-currency partners. Other things equal, and from a pure trade-gain perspective, a country will always prefer "large" countries as common-currency partners. This was the initial motivation for common currency areas, postulated by Mundell (1961): the wider the area of common currency, the larger the gains coming from integration. Why not a single global currency? By forming a currency union, countries give up their monetary independence and hence lose their ability to respond to local disturbances. If countries are affected by idiosyncratic shocks, then, the larger the area of common currency, the lower is the ability to respond to these local shocks. These trade-offs are discussed in the following section.

2.3 Monetary Independence versus Currency Union

This section extends the baseline model to highlight the role of comovement of economic shocks in the formation of common currency areas. To introduce a potential role for monetary policy, the model assumes that the nominal prices of specialized goods involve some stickiness, whereas the price of competitive and homogeneous goods are flexible. In this setup, surprise inflation in the price of the final product tends to reduce the relative price of intermediates. The expansionary effect on output emulates the effect derived from lower markups μ. Hence, some amount of unexpected inflation can look desirable, ex post, to the monetary authority. Moreover, if markup ratios vary over time, the policymaker will value unexpected inflation more when markups are high.

Actual inflation π might also affect transaction costs in the domestic economy; Alesina and Barro (2001) model this cost as a function $\beta(\pi)$, increasing in π, that follows an iceberg technology similar to the one for foreign trade costs, b. In turn, this last parameter b is likely to be affected by inflation in both countries.

Including nominal elements in the model leads to the following expression for output:

$$Y^I = A^{\frac{1}{1-\alpha}} \alpha^{\frac{\alpha}{1-\alpha}} L^I \left[\left(\frac{1-\beta(\pi)}{\mu^I} \frac{p}{Ep} \right)^{\frac{\alpha}{1-\alpha}} N^I + \left(\frac{1-b(\pi,\pi^*)}{\mu^{II}} \frac{p^*}{Ep^*} \right)^{\frac{\alpha}{1-\alpha}} N^{II} \right] \tag{8}$$

The corresponding expression for per capita consumption is given by:

$$\begin{aligned} \frac{C^I}{N^I} = A^{\frac{1}{1-\alpha}} \alpha^{\frac{\alpha}{1-\alpha}} \{ (\tfrac{1}{\mu^I} \tfrac{p}{Ep})^{\frac{1}{1-\alpha}} [(1-\beta)^{\frac{\alpha}{1-\alpha}} (\mu^I \tfrac{Ep}{p} - \alpha) N^I + \\ + \alpha (1-b)^{\frac{\alpha}{1-\alpha}} (\mu^I \tfrac{Ep}{p} - 1) \cdot N^{II}] + (1-\alpha) (\tfrac{1-b}{\mu^{II}} \tfrac{p^*}{Ep^*})^{\frac{\alpha}{1-\alpha}} \cdot N^{II} \} \end{aligned} \tag{9}$$

From the standpoint of a social planner whose objective function is maximizing consumption, some inflation will be valuable. As the amount of unexpected inflation increases ($\pi - \pi^e = \ln \frac{p/p_{-1}}{Ep/p_{-1}} = \ln \frac{p}{Ep}$), the gain in consumption decreases, eventually becoming nil and, for higher values of inflation, the effect on consumption becomes negative.[7] Abstracting from the effect of lower conversion costs on trade, the effect of inflation on consumption (and welfare) can be approximated by a loss function equal to:

$$\pounds_I = \Psi + \delta \pi_I + \gamma/2 \cdot \pi_I^2 + \theta/2 \cdot [\phi(\pi_I^e - \pi_I) - z_I - \eta_I]^2, \tag{10}$$

with $\theta > 0$, $\gamma > 0$, $\phi > 0$ and $\delta > 0$; $z_I > 0$ relates to the average level of markups in country I and the term η_I corresponds to fluctuations of the markup ratio around the mean value; η_I is assumed to follow a serially independent process with zero mean and constant variance $\sigma^2_{\eta_I}$. Ψ summarizes all the terms that cannot be affected by the monetary authority. The dependence on actual inflation represents the loss coming from inflation-induced transaction costs.[8] Discretionary equilibrium results in an inflation rate equal to:

$$\tilde{\pi}_I = -\frac{\delta}{\gamma} + \frac{\theta \phi z_I}{\gamma} + \frac{\theta \phi \eta_I}{\gamma + \theta \phi^2}, \tag{11}$$

[7] The model gives rationale to a loss function analogous to the one postulated in Barro-Gordon (1983).

[8] Alternatively, in a more general model, it can also be viewed as representing seignioriage revenues (in which case $\delta < 0$).

where the second term represents the inflation bias caused by monopoly distortions. If the country could commit to a given level of inflation one period ahead, then the inflationary bias will disappear. For the sake of the argument, assume that country I is unable to follow a monetary rule. If preference and costs parameters are the same in country II, a similar expression will hold for foreign inflation. Suppose furthermore that the foreign country is able to commit to a policy rule. In this case, its inflation will be given by:

$$\tilde{\pi}_{II} = -\frac{\delta}{\gamma} + \frac{\theta\phi\eta_{II}}{\gamma + \theta\phi^2} \tag{12}$$

If country I were to adopt country II's currency, its inflation rate would be equal to that in country II plus the change in the relative price of the two countries' baskets. In the baseline model, there is only one type of consumption good and the law of one price is assumed to hold. In this setup, inflation rates will be equal if countries use the same currency. The model can be generalized by introducing a term ε that reflects shocks to the relative prices of the two baskets. For simplicity, this shock is assumed to be serially uncorrelated, zero mean and constant variance σ_ε^2. The rate of inflation for country I after adopting country II's currency will be given by:

$$\pi_I^{II} = -\frac{\delta}{\gamma} + \frac{\theta\phi\eta_{II}}{\gamma + \theta\phi^2} + \varepsilon \tag{13}$$

