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Monetary Policy Coordination, Monetary Integration and other essays

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by

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To Irene, who has taught me so much, and whose love and support kept me going all this time.

To Federico, Juan Andrés and Santiago.

To my mother and all her sacrifice, and to you dad, wherever you are…

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ABSTRACT OF THE DISSERTATION

Monetary Policy Coordination, Monetary Integration

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Gerardo Marcelo Licandro Ferrando

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President Menem's proposal for a common currency in Mercosur poses the question of whether there are sufficient economic reasons to justify such a move. The first chapter paper researches the Mundellian idea that if shocks affecting countries in a region are symmetric there is no need to use the nominal exchange rate as an adjustment tool. By using three different methodologies, we are able to establish that shocks in Mercosur are not similar. In fact, there is neither an identifiable pattern of similarity nor one of dissimilarity. Shocks in Mercosur are, however, historically much larger than shocks in the EU or NAFTA, and the exchange rate has played a strong role in processes of

adjustment in the region. In the final section, we discuss possible additional motives for a single currency in the region, stressing the value of stability and the cost of debt. We reach the conclusion that even though the small countries might have grounds for a push towards monetary union, it seems unlikely that Brazil would be interested in this kind of arrangement.

The second chapter explores the idea of building a currency union as a commitment device that would help countries in MERCOSUR deal with their past history of failed stabilizations. It is shown that even in time consistent equilibria, coordination of monetary policy can arise as a time consistent policy when it provides a signal to the private sector about the policymaker's type. It is shown that in that case coordination and inflation stabilization go hand to hand. This need for extra commitment in order to lower inflation is what makes the model appealing for the case of the southern cone countries. However, we show that bad history in inflation control, policy instability, and low levels of interdependence, main characteristics of the region, make it harder to achieve this kind of coordination.

Finally, the third chapter deals with the issue of optimal currency composition of Uruguayan public debt. In a Calvo and Guidotti (1992) environment we find that the current full dollarization of public debt is not optimal. In the Uruguayan case, this debt has two undesirable features. On the one hand, dollar instruments have associated a highly volatile real yield. On the other hand, the cost of dollar denominated debt is negatively correlated with the rate of GDP growth, and thus, with government revenues.

The chapter makes a case for the inclusion of CPI indexed debt in the Uruguayan government's portfolio of liabilities. Moreover, in the case of Uruguay, nominal debt should be discharged, not only because of its high cost, but also because of its undesirable stochastic properties.

Chapter 1. Is Mercosur an Optimal Currency Area?

A shock correlation perspective

1.1. Introduction

In January 1998, at the ceremony of assumption of the *pro tempore* presidency of Mercosur, the Argentinean president, Carlos Menem, proposed the building of a currency union that would include Argentina, Brazil, Paraguay and Uruguay. A year later, President Cardoso of Brazil talked about the need to build a little Maastricht in the region, undoubtedly referring to the idea of a common currency. President Cardoso of Brazil talked about the need to build a little Maastricht in the region, undoubtedly referring to the idea of building a common market with a single currency.

According to the classical Mundellian view of Optimal Currency Areas (hereafter, OCA), countries in a region would find it optimal to give up their currencies whenever the nominal exchange rate is not necessary to adjust the real exchange rate when those economies face asymmetric shocks. This might happen if shocks affecting the region are similar (not asymmetric), if prices are flexible, and /or there is free labor and capital mobility within the region.

The paper researches the first of these conditions for the Mercosur countries. By using four different methodologies, we are able to establish that shocks in Mercosur are not

similar. In fact, there is neither an identifiable pattern of similarity nor one of dissimilarity. The size of shocks is, however, historically much larger in Mercosur than in the EU or NAFTA, and the exchange rate has played a strong role in processes of adjustment in the region. The historical importance of the exchange rate is partly associated with the large number of failed attempts to stabilize inflation. Since these programs would not have a place in a supposedly stable common currency agreement, we should be cautious about claiming that Mercosur is not an optimal currency area; other factors need to be put in the balance.

One factor to be considered is that deeper economic integration could make the productive structures more similar, thereby reducing the possible asymmetry of shocks. We show that the increase in intra-industry trade among countries in the region supports this view. Additionally, despite the fact that we do not know whether Mercosur's labor markets are better able to adjust to shocks than those of other regions in the world, or whether the degree of labor mobility is capable of making up for the potential effects of asymmetric shocks, Mercosur might have its own reasons to move to a currency union.[1]

The following motives should be considered when contemplating a move towards Monetary Integration: the fact that, at present, each country's ability to manage exchange rates and monetary policy is greatly limited, and that the cost of debt is elevated due to reputations of bad macroeconomic management, as well as the possibilities of, under a single currency scheme, a reduction in the cost of reserves and

constituting the common currency in a reserve currency. We also suggest that, instead of losing sovereignty, the region might increase its ability to adjust to common external shocks with exchange rate policies, an alternative that is currently not available for Argentina, and very costly to Brazil.

The paper proceeds as follows. Section 1.2 analyzes the theory of OCA, and existing empirical work on Mercosur as an OCA. Section 1.3 studies the correlation of shocks in Mercosur as compared to the correlation of shocks in the EU and NAFTA. Section 1.4 discusses the importance of exchange rate variability and transaction cost arguments for the region. Section 1.5 sets forth a list of possible motives for some kind of regional monetary arrangement for Mercosur countries, and section 1.6 states the conclusions of this paper.