To assess the convenience of adopting the currency of country II, country I will compare the welfare loss under the two regimes. (The final decision will also take into account the trade gains discussed in the previous section). Evaluating the loss function under the two inflation outcomes, (11) and (13), and taking the differences in expectations, the incremental gain of adopting the foreign currency for country I is given by:

$$\begin{aligned} \Delta E\pounds &= E\pounds^{indep\$} - E\pounds^{foreign\$} = \\ &= \frac{(\theta\phi z_I)^2}{2\gamma} - \frac{1}{2}\left[(\gamma + \theta\phi^2)\sigma_\varepsilon^2 + \frac{(\theta\phi)^2}{\gamma + \theta\phi^2} Var(\eta_I - \eta_{II})\right] \end{aligned} \tag{14}$$

$\Delta E\pounds > 0$ indicates that the adoption of the foreign currency leads to higher welfare than monetary independence. The gain of adopting the foreign currency increases with the level of monopoly distortions in country I, z, which leads to the inflationary bias under discretion. The second term reflects the loss of giving up monetary independence caused by fluctuations in terms of trade. Country I inherits country II's inflation plus random variations in relative prices. Higher comovement of terms of trade shocks (lower σ_{ε}^2) makes monetary independence less advantageous. Finally, the third term captures asymmetric shifts to the extent of competition. Under an independent regime, the authority can react to variations in η_I. Absent this ability, the loss of using a foreign currency will decline with the extent of comovement in shocks to competition.

In this simplified version of the model, only unilateral adoption is considered. In a multilateral currency union, the union's authority will take into account idiosyncratic shocks in all countries and then the split of power among the members will be relevant. Asymmetry in sizes might be a concern when the country that stands out does not have a strong capacity to commit. A union formed by South American countries, without an external anchor, seems infeasible given the preponderance of Brazil and its limited capacity to provide price stability. Absent fragmented collusion, a union between equally-sized countries may lead to a more sustainable equilibrium.

In the next sections I explore the main forces emphasized in the model, trying to assess the roles of comovement of price and output shocks, absolute and relative size, trading costs and colonial heritage as determinants of currency unions. This motivates a selection model for currency union membership, which I then use to offer new estimates of the effect of currency unions on trade.

3 Data and Methodology

The raw data set consists of annual observations for over two-hundred countries and small political units (territories or dependencies of other countries) from 1978 to 1997. The data set includes annual bilateral trade information extracted from the *World Trade Database*, compiled by Feenstra, Lipsey and Bowen (1997). This database is complemented with data from the *United Nations Statistical Yearbook.* Trade data are expressed in thousands of (nominal) US dollars.[9] In order to aggregate trade flows, I deflate nominal values using the US GDP deflator. Data on real GDP, population and prices (PPP of GDP) come from the Penn World Tables and the World Development Indicators.

To compute bilateral distances, I use the great-circle-distance algorithm provided by A. Gray (2001).[10] Data on location, as well as contiguity, landlockedness, language and colonial relationships come from the *CIA World Fact book 2001.* Data on free trade agreements come from Frankel and Rose (2000) and are complemented with data from the *World Trade Organization* web page.

The database includes many countries that traded in some years and not in others.[11] For instance, Central African Republic and Chad, which, parenthetically, are members of the CFA monetary union, reported positive trade in nine out of twenty years (1978 to 1980, 1983, 1989, 1993, 1994, 1995 and 1996); Central African Republic and Cote D'Ivoire, also in the CFA union, reported positive trade from 1978 to 1983, 1985, 1989 and from 1993 to 1996.

Zero-valued trade flow entries present a problem for econometric estimation because the "gravity" literature predicts a log-linear relationship between trade flows and the product of

[9] For the sources of data, I follow Rose (2000).

[10] Data on bilateral distance and/or the program can be downloaded from my web page.

[11] The sample excludes pairs of countries that never engaged in trade during the period 1977-1997.

outputs, after controlling for distance and other variables creating "trade resistance." The empirical literature has adopted different approaches to deal with zero-valued entries in the gravity equation. The most common strategy has been to exclude pairs with no trade (for a discussion, see Frankel, 1997). This was the approach followed by Rose (1999), Frankel and Rose (2001) and several subsequent papers studying the effect of currency unions on trade.[12]

Countries in currency unions tend to exhibit a more irregular pattern of bilateral trade, alternating between years of no trade at all and years of relatively large trade volumes. Given this behavior of trade flows, dropping zero-valued observations creates an artificially large effect of currency unions on trade. Theory does not precisely constrain the time interval over which trade flows should be defined and hence, to minimize the number of zero entries, I aggregate trade flows over five-year periods. By aggregating trade flows over time, more than 3,000 year-pair-country observations are added (in approximately 23,000 total observations).

In this data set, approximately forty countries were members of currency unions or used some other country's currency.[13] Since only a few countries switched regimes during this

[12]Rose (1999) provides alternative estimates using a two-step procedure to account for non-randomly missing observations. There are, however, two problems with the proposed procedure: one is that the exclusion restriction is not satisfied (colonial links are used in the first-stage equation to determine whether trade is observed and then excluded from the trade equation, where they are likely to belong). A second concern is that the sample only uses yearly trade data at five points in time (1970, 75, 80, 85, 90). It is not clear why all countries - particular small ones - should feature a smooth bilateral trade pattern, when measured on a yearly basis. Averaging over years can give a more accurate measure of bilateral trade links. A second approach within the gravity equation literature implemented, for example, by Havrylyshyn and Pritchett (1991), is to use a Tobit model to determine first whether countries trade or not and then estimate the gravity equation in levels. The main objection is that censoring points are arbitrary. Given that I already have a selection equation for currency unions, I prefer to address the issue of zero-valued entries by averaging over time.

[13]See the list of countries in Table A1. While 40 out of 218 countries in sample were part of a currency union, only 1% of the country-pairs shared a common currency.

period (e.g., Anguilla joined the ECCA and Guinea-Bissau adopted the CFA franc in 1987), the estimation relies mainly on cross-sectional variation.

I use the binary variable CU_{ij} to indicate whether countries i and j share the same currency or not. I model the propensity to belong to a currency union as a latent index, CU^*_{ij}:

$$CU^*_{ij} = \boldsymbol{\theta}'\mathbf{x}_{ij} + \epsilon_{ij}$$

where $\mathbf{x}$ is independent of ϵ. The latent index in (15) can be interpreted as the expected net benefit, for a given pair of countries, from being members of a common currency area. The vector $\mathbf{x}$ includes a set of variables that account for these costs and benefits, as described below.[14]

When benefits exceed costs, countries form a currency union; in that case, the dummy variable CU_{ij} takes on the value one. When gains fall below costs, countries use different currencies ($CU_{ij} = 0$). This is summarized in equation (16):

$$CU_{ij} = 1 \text{ if } \boldsymbol{\theta}'\mathbf{x}_{ij} > -\epsilon_{ij} \text{ and } CU_{ij} = 0, \text{ otherwise} \tag{16}$$

Participation is modeled as a probabilistic function. Assuming symmetry of the distribution, we can write:

$$\Pr(CU_{ij} = 1) = \Pr(\epsilon_{ij} < \boldsymbol{\theta}'\mathbf{x}_{ij}) \tag{17}$$

As a measure of (lack of) comovement of output shocks, vector $\mathbf{x}$ includes the variable vy_{ij}, calculated as the standard deviation (error) of the ratios of real GDP per capita (in logs) between country i and country j from a second order autoregressive equation.[15] This

[14] I use the term "country" for simplicity; some of the geographical units considered in the study are, however, dependencies or territories of other countries.

[15] $vx_{ij} = vx_{ji}$ is calculated as the root mean squared error of the regression:

variable is meant to proxy for shifts in the extent of competition generated by fluctuations in real markups, i.e., the term $Var(\eta^I - \eta^J)$ in the model. More generally, it captures the extent of asymmetries in shocks generated by demand and supply forces.

As a measure of (lack of) comovement in the prices of the two countries' baskets, the latent index includes vp_{ij}, defined in the same way as vy_{ij}, using PPP in lieu of GDP. A lower value of vp (vy) means that the two countries feature higher price (output)-shock synchronization.

To control for size, I use *lareap*, the sum of the geographical areas (in logs) covered by the countries. This term captures the "gravity effect" described in Section 2. To control for relative sizes, I use the absolute difference in (the log of) area sizes, *difla*.[16]

In order to quantify the importance of trading costs in the propensity to form a currency union, one would ideally like to have direct measures of bilateral transaction costs other than currency conversion. However, there is no homogeneous compilation of these data for all bilateral pairs. As is standard in the trade literature, I use a set of geographic variables to proxy for these costs. Thus, the latent index equation includes (the log of) geographical distance ($ldist$), a dummy variable for whether the countries (or political units) share a common border ($border$) and two dummies, respectively, for whether one or both countries in the pair are landlocked (ll_1, ll_2).[17] Being landlocked is typically associated with larger trading costs, given the lack of access to cheaper ocean transportation.

Measures of cultural similarity are also included, as they may also reflect other dimensions of transaction costs. Sharing a common language and a common colonial history may facil-

$\ln\left(\frac{x_{i,t}}{x_{j,t}}\right) = \alpha_0 + \alpha_1 \ln\left(\frac{x_{i,t-1}}{x_{j,t-1}}\right) + \alpha_2 \ln\left(\frac{x_{i,t-2}}{x_{j,t-2}}\right) + \varepsilon_{ij,t}$. The time span for this calculation is 1960-1997.

[16] $difla_{ij} = |\ln A_i - \ln A_j|$

[17] $ll-1$ equals one when only one country in the pair is landlocked and zero otherwise; $ll-2$ equal ones when both countries are landlocked.

itate communication and hence lower the cost of exchange. The variable *comlang* indicates whether the two countries (or geographical units) speak the same language or not; *comcol* indicates whether they were colonies of a common country; *colonial* indicates whether one of the countries was a former colonizer of the other. In order to capture stronger social and political links, I add two other variables, *com*70 and *comctry*. The first one indicates whether the two geographical units were part of the same country at least until 1970 and the second indicates whether they are currently part of the same country. These two variables reflect the additional effect of having been part of a common administration for a longer period of time. Geographical proximity and cultural similarity may also contribute to more labor mobility between countries and hence reduce the costs of forming a currency union.

Table 1 presents summary statistics for all country pairs (Panel A) and for countries in currency unions(Panel B). On average, in comparison to country pairs in the full sample, countries sharing a common currency tend to be geographically closer, share the same language and the same colonizer. More than a third of the pairs in currency unions were part of a common country until the seventies. They also exhibit a more irregular pattern of trade. In many single years, trade between two particular countries is zero and hence the (log of) trade volume is missing. The (log of) average volume of trade is still available, as within a five-year interval they are more likely to experience some trade. This pattern is of greater concern for countries in currency unions, perhaps due to their smaller size.

As already mentioned, many countries join currency unions as a mechanism to combat inflation and this motivation should be included in the latent index equation. Monopoly distortions in the economy, inefficiencies in the fiscal system (which may increase the need of seigniorage), and, more generally, deficient institutions may all contribute to increase the inflationary bias and hence the gains from joining a currency union. While these forces are likely to determine participation, data availability is a constraint: there is no information on

monopoly distortions or potential for committed policies for all of the countries under study.