1.2. OCAs in theory and practice.

The purpose of this section is to present some of the views offered in previously written literature related to the prospect of a currency area for Mercosur. We start with an overview of some existing theories and go on to describe the empirical efforts developed to evaluate the prospects of Monetary Integration in the region.

1.2.1 A short glance at Mercosur's genesis.-

Although Mercosur might have appeared out of the blue for some international

[1] .- Since Brazil has capital controls in place, there is no free capital mobility inside the region.

observers, the project of economic integration in the region had been initiated several times before the signing of the Asuncion Treaty in 1991.

Marked by a history of alternating rivalries and alliances, Argentina and Brazil started to discuss regional economic integration in the late 1960s with the Cartagena Consensus and ALADI. The political turmoil of the 1970's presented obstacles for the proccess of integration of the two South American giants. Nevertheless, regional links between the smaller countries in the region, whose development began under ALADI with the LFN clause to Uruguay and Paraguay, kept on growing. In 1974 and 1975, Uruguay signed integration treaties with Argentina (CAUCE) and Brazil (PEC), respectively, which were responsible for the strong surge in bilateral trade in the second half of the 70's.

The eighties witnessed an increase in bilateral trade, largely due to the fact that both Argentina and Brazil pursued exchange rate based inflation stabilization programs and were more concerned about stability issues, as reflected by the signature of the 1987 Gaucho Protocol. The Protocol, one of several signed under the Argentine-Brazilian Cooperation and Integration Act, established the need study the possibility of a common currency for Argentina and Brazil. The enthusiasm generated by the integration process in 1987 and 1988 cooled off with the arrival of the exchange rate crisis in both countries, not to return to the arena until 1990, when Argentina and Brazil agreed to set the date for the establishment of a free trade area for the end of 1994.

The diplomatic requests made by Paraguay and Uruguay set the stage for the creation of the Asuncion Treaty, which laid the foundations of Mercosur. A short glance at the

treaty suffices to show that what once was thought of as a commercial agreement became a much more ambitious project, aiming at the creation of a common market.

Milestones in the creation of Mercosur	
1974	Signing of the *Argentine-Uruguayan Economic Cooperation Act* (CAUCE)
1975	Signing of the *Comercial Expansion Protocol* (PEC) between Brazil and Uruguay
1985	Signing of the *Colonia Act*, known as CAUCE II
1986	Signing of the *Argentine-Brazilian Cooperation and Integration Act*.
1986	Signing of the *Brasilia Agreements*, deepening PEC
1988	Signing of the *Cooperation and Development Treaty* Between Argentina and Brazil
1991	Signing of the *Asunción Treaty* between Argentina, Brazil, Paraguay and Uruguay creating the Common Market of the South (Mercosur).

1.2.2.- The Theory

Under what conditions should a region renounce individual currencies to advance into a currency union? The traditional framework to address this question was created by Mundell (1961), McKinnon (1963) and Kenen (1969) and later formalized by

Bayoumi (1994) and Ricci (1997).

Mundell (1961) proposed a simple idea to determine whether it is beneficial for countries in a region to create a common currency area. Suppose that a region composed of two countries, A and B, is hit by an asymmetric shock. The shock is called asymmetric because it increases the quantity demanded for labor and capital in one country (A) and lowers it in the other (B). With flexible prices, the reduction of the quantity demanded lowers real wages and rents in country B, and unemployment is not an issue. If prices are not flexible but there is labor mobility, unemployment does not necessarily increase. As the quantity demanded of labor decreases in country B, pressuring down real wages and rents, the quantity demanded of labor and capital increases in country A, pressuring up real wages and rents. Workers and capital in B will start moving to country A, increasing the supply of labor and capital and lowering the excess demands, and they will keep on moving until some kind of arbitrage is reached. If there is neither price flexibility nor factor mobility, the adjustment is made by the nominal exchange rate. In a floating regime, the reduction of exports and increase of imports will pressure up the nominal exchange rate in country B. A country only needs to use the nominal exchange rate as an adjustment tool, then, if the region is hit by asymmetric shocks, if there is no price flexibility, and no factor mobility.

Kenen (1969) argues that the expected cost of an asymmetric shock is inversely related to the level of diversification in the production of a country. A country that depends very heavily on certain kinds of goods would be very affected by a shock to that kind of production. If, on the other hand, a country has a diversified product mix, a fall in price

of one of these products will not cause a big impact in the aggregate. Kenen (1995) explains that

When national economies are highly diversified, industry -specific shocks need not show up as country-specific shocks. They may offset each other and thus average out instead of adding up.