In this regard, however, I include a dummy for free trade agreements, under the presumption that countries willing to promote free trade policies are also willing to promote more competition within the internal economy and are therefore less prone to have an inflationary bias. Moreover, if inflation generates positive externalities to other countries, as in the Alesina and Barro setup, the implication is that more open economies have lower incentives to introduce surprise inflation and hence should feature lower inflation rates under discretion. To the extent that regional agreements lead to more openness, they will tend to reduce inflation rates and hence lower the need to use currency unions as a commitment device. Inflation in a given country, however, may not beneficial to other countries.

The baseline Alesina-Barro model rules out the possibility that producers in different countries compete directly in the provision of intermediate goods. Direct competition creates incentives for competitive depreciations which, in turn, can induce high-inflation spirals. Countries that sign on preferential trade agreements may potentially use the agreement as a threat to prevent "beggar-thy-neighbor" policies. So, in many ways, free trade agreements may act as substitutes for currency unions. More generally, preferential trade agreements affect trading costs and, as already argued, theory does not predict an unambiguously signed relationship between currency union and trading costs.

4 Determinants of Currency Unions

Table 2 estimates the determinants of common currency areas, assuming a standard normal distribution for ϵ, the error term in the latent-index equation. Table 2 bis converts the results into probabilities.[18]

[18]The conditional expectation function $E(CU/\mathbf{x})$ is nonlinear in x. $E(CU/\mathbf{x}) = F(\mathbf{x}'\boldsymbol{\theta})$, where F is a standard normal or logistic cdf. The Appendix provides the corresponding values for the marginal effects,

Columns 1 and 2 show the relationship between the probability to share a common currency and the comovement of shocks to prices and output. In particular, synchronization of price shocks tends to increase the propensity to form a common currency area. Comovement of GDP per capita, on the other hand, has at best a weak effect on participation. Moreover, after introducing other controls (see columns 3 and on), comovement of output shocks seems to decrease the propensity to share a currency. One interpretation of this finding is simply that collinearity between output and price shocks affect the identification of the two coefficients. (The two measures of comovement are positively correlated.) A closer look at the data suggests that European countries might be influencing this relationship. Western European countries feature a large extent of comovement of output shocks and, during the period under study, they were not part of a currency union.

Speaking a common language (*lang*) increases the propensity to form a currency union. The historical link between a former colony and its colonizer does not have any impact on this propensity. However, the link between former colonies of a common colonizer (*comcol*) increases the probability of sharing a common currency. Having remained part of the political union for a longer period reinforces this last effect (*com*70).[19] Finally, being part of the same country further increases the propensity to form a union.

Overall, tighter cultural links increase the chances of sharing a common currency. Geographic proximity also contributes in this direction. The two candidates to mediate this effect are trade and mobility. Countries with lower transaction costs - and, presumably, more trade - are more prone to form a currency union to save the costs of currency exchange. Two dimensions of trading costs seem to call for an exception: one is lack of access to the ocean, typically associated with larger transaction costs (given the direct access to cheaper ocean

$\partial E(CU/\mathbf{x})/\partial x_j = f(\mathbf{x}'\boldsymbol{\theta}) \cdot \theta_j$, where $f(.)$ stands for the pdf standard normal or logistic.

[19] The coefficients for *com*70 and *comctry* should be read as the additional effect over *comcol*.

transportation) which tends to increase the propensity to join a currency union. The second exception is contiguity; countries sharing a border are less prone to form a currency union. This might simply reflect the fact that approximately half of the countries in currency unions are islands and hence do not share a border with any country. In any case, the marginal effect of sharing a border on the propensity to form a currency union is almost nil.

When controlling for comovement of shocks and the different dimensions of trading costs, a larger joint geographical area increases the probability of sharing a common currency, which gives support to the "integration" motive to join a monetary union. As discussed in Section 2.2, the "gravity force" is also present in the propensity to share a common currency (after controlling for other determinants).

Relative size also matters. As the difference in size between two countries increases, the probability of sharing a common currency declines. A crude look at the data indicates that, except for the anchors in unilaterally dollarized countries, countries sharing a common currency tend to be equally sized. In multilateral currency unions, a fair split of power might be a way to preclude excessive discretion from one of the members (especially when none of the countries is able to commit to low levels of inflation). This could explain the success of the CFA African countries in terms of low inflation (particularly when compared with other non-currency union members in Africa).[20] This is also consistent with the argument that a common currency area for South American countries is infeasible, given the preponderance of Brazil and its limited capacity to commit to a monetary rule. In the case of unilaterally dollarized countries, this unbalance of power might not be a concern, given that the US can by itself offer a higher comitment to price stability. Still, the empirical pattern seems to be that unilaterally dollarized countries are roughly of the same size (typically small) and this reinforces the negative coefficient for the variable $difla$.

[20] They kept firm convertibility to the French Franc since 1958, except for the 1994 devaluation.

Free trade agreements decrease the propensity to form currency unions. One interpretation, already suggested, is that trade openess leads to lower inflation rates under discretion and hence reduce the value of currency unions as commitment devices to temper inflation. This variable, however, is an imperfect measure of tariff and non-tariff barriers, which raises concern about omitted variables.[21]

The marginal effects shown in Table 2 b are evaluated both at the mean values of the sample and at the mean of the subsample of CU pairs. The effects are highly non-linear. The first column in this table shows that the marginal effects at the mean are economically insignificant. The explanation is simple: in this unbalanced sample almost 99% of the country-pairs do not share a common currency. Therefore, the typical country is far away from the margin of using a common currency. (In other words, evaluating the effect at the mean is almost analogous to evaluating them at the mean of non-CU pairs.) The effects, however are economically large for the subsample in CU. (The numbers should be read as percentage points. Expand explanation!!!)