If the product mix of a country is diversified, in the sense of having a production portfolio with risks that are negatively correlated, that country will not give up much by entering a common currency area. The cost of entering the union is low, both because the diversification of production reduces the impact of price specific shocks, and because the highly diversified economies are more similar, whereby shocks affect them the same way.[2]

McKinnon (1963) points out that very open countries would rather not use the exchange rate as an adjustment instrument. According to his reasoning, in a very open country we would expect to observe something close to PPP to happen. In that case, the use of the exchange rate would affect most prices in the same way, and the exchange rate policy would not be able to generate the changes sought in relative prices. Krugman (1990) claims that adjusting to a 1 percent imbalance in the current account is easier the more open the economy is. Gross and Steinherr (1996, 1997) and Ricci (1997) debate McKinnon's postulate. Using the Mundell-Fleming model, they compare three policy regimes: fixed exchange rates, a float with monetary policy oriented to income

[2] .- Corden (1972) and , more recently Masson and Melitz (1990) stress that being affected by similar shocks does not imply countries would want to react to them in the same manner. Differences in policy preferences matter too.

stabilization, and a float with fixed money supply. They find that the cost of fixing the exchange rate increases as the degree of openness increases in the presence of external shocks. They argue that the effects of external shocks are greater in a highly open economy than in a relatively closed one. Hence, having wrong relative prices is more costly the more open the economy is. Calvo (1999) points out that small dollarized countries would find it costly to make use of the exchange rate as an adjustment device. When credit is dollarized, the payments system is exposed to an additional risk: when the financial system hedges exchange rate risk there is the risk of private sector default, when the hedge is not present the financial system is exposed to exchange rate risk. A devaluation might endanger the banking system or even the entire payments system.

In a very broad sense, we can postulate that a region constitutes an optimal currency area whenever the costs of relinquishing sovereign monetary management are lower than the benefits. What are, then, the theoretical conditions which constitute an OCA?, i.e., What questions should be addressed in order to determine whether Mercosur is an OCA or not?

a) First we should see whether the region is hit by asymmetric shocks of the kind described above. Otherwise, the exchange rate is superfluous as an intra region adjustment mechanism.

b) Then we need to know how relevant those shocks are and how they affect the factor markets. Are Mercosur's labor markets flexible? Is there an appropriate level of labor mobility to accommodate asymmetric shocks if they occur?

Related to the issue of the correlation of shocks is the issue of the degree of

diversification of the economies. How diversified are the productive structures of countries in the region compared to those of other proposed currency unions?

Since capital mobility would facilitate portfolio diversification and risk sharing, it is important to know how mobile capital is inside the region. Capital mobility is also necessary to accommodate the shifts in productivity caused by asymmetric shocks.

In order to assess the magnitude of the traditionally recognized benefits of the currency union, we must determine how open and interdependent countries in the region are. Further: How large are exchange rate shocks?

Are there other motives for the building of a common currency area in Mercosur?

Because the range of questions to answer is too large to be embraced on one paper, we should focus on item a) of the upper list, and converse about items e) and f). In the next section we discuss the pertinence of the so called traditional benefits of Common Currency areas: the lowering of both transaction costs and exchange rate uncertainty.

1.2.3 Empirical analysis

Despite the wealth of empirical literature on OCAs written for the European Union, the case of Mercosur has received only marginal attention. Bayoumi and Eichengreen (1994), using the scheme proposed by Bayoumi (1992), identify series of demand and supply shocks for countries in different regions of the world between 1960 and 1990 and study their correlation. The correlation of supply shocks for the European Union and Mercosur are reproduced in table 1.1 The coefficients are considered to be

significant at the 5% level for the EU if the value is higher in absolute value than 0.37, and significant at the 10% level for Mercosur if the absolute value is bigger than 0.39. The study finds that supply shocks in the European Union show a strong positive correlation. As shown in Table 1.1, European Union countries exhibit high values for shock correlation. Not only are shocks similiar among the core countries, but there is also high similarity between shocks in these large countries and those in the smaller countries of the EU. There are no significant cases of asymmetric shocks (negative correlation coefficients). Supply disturbances affect the members of the European Union in similar ways. This is not true for Mercosur, where the only countries which show a large correlation in their supply shocks are Argentina and Brazil (34%). The correlation coefficients of shocks affecting the rest of the member states are very low, and for Argentina and Uruguay, this coefficient is, surprisingly enough, pronouncedly negative. Except for the correlation between Argentina and Uruguay, none of these correlation coefficients are significant.

Although very suggestive, these results are all but conclusive. The approach popularized by Bayoumi (1992, 1993) entails the estimation of demand and supply equations with a restricted-VAR technique. The first stage of this technique consists of running a national VAR of changes of output and prices. To identify the coefficients of the structural form, Bayoumi assumes the orthogonality of supply and demand shocks, that only supply shocks are able to effect the level of output, and that demand shocks are short lived. This approach comes with several caveats. First of all, since the logs of output and prices in quarterly format are cointegrated in several of the countries of

the sample, the coefficients of the VAR are asymptomatically biased. Furthermore, as Bayuomi recognizes, neither the orthogonality of supply and demand shocks nor the short duration of demand shocks are uncontestable assumptions. A shock to terms of trade would affect both aggregate supply and demand. In economies with high unemployment rates, demand shocks can be expected to have effects that are highly persistent, if not permanent. In a sample of only 29 observations, after adjusting for endpoints, it is not possible to identify what is of a permanent or a temporary nature. Changes in preferences, in particular related to the change in the saving behavior of domestic agents, are domestic demand shocks with durable effects, which would be included as supply effects in this framework.