5 The Effect of Currency Unions on Trade

In a notable paper, Rose (2000) makes a first attempt to estimate the effect of currency unions on trade flows. The empirical work relies on the standard gravity model, which states that bilateral trade between a pair of countries is proportional to the product of their GDPs and inversely proportional to their distance, broadly construed to include all factors that may create "trade resistance."

Rose augments the gravity equation with a dummy variable that indicates whether or not

[21] For instance, countries in the CFA franc-zone are not considered as part of a FTA according to the WTO classification, even though they have lower tariff and non-tariff barriers when compared with other African countries outside the CFA.

the countries share the same currency. The OLS estimate of the coefficient on this dummy has been interpreted as the currency union effect. The conclusion from this study is that bilateral trade between countries that share the same currency is over two-hundred percent larger than bilateral trade between countries with different currencies. Subsequent papers, including Frankel and Rose (2000) and Glick and Rose (2001), have expanded the original data set and generally confirmed the large enhancement effect of currency unions on trade.

As mentioned before, one of the problems with these estimates is that countries with zero trade were eliminated from the sample. To address this sample selection problem, I average trade flows over five-year intervals. Results are reported in Table 3. Columns (2) shows the results for averages and column (1) shows the results for the corresponding single years (1980, 1985, 1990 and 1995). The enhancement effect of currency unions on trade falls from approximately 200% to 100% when the information in zero-valued trade is incorporated.[22]

The remaining variables in the gravity equation exhibit the expected relation with trade. The product of GDPs and per capita GDPs in the two countries increase the volume of bilateral trade. Geographical distance and lack of access to the ocean deters trade, whereas sharing a border, speaking the same language and having a common colonial heritage enhances it. Trade is significantly larger for political units that remained part of a common country as of 1970. The additional effect of being part of a common country is insignificant, however. These last two findings are consistent with the idea that trade flows are persistent.

A second issue with the original estimates of the effect of currency unions on trade is self-selection. The implicit assumption in previous OLS-based estimates is that currency unions are randomly assigned. The theoretical and empirical model of currency unions suggests, however, that self-selection into currency unions might be a concern. To correct for potential

[22] The coefficients in Table 3 are, respectively, 1.1 and 0.7. The corresponding "enhancement-effects" are $200\% = \{exp(1.1) - 1\} \cdot 100$ and $100\% = \{exp(0.7) - 1\} \cdot 100$

self-selection, I use the model estimated in the previous section and re-estimate jointly the decision to participate in a currency union and the trade equation.

The econometric model reduces to:

$$\begin{aligned} \ln T_{ij} &= \alpha_0 + \alpha_1 \ln Y_i Y_j + \alpha_2 \ln y_i y_j + \boldsymbol{\gamma}' \mathbf{d}_{ij} + \beta CU_{ij} + \mu_{ij} \qquad (18) \\ CU^*_{ij} &= \boldsymbol{\theta}' \mathbf{x}_{ij} + \epsilon_{ij} \\ CU_{ij} &= 1 \text{ if } \boldsymbol{\theta}' \mathbf{x}_{ij} > \epsilon_{ij} \text{ and } CU_{ij} = 0, \text{ otherwise} \\ & \text{Assuming symmetry,} \\ \Pr(CU_{ij} &= 1) = \Pr(\epsilon_{ij} < \boldsymbol{\theta}' \mathbf{x}_{ij}) \end{aligned}$$

where ϵ and μ are assumed to follow a joint standard normal distribution $\tilde{} N\left\{\mathbf{0}, [(\sigma^2, \rho)'(\rho, 1)']\right\}$.

The gravity equation includes the usual regressors: log products of real GDP and real per capita GDP; various measures of distance, language, colonial links, access to the ocean and the currency union dummy. The identification strategy relies on the exclusion of the comovement of shocks from the gravity equation. The two equations are jointly estimated using maximum likelihood. Panel A in Table 4 shows the results for the gravity equation, using as dependent variables *laverage*. Panel B shows the corresponding selection equation. Table 4b includes non-linear terms in output and output per capita.

The effect of currency unions on trade, after correcting for self-selection and exclusion of zeros, becomes smaller and loses statistical significance. The point estimates are still important: the implied enhancement-effect is approximately 60% -Table 4- (and 25% when non-linear terms in income and income percapita are included -Table 4b); but the conclusion here is that the impact of currency unions on trade, after correcting for self-selection, is considerably smaller and less robust than the effect documented in several studies. The findings suggest that there are omitted variables affecting both the volume of trade and the propensity to share a common currency. Potential candidates for omitted factors causing the bias

include: compatibility of legal systems, political views towards openess versus protectionism, political ties between countries (two countries that are willing to form a currency union might also be more prone to invest in trade infrastructure, lower trade barriers, harmonize systems, etc.), tied bilateral transfers and cultural similarities that go beyond language and colonial history.

These results are in line with Torsten Persson's (2001) findings, even though the approach followed in this paper is methodologically different. Persson (2001) uses a semi-parametric method, mainly concerned by the presence of non-linearities in the gravity equation and selection on observables. His approach relies on the "conditional independence" assumption: after controlling for all the regressors of the gravity equation, the error term in the selection equation is assumed to be independent of the error term in the trade equation. It is not a priori obvious why this condition should hold in this particular case and, on the contrary, the pressumption is that there might be a positive correlation.) Notice that the selection equation in this paper is also different from that in Persson. (The selection equation in Persson includes the variables entering the gravity equation.) However, despite these methodological differences, both this study and Persson's study indicate a weaker effect of currency unions on trade.