Additionally, since beggar-thy-neighbor kind of policies would not have a place in a common currency area, the study of the correlation of demand shocks does not necessarily give useful insights. Take the case of Greece and Germany or Italy and Germany. Those countries could not keep up with the monetary and fiscal discipline of Germany until convergence was achieved under the Maastricht Treaty. Between 1970 and 1995 both countries had to devalue their currencies against the Deutch Mark to regain the competitive pulse of their business. Since the data for the period studied includes several examples of this kind of policy, we can conclude that the correlation coefficient of demand shocks probably underscores the true value of this coefficient. This kind of policy would not exist in a common currency area, and therefore, interpreting the correlation of demand shocks between Germany and Italy, or Greece and Germany becomes extremely slippery ground.

Other authors have tackled the issue of shock correlation. Carrera et al. (1998) found increasing similarity in the behavior of the economies of Argentina and Brazil after 1980. The authors used the international interest rate and a series of Latin American export prices as proxies for international supply and demand shocks, respectively, in a vector error correction model. The system also includes national GDP and CPI series as national variables. Using a comparison of impulse responses to international shocks, the authors are able to establish that, despite the existence of clear differences in the size and speed of adjustment to shocks, the responses become increasingly similar after 1980.

Overall, despite the perception that some shocks are becoming less asymmetric (more symmetric), the existing literature does not allow us to determine the degree of symmetry of the shocks that effect Mercosur.

1.3. Shock correlation in Mercosur and other proposed areas

In this section we will tackle the topic of the correlation of the shocks hitting countries in Mercosur. Since this is not a threshold question in which we know that symmetry is no longer a problem if shock correlation is bigger than a certain value, we will do the usual comparative analysis. In this case the benchmarks of the comparison are NAFTA and the EU. Rather than proposing a mechanism to measure shocks, this section intends to give the most accurate possible assessment of the question posed. To achieve this, we will report the results of several techniques, searching for a common message. We

will start by setting up the conceptual framework to serve as a basis for the empirical analysis, then go on to describe the estimation strategy, and finally we present the results.

1.3.1 Shock identification strategies

Before we study the correlation of shocks, we need to determine a series of shocks. Any time series can be decomposed in the following way:

$$y_t = b_t + s_t + e_t$$

where b_t represents a behavioral component, or the component that can be modeled, i.e. includes a time trend when appropriate, as well as the portion of the behavior of the series explained by the information contained in a set of explanatory variables; s_t is the seasonal component, and e_t is the innovation component or shock. When we work with seasonally adjusted data, the series of shocks are obtained as a residual:

$$e_t = y_t - b_t$$

It is clear from the above expression that the accuracy of our residual estimate depends crucially on the way we fit the behavioral component (b_t), and that the interpretation of these residuals varies depending on the meaning we assign to b_t.

Following the work of Mundell, the usual way to approach the identification of shocks in empirical OCA literature is based on the estimation of shocks to aggregate supply and aggregate demand equations (see Bayoumi and Eichengreen 1992,1994). This

method, even when we avoid biasing the estimates by working with the data in levels, comes with several caveats, which make this approach inconclusive.

In an effort to work around the limitations of particular techniques, this paper tries three different shock identification methods. The first two are reduced form models, then we try the structural VAR approach popularized by Bayoumi (1992). [3]

All the methodologies used come with caveats, and, as we previously said, we are looking for a common message.

1.3.2 Reduced Form Models

1.3.2.i Steady state innovation correlation

In this section we study the correlation of residuals from estimation of regional VARs. Since these are residuals from equilibrium output and prices, they can be interpreted as innovations on steady state values. The residuals include permanent and temporary shocks, demand and supply, and among demand shocks, competitive demand shocks and non competitive demand shocks. We have already pointed out that in a currency union we would not observe competitive demand policies, and we should be aware of these kinds of effects on historical data. Table 1.1 gives the results of GDP shock correlation.

In general, the results for the European Union show that there is high correlation of

[3] Baxter and Stockman (1989) worked with simpler approaches based on the more basic analysis of the data. In this case, it is not clear what kind of shocks we are working with, so that we are not able to leave aside demand shocks originated in competitive government policies.

shocks between core countries, and there are few negative correlation signs, none of which are significant. Italian supply shocks, despite showing a strong link to French, German and Spanish ones, do not present significant correlation with the rest of the countries. In the other two previous examples, the result is pretty much the same. Thus, for Italy, the advantages of participation in the EU lie in its links with the leaders of the agreement.

This methodology magnifies the ties between Canada and the US, whose correlation of GDP innovations rises to 0.67. The correlation of innovations between Canada and Mexico remains pretty much the same as in the previous cases, as does the one corresponding to Mexico and the US.

In Mercosur, the correlation coefficients are positive but not significant.

1.3.2.ii Innovations to GDP and CPI equations in an Error Correction Model.

For the sake of completeness, we add another technique: an error correction model for Mercosur and NAFTA. We run a cointegration test on the GDP and CPI variables of the countries of the two agreements and find the existence of one cointegrating equation for each region. Computing the VAR with Johansen's error correction mechanism, we report the resulting structural innovation correlations in Table 1.2. Once more, the correlation coefficients for the case of Mercosur, although positive for the case of Brazil with Argentina and Uruguay, are not significant. The results also remain

unchanged in the case of NAFTA. The GDP shock correlation between USA and Canada is positive and significant, although it is smaller than in the other estimates. [4]

1.3.3 Structural Form model

This section will provide a brief explanation of the technique chosen to identify supply shocks, and to set up an alternative for future work.

1.3.3.i Bayoumi's technique

The procedure used is a modification of Blanchard and Quah (1989), developed by Bayoumi (1992). Consider a syatem in which the true model can be represented by an infinite moving average of a (vector)of variables Z_t and an equal number of shocks ε_r. Using the lag operator L, this can be written as

$$\begin{aligned} Z_t &= A_0\varepsilon_t + A_1\varepsilon_{t-1} + A_2\varepsilon_{t-2} + \ldots + A_n\varepsilon_{t-n} + \ldots. \\ &= \sum_{i=0}^{\infty} L^i A_i \varepsilon_{t,} \end{aligned}$$

where the matrices A_i represent the impulse response functions of the shocks to the elements of Z.

Let Z be made up of the log of output and prices, and let ε_t be the supply and demand shocks. The model defined becomes

$$\begin{bmatrix} y_t \\ p_t \end{bmatrix} = \sum_{i=0}^{\infty} \begin{bmatrix} a_{11i} & a_{12i} \\ a_{21i} & a_{22i} \end{bmatrix} \begin{bmatrix} \varepsilon_{st} \\ \varepsilon_{dt} \end{bmatrix},$$

[4] For a detailed discussion of identification through Error Correction Models, see Johansen (1995).

where a_{11i} represents element a_{11} in matrix A_i, and ε_{st} and ε_{dt} are independent supply and demand shocks.

We assume that the model defined above can be estimated using a finite order VAR. Using B to represent these estimated coefficients, the VAR can be written in matrix form as

$$\begin{aligned} Z_t &= B_1 Z_{t-1} + B_2 Z_{t-2} + ... + B_n Z_{t-n} + e_t \\ &= [I - B(L)]^{-1} e_t \\ &= [I + B(L) + B(L)^2 + B(L)^3 + ...] e_t \\ &= e_t + D_1 e_{t-1} + D_2 e_{t-2} + ... \end{aligned}$$

where e_s represents the residuals from the equation in the VAR, i.e. the residuals of the output and price equations, and we label those e_{yt} and e_{pt} respectively.

To recover the structural model from the reduced form model, the residuals from the VAR (e) have to be converted into supply and demand shocks (ε).

Writing

$$C_0^{-1} \varepsilon_t = e_t$$

The identification of the model is achieved, in the two by two case described above, by the use of two normalization restrictions on the variance of ε_{st} and ε_{dt}, the orthogonality of supply and demand shocks and the condition that the demand shocks only have short run effects on supply. This last assumption implies in terms of the model we have just drawn that

$$\sum_{i=0}^{\infty} \begin{bmatrix} d_{11i} & d_{12i} \\ d_{21i} & d_{22i} \end{bmatrix} \begin{bmatrix} c_{11} & c_{12} \\ c_{21} & c_{22} \end{bmatrix} = \begin{bmatrix} . & 0 \\ . & . \end{bmatrix}$$

To circumvent the problem of cointegration, we apply Bayoumi´s (1992) technique to the variables in levels. Since the interpretation problems are still the same, at this stage we will only analyze the correlation of supply shocks. Because demand shocks with persistent effects are incorporated by the technique as supply shocks, the way to interpret the correlation coefficients we report in Table 1.4 is as a correlation of supply and long lasting shocks.

Supply shocks derived through this methodology show a significant positive correlation for countries in the EU between 1970 and 1996. We could properly say that, according to these figures, most countries in the sample have the shock correlation necessary for inclusion in a currency union. All countries but Spain and Sweden seem to maintain significant positive supply-shock correlation patterns with Germany, France, Italy and the United Kingdom (the core countries). Furthermore, it seems that there is a clear positive supply-shock correlation among core countries. More importantly, since there is no significant negative correlation coefficient, we find no evidence of shock asymmetry in the European Union. [5]

Nor do we find evidence of supply shock asymmetry in NAFTA. Even though the correlation of supply shocks hitting the U.S. and Mexico is negative in the sample, the coefficient is not noticeably different from zero. Canada appears to be the least problematic country; its supply shocks are positively correlated with Mexican and U.S. supply shocks, and the correlation coefficient is positive.

[5] The values are, in general, lower than those found by Bayoumi and Eichengreen (1994). The use of quarterly instead of yearly data would typically reduce the correlation coefficients.

Supply shocks in Mercosur do not follow an identifiable correlation scheme. Correlation coefficients are positive all around, with a .172 correlation between Brazilian and Uruguayan Supply Shocks. Note, however, that none of them is distinguishable from zero. See Table 1.3 for a distribution of the statistic for the correlation coefficient.

1.3.3.ii A proposal for a parametric identification of Supply Shocks.

One alternative to the method we have just seen would be to use a parametric identification of Supply and Demand Shocks. Instead of restricting the correlation of demand and supply shocks or the duration of demand shocks, we could try to achieve identification introducing meaningful economic restrictions on the parameters of Supply and Demand equations.