6 Conclusions

Members of currency unions and countries that unilaterally use another country's currency tend to be geographically close, to be roughly similar in size, to speak the same language and to share strong colonial links; they exhibit high comovement of shocks to prices and they are typically smaller than countries with independent currencies. Like other small countries, they do not exhibit a smooth pattern of bilateral trade, when trade flows are recorded on a

yearly basis.

This paper studies the role that these variables play as determinants of currency unions. It then uses the empirical model of currency unions to revisit the effect of sharing a common currency on trade, addressing the econometric problems caused by the exclusion of zero-valued trade flow entries and, perhaps more interestingly, endogenous selection into common currency areas.

Correcting for exclusion of zeros reduces the estimated effect of currency unions on trade from approximately 200% to 100%. Further correction for self-selection indicates that simple OLS estimations are biased upwards by omitted unobservables which affect both the decision to share a common currency and the volume of trade. Point estimates indicate an average effect below 60% (25% when non-linearities in the gravity equation are allowed), although the estimates are not significantly different from zero. The lack of statistical significance suggests that the impact of currency unions might not be as large and robust as reported in previous studies.

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Table 1. Summary Statistics

Sample 1980-1995	All-Country Pairs		CU-Country Pairs	
Variable	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
cu: currency union dummy	0.012	0.11	1	0
laverage: log of (5-year average trade)*	8.563	3.48	7.293	3.05
lrgdp: log of (product of real GDP)	47.765	2.90	42.855	3.06
lrgdppc: log of (product of real GDP per cap)	15.816	2.15	14.218	2.42
ldist: log of distance (in km)	8.674	0.81	7.217	1.16
border: contiguity dummy	0.023	0.15	0.148	0.36
lang: common language dummy	0.173	0.38	0.919	0.27
comcol: common colonizer dummy	0.115	0.32	0.771	0.42
colonial: colonizer-colony dummy	0.018	0.13	0.047	0.21
com70: common country at least until 70	0.010	0.10	0.303	0.46
comctry: common country dummy	0.002	0.04	0.111	0.31
FTA: free trade agreement dummy	0.030	0.17	0.195	0.40
ll_1: 0ne country landlocked dummy	0.204	0.40	0.303	0.46
ll_2: Two countries landlocked dummy	0.012	0.11	0.037	0.19
vy: inverse of comovement of output shocks	0.082	0.10	0.087	0.03
vp: inverse of comovement of price shocks	0.152	0.09	0.073	0.04
lareap: log of (product of areas in km2)	23.865	3.42	21.538	5.21
difla: absolute difference in log of (areas)	2.553	2.19	1.748	1.88
Observations	25695		297	

*Centered on 1980, 85, 90, 95

Table 2. Determinants of Currency Unions. Probit Estimation.

Dependent Variable: Currency Union Dummy

	(3)	(4)	(5)	(6)	(7)
vp	-12.298**	-15.068**	-15.574**	-16.084**	-16.062**
	(0.89)	(1.78)	(1.94)	(1.95)	(1.95)
vy	0.890**	1.152**	1.267**	1.319**	1.309**
	(0.11)	(0.37)	(0.37)	(0.31)	(0.31)
ldist	-0.503**	-0.717**	-0.696**	-0.717**	-0.716**
	(0.03)	(0.04)	(0.04)	(0.04)	(0.04)
border	0.028	-0.575**	-0.681**	-0.786**	-0.784**
	(0.12)	(0.13)	(0.13)	(0.14)	(0.14)
Lang		0.896**	0.867**	0.893**	0.895**
		(0.11)	(0.11)	(0.11)	(0.11)
comcol		1.472**	1.482**	1.402**	1.394**
		(0.14)	(0.15)	(0.14)	(0.15)
com70		0.289*	0.322*	0.583**	0.597**
		(0.14)	(0.17)	(0.19)	(0.19)
colonial		-0.04	0.002		-0.092
		(0.21)	(0.21)		(0.21)
comctry		2.548**	2.572**	2.464**	2.501**
		(0.35)	(0.35)	(0.36)	(0.36)
FTA		-1.369**	-1.202**	-1.176**	-1.181**
		(0.18)	(0.17)	(0.17)	(0.17)
ll_1			0.598**	0.546**	0.545**
			(0.09)	(0.09)	(0.09)
ll_2			0.790**	0.754**	0.750**
			(0.22)	(0.22)	(0.22)
lareap				0.036**	0.036**
				(0.01)	(0.01)
difla				-0.049*	-0.049*
				(0.02)	(0.02)
Year Effects	No	No	No	Yes	Yes
Observations	25070	25070	25070	24570	24570
Pseudo R2	0.33	0.61	0.62	0.63	0.63

Robust standard errors in parentheses. Constants included.

*** significant at 5%; ** significant at 1%**

Table 2 bis. Determinants of Currency Unions. Marginal Effects (dF/dx)

	Marginal Effect at Mean *100%	Mean	Marginal Effect at Mean of CU=1 *100%	Mean for CU=1
vp	-0.04	0.15	-624.21	0.07
vy	0.00	0.08	53.77	0.09
ldist	0.00	8.66	-28.03	7.22
border	0.00	0.02	-26.51	0.15
lang	0.01	0.17	27.63	0.92
comcol	0.10	0.11	44.66	0.77
com70	0.01	0.01	22.20	0.30
colonial	0.00	0.02	-5.92	0.05
comctry	2.76	0.00	67.81	0.11
FTA	0.00	0.03	-38.36	0.20
ll_1	0.00	0.19	21.90	0.30
ll_2	0.01	0.01	29.77	0.04
lareap	0.00	23.55	1.20	21.54
difla	0.00	2.71	-2.17	1.75

Columns (1) and (3) report the corresponding marginal effect of column (7) in Table 2.