1.3.4 Size and importance of shocks.

In addition to identifying the correlation of shocks, it is important to determine the relevance of those shocks to the economies in the sample. In Table 1.5 we report own calculations of a simple measure of size previously used in Bayoumi and Eichengreen (1994), and Kenen (1995). The size indicator is the portion of variation unexplained by the right hand side variables. According to the table, shocks play a much larger role in Mercosur than in the other two regions, regardless of the methodology we use.

1.3.5 Summing up

We have tried to identify the similarities between shocks hitting different regions in order to know whether these regions are good candidates for a currency union in this, partial, sense. Three different methodologies have left us the same message that can be summarized as follows: first, even though there is no magical threshold indicating the passage to an OCA, in the comparison with the EU and NAFTA, Mercosur ranks third by far. The EU shows strong positive correlation of supply shocks on average, and particularly high correlation coefficients among core countries of the region. NAFTA seems to fulfill the precondition of a positive correlation between Canada and the U.S.A., making currency union feasible (however unlikely) in North America.

In the case of Mercosur, shocks show no significant correlation. This means that, on average, symmetric and asymmetric shocks seem to be evenly matched.

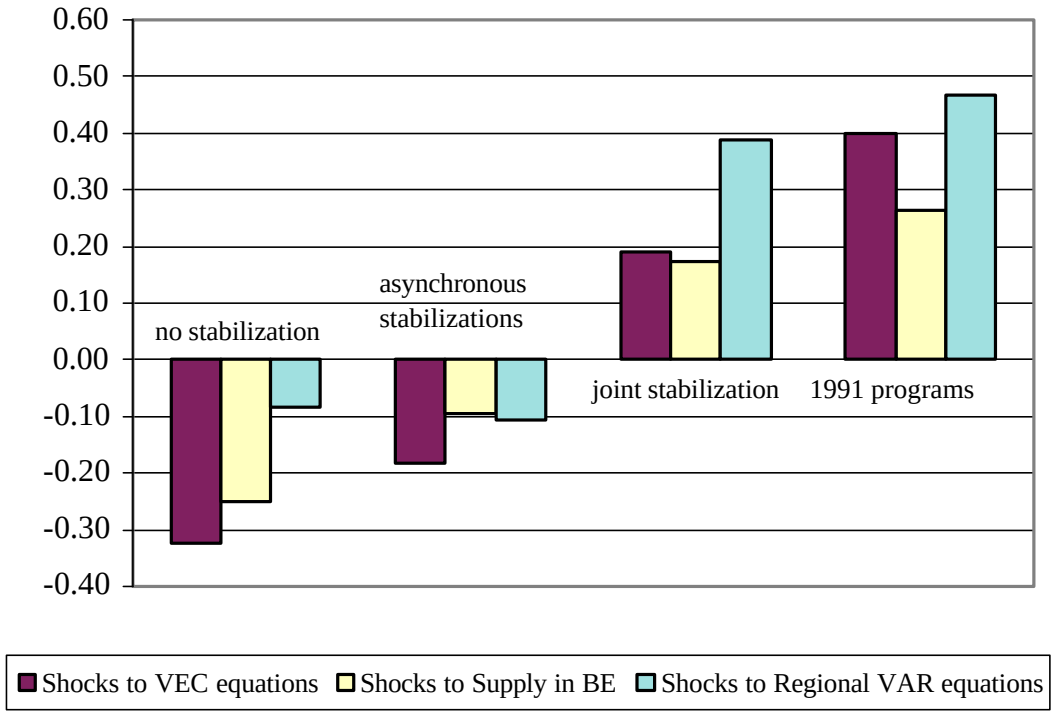
Symmetric shocks like the debt crisis are balanced out by asymmetric shocks like the increase in the price of coffee beans. This result, which seems to correspond to intuitive notions regarding the differences between Argentinean and Brazilian productive structures, remains a puzzle in the case of the correlation of shocks between Argentina and Uruguay, two countries with very similar productive structures.

The role of inflation stabilization.

A possible explanation for this puzzling result is the fact that the largest shocks affecting the region, apart from the debt crisis and oil shocks, were the stabilization plans implemented in each country. Exchange rate based stabilization programs

generate an initial appreciation of the currency, an initial consumption boom (Vegh, 1992; Kiguel and Liviatan, 1992) and a late recession. In the aftermath of a failed stabilization attempt, inflation picks up. What happens when two such plans in two countries overlap? If the duration, starting times and ending times of the plan are the same, the departure from the tendency will be very similar in both countries, which will result in a positive correlation of the shocks. The second moments of GDP and CPI will determine the size of the correlation, but it will nevertheless be positive. If the two plans start at different moments (i.e. a plan starts when the recession is taking place in the other) the impact on the correlation coefficients will be very different. As the second country starts to experience the consumption boom, the first country will be involved in a recession, generating a negative correlation in the departures from the tendency of GDP. The latter seems to describe more accurately what happened in Mercosur until 1990. The former is undoubtedly present beginning in 1994, and persists to date. These kinds of shocks would not appear in a common currency area and should be ruled out from the sample.

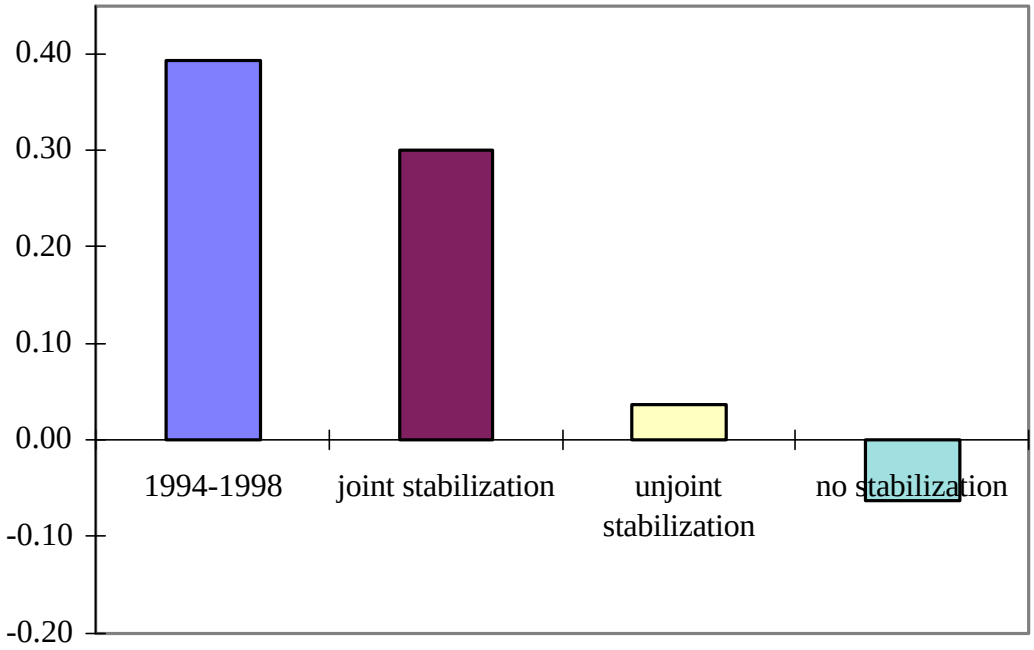
Graph 1.1
Shock correlation and inflation stabilization
Argentina and Uruguay 1975-1996



If we look at graph 1, the joint occurrence of inflation stabilization in Argentina and Uruguay is key for the observation of the correlation of supply shocks. The correlation coefficient, strongly positive during the periods of joint stabilization, becomes strongly negative when the implementation of stabilization programs is asynchronous. As in Talvi (1994), when both countries are implementing an exchange-rate-based stabilization, the correlation of the business cycles becomes high. This fact is clearly seen when we observe the latter period of inflation stabilization (which persists to the present), in which the correlation of shocks between both countries reaches its peak.

The influence of stabilization plans on the correlation of shocks is also clear in the case of Argentina and Brazil. Graph 2 is rather eloquent.

Graph 1.2
Argentina and Brazil: Supply shock Correlation
1975-1998



Overall, shocks hitting the region are relatively large. This suggests, as in Gross and Steinherr (1997), that the exchange rate might be more important for countries in Mercosur than in the EU and NAFTA. However, the passthrough of devaluations to prices has not been analyzed. If, as one can presume, the transmission of nominal shocks is very fast, the ability of the exchange rate to generate changes in relative prices might be severely limited.

1.3.6 Have shocks become alike?

In its report tilted “One Market One Money,” the Commission of the European Communities argued that deeper economic integration generates more intra-industry trade, and therefore generates higher productive diversification, and business cycles that are more closely related. This attractive point, based on empirical studies of the integration of Europe, is contrary to traditional specialization paradigms. According to Ricardian Theory, when they open to trade, countries accept the fact that their economies will become specialized according to their comparative advantage. In the Herscher-Ohlin-Samuelson model, specialization derives from factor endowments. Fortunately, the ambiguity is not supported by the data. Frankel and Rose (1996), using a panel of 30 years for 20 industrialized countries, find a strong positive relationship between bilateral trade intensity and the cross-country correlation of business cycle activity.

By showing these examples we have set up the question for Mercosur. Are shocks in the region becoming more similar as economic integration deepens? In order to answer the question we divide the sample of observations in two periods: 1975-1989, and 1990-1997:1. We test whether we can identify a breakpoint in 1990:1 and find a structural change in Argentinean parameters. We repeat all calculations described in section 1.3 in both sub-samples. Table 1.6 shows the correlation of shocks to GDP and CPI equations in the regional VAR.

We observe an increase in the correlation coefficient between Argentinean and

Brazilian shocks to GDP, which shifts from -0.04 to 0.24. However, neither the absolute value of the coefficient nor the change is significant. It is possible to observe an increase in the correlation of shocks affecting prices in Argentina and Uruguay, but, once more, neither the correlation coefficient nor the change in the parameter value is significantly different from zero. The only change of significance is the increase in the correlation of shocks to GDP between Argentina and Uruguay, which has been analyzed in III.6. We are reluctant to admit that only increased integration is the cause for this, especially considering that there are simultaneous stabilization plans in Argentina and Uruguay. The correlation of shocks to GDP between the core countries of the agreement does not show any significant change between periods.