Numbers can be read as percentage points. (Notice the effect is highly non-linear)

Table 3: Effect of Currency Union on Trade. OLS Estimation

	Dependent Variable	
	lvalue	**laverage**
cu	1.090**	0.721**
	(0.14)	(0.12)
lrgdp	0.879**	0.939**
	(0.01)	(0.01)
lrgdppc	0.123**	0.141**
	(0.01)	(0.01)
ldist	-1.148**	-1.235**
	(0.02)	(0.02)
border	0.387**	0.366**
	(0.09)	(0.09)
Lang	0.658**	0.725**
	(0.04)	(0.04)
colonial	1.141**	1.144**
	(0.09)	(0.10)
comcol	0.144**	0.110*
	(0.05)	(0.04)
com70	0.985**	1.071**
	(0.15)	(0.14)
comctry	-0.007	0.061
	(0.31)	(0.31)
fta	0.702**	0.644**
	(0.08)	(0.08)
ll_1	-0.527**	-0.576**
	(0.03)	(0.03)
ll_2	-0.597**	-0.484**
	(0.11)	(0.11)
Observations	22096	25695
R-squared	0.69	0.70

Robust standard errors in parentheses. Year Effects and Constants included.

* significant at 5%; ** significant at 1%

Table 4. Selection Model. ML Estimation

Panel A: Gravity Equation		
	Dependent Variable: laverage	
	Coef	**Std. Error**
cu	**0.471**	**0.316**
lrgdp	**0.939****	**0.005**
lrgdppc	**0.147****	**0.007**
ldist	**-1.256****	**0.019**
border	**0.358****	**0.087**
lang	**0.752****	**0.041**
colonial	**1.071****	**0.075**
comcol	**0.114***	**0.050**
com70	**1.258****	**0.180**
comctry	**0.120**	**0.252**
FTA	**0.470****	**0.084**
ll_1	**-0.589****	**0.030**
ll_2	**-0.634****	**0.106**
Panel B: Treatment Equation		
	Dependent Variable: cu	
	Coef.	**Std. Error**
vp	**-20.454****	**2.270**
vy	**1.231***	**0.481**
ldist	**-0.713****	**0.054**
border	**-0.997**	**0.185**
lang	**-0.935****	**0.147**
comcol	**1.528****	**0.227**
comctry	**2.410****	**0.406**
colonial	**-0.124**	**0.235**
com70	**0.717****	**0.259**
FTA	**-1.117****	**0.185**
ll_1	**0.548****	**0.122**
ll_2	**0.826**	**0.309**
difla	**-0.043***	**0.021**
lareap	**0.041***	**0.018**
Observations	**23814**	
Wald chi2	**66847.6**	
Prob > chi2	**0.000**	

Robust Standard Errors. Year Effects and Constants Included.

*** significant at 5%; ** significant at 1%**

Table 4b. Selection Model. ML Estimation. Non-linearities.

Panel A: Gravity Equation		
	Dependent Variable: laverage	
	Coef	**Std. Error**
cu	**0.222**	**0.322**
lrgdp	**0.025**	**0.104**
lrgdppc	**0.123***	**0.069**
ldist	**-1.234**	**0.019**
border	**0.363****	**0.087**
lang	**0.739****	**0.041**
colonial	**1.118****	**0.077**
comcol	**0.118***	**0.050**
com70	**1.094****	**0.182**
comctry	**0.347**	**0.256**
FTA	**0.290****	**0.082**
ll_1	**-0.571****	**0.031**
ll_2	**-0.621****	**0.105**
lrgdps	**0.010****	**0.001**
lrgdppcs	**0.001**	**0.002**
Panel B: Treatment Equation		
	Dependent Variable: cu	
	Coef.	**Std. Error**
vp	**-16.359****	**2.051**
vy	**1.377****	**0.330**
ldist	**-0.731****	**0.044**
border	**-0.791****	**0.138**
lang	**0.870****	**0.110**
comcol	**1.419****	**0.181**
comctry	**2.411****	**0.373**
colonial	**-0.174**	**0.222**
com70	**0.643****	**0.216**
FTA	**-1.23****	**0.175**
ll_1	**0.585****	**0.094**
ll_2	**0.765****	**0.234**
difla	**-0.057***	**0.024**
lareap	**0.034****	**0.014**
Observations	**23814**	
Wald chi2	**74368.7**	
Prob > chi2	**0.000**	

Robust Standard Errors. Year Effects and Constants Included.

*** significant at 5%; ** significant at 1%**

Table A.1 Currency Unions 1978-1997

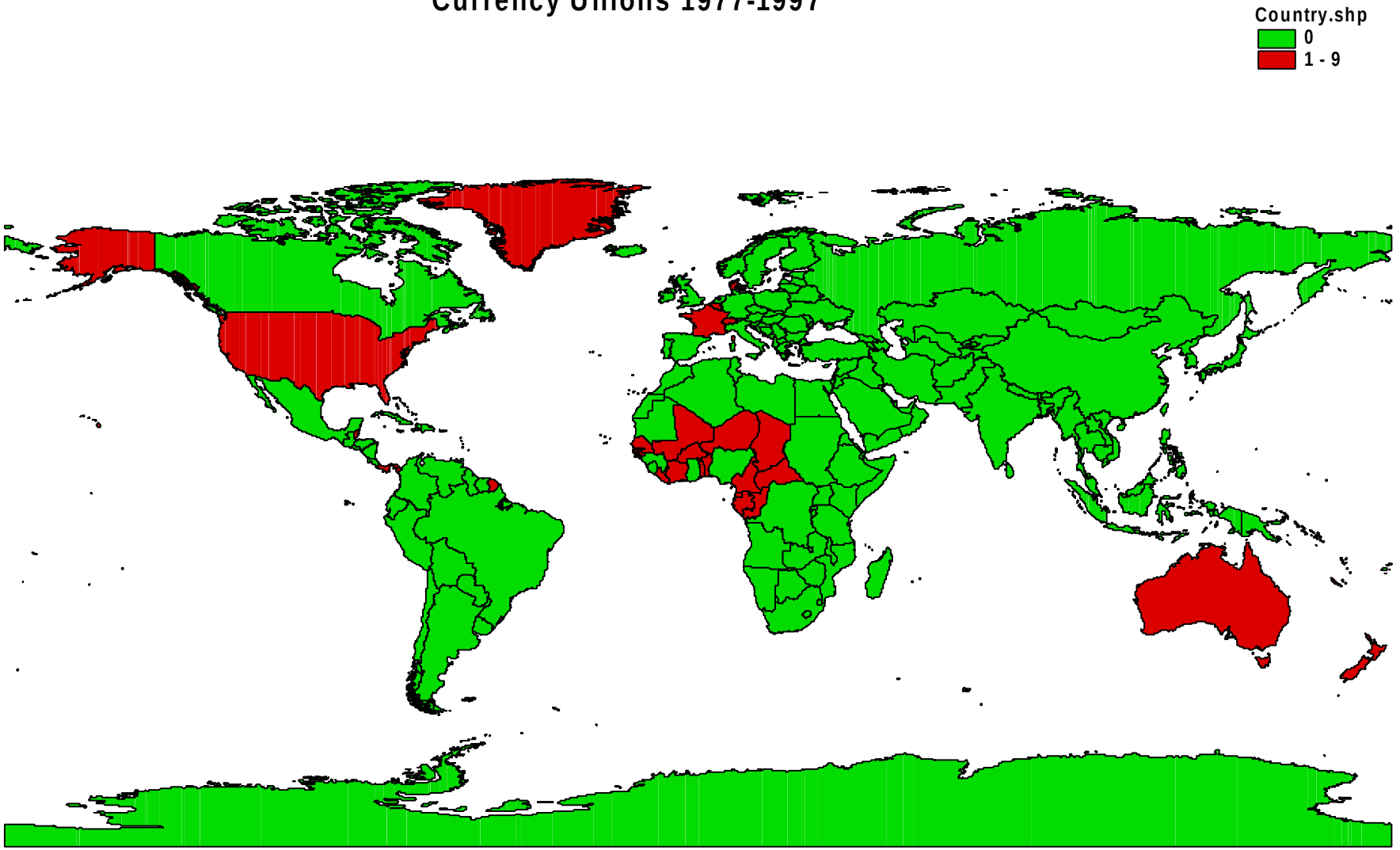
CFA	**ECCA**
Benin	Anguilla (post ’87)
Burkina Faso	Antigua and Barbuda
Cameroon	Dominica
Central African Republic	Grenada
Chad	Monstserrat (terr. Of UK)
Comoros*	St. Kitts and the Nevis
Rep. of Congo	St. Lucia
Cote d’Ivoire	St. Vincent and the Grenadines
Equatorial Guinea (post ’84)	
Gabon	**Denmark**
Guinea-Bissau (post’87)	Faroe Islands
Mali (post ’84)	Greenland
Niger	
Senegal	**USA**
Togo	US Virgin Islands
	British Virgin Islands
France	Turks & Caicos Islands
French Guiana	Bahamas
French Polynesia	Bermuda
Guadeloupe	Liberia* (pre ’97)
Martinique	Panama
Mayotte	Belize
Reunion	American Samoa
Saint Pierre and Miquelon	Marshall Islands
	Micronesia
New Zealand	Puerto Rico
Cook Islands	
Nieu	**Australia**
Pitcarn Islands	Kiribati
	Nauru
Belgium	Tuvalu
Luxembourg	
	UK
Switzerland	Falkland Islands
Liechtenstein	Gibraltar
	Saint Helena

***** *Long-term fixer*

Table A.2. Regional Trade Agreements

NAFTA, 1994	**Canada-US, 1989**
Canada	Canada
Mexico	US
US	**ASEAN, 1992**
MERCOSUR, 1991	Brunei Darussalam
Argentina	Cambodia
Brazil	Indonesia
Paraguay	Laos
Uruguay	Malaysia
G3, 1995	Myanmar
Colombia	Philippines
Mexico	Singapore
Venezuela	Thailand
EEC/EC	Viet Nam
Austria	**Bolivia-Mex, 1995**
Belgium	Bolivia
Denmark	Mexico
Finland	**CER, 1983**
France	Australia
Germany	New Zealand
Greece	**Israel/US, 1985**
Ireland	Israel
Italy	US
Luxembourg	**CACM, 1963**
Netherlands	Costa Rica
Portugal	El Salvador
Spain	Guatemala
Sweden	Honduras
United Kingdom	Nicaragua
EFTA, 1960	**CARICOM, 1973**
Iceland	Antigua and Barbuda
Norway	Bahamas
Switzerland	Barbados
Liechtenstein	Belize
SPARTECA, 1980	Dominica
Cook Islands	Grenada
Federated States of Micronesia	Guyana
Fiji	Haiti
Kiribati	Jamaica
Marshall Islands	Montserrat
Nauru	Trinidad and Tobago
Niue	St Kitts and Nevis
Papua New Guinea	St Vincent and the Grenadines
Solomon Islands	Surinam
Tonga	**PATCRA, 1977**
Tuvalu	Australia
Vanuatu	Papua New Guinea

Currency Unions 1977-1997



Currency Unions Post 2000