The analysis of supply shocks gives a similar message. In the table below it is possible to appreciate a marked increase in the correlation of Argentinean and Uruguayan shocks, while the other two coefficients remain basically unchanged. Once more, the correlation coefficient is not significant, but, in this case, the difference is significantly different from zero.

Table 1.7
Supply Shocks: Are they more correlated now?

1990-1996			
	Argentina	Brazil	Uruguay
Argentina	1.0000		
Brazil	0.1089	1.0000	
Uruguay	0.2302	0.1638	1.0000

1975-1989			
	Argentina	Brazil	Uruguay
Argentina	1.0000		
Brazil	0.0067	1.0000	
Uruguay	-0.2315	0.2411	1.0000

The message is, then, mixed: There is some evidence of an increase in the correlations, but neither the changes nor the absolute values are important enough to conclude that the asymmetry of shocks is no longer an issue. Could we have expected anything different? NO. In the first place, the techniques used in the paper require a large number of observations. OLS estimation of VAR systems provides consistent estimations of the parameters regardless of the time series properties of the series in the sample. However consistent, the OLS estimators in this environment do not have very good small sample properties, and sharp changes in the results are not rare. The need to set a sub-sample sometime near the signature of the Asunción Treaty conspires against a clear identification of the shocks in the Mercosur period. Furthermore, a sample of only seven years appears to be too short in order to identify a trend, even with other types of techniques. In seven years at most two cycles are completed, and that is not enough to characterize this kind of phenomenon.

We cannot say that shocks are becoming increasingly similar. Can we say that they are becoming increasingly different? The answer again is NO.

It has been argued that regions should not worry about past asymmetries, since what really matters is how shocks are going to behave in the future (Kenen, 1995). We have already mentioned Frenkel and Rose's (1996) finding that increases in economic integration tend to make shocks more similar. If that is true, countries in Mercosur should only strive to become increasingly integrated.

In fact, deeper economic integration inside Mercosur could be generating a more highly diversified export structure for Uruguay, Argentina and Brazil. Graph 3 presents the Intra-Industry trade index Ct developed by Grubel and Lloyd (1975) for total uruguayan trade. The index measures the weight of intra industry trade in total trade.

The index was computed with trade information at four digits of the UIC. In graph 3 it is possible to observe an increasing trend, compatible with the strong increase in industrial exports to the region experienced by Uruguay the last seven years. Lorenzo (1990) has documented this process for trade in manufactured goods at four digits of the UIC (Uniform Industrial Classification). According to this author, the Ct index increases from a 19.4 % average in 1975-1979 to 25.5 % in 1984-1988.

The increase in the aggregated measures corresponds to a generalized phenomenon at the branch level, and is related to the commercial agreements with Argentina and Brazil. Graph 3 shows that the increase in intra industry trade is associated to the increase in the proportion of exports oriented to the region. Intra industry trade is the main explanation of trade between Uruguay and Argentina, where the Ct index

surpasses 70 % in 1996 and 1997. Even if trade with Brazil follows an inter-industry pattern, the intra-industry component has been growing steadily over the last 20 years.

There is evidence that the same phenomenon could be happening with Argentinean and Brazilian trade. Graph 4 shows that bilateral trade between these two countries, according to the data taken from ALADI, exhibits an increasing intra-industry component. Although the Ct index shows higher volatility for these two countries than it does for the case of bilateral trade between Argentina and Uruguay, there is a clear increasing trend, which shows a positive association with the increase of the participation of the region on total trade.

Uruguayan exports have experienced a process of deconcentration. Licandro (1998) shows that the increase in trade with the region is accompanied by a reduction in the concentration indexes of Uruguayan trade. Hence, available evidence suggests that Uruguay's increase in export diversification is due to higher intra-industry trade.

Although the patterns in Mercosur might match those set forth by of Fankel and Rose (1996), we do not have enough information as of now to sustain this fit. Therefore, it is not possible to reverse the conclusion reached in section 1.3; the similarity of the shocks affecting Mercosur cannot be included as a motive for monetary integration in the region.

1.4.- An approximation to the issues of transaction cost and exchange rate uncertainty

In a region composed of countries of similar sizes, which is highly open, where regional trade is a large portion of total trade, the incentive to reduce the exchange rate transaction cost and exchange rate uncertainty is high.

We first show that this description fits the structural characteristics of the European Union better than those of Mercosur. Then, in section 1.5, we discuss further problems of the latter region that could have great effects on plans of monetary integration among its member countries.

1.4.1 The levels of interdependence

Countries in the European Union show higher levels of interdependence than do those of Mercosur. Graph 5 shows exports to the region as a percentage of GDP for Germany and Brazil, as well as for the average of countries in the European Union and Mercosur. At the time of the Werner report in 1970, the average weight of exports to the region on GDP was close to 9% for EU countries. This figure increased over time and reached 14% by 1992. Germany's values and evolution are close to the average. In contrast, for the year the Asunción Treaty was signed (1991), the average level of interdependence in Mercosur was close to 2%, and for Brazil it was 1%.

While all countries in the European Union export a significant amount of their GDPs to the region, the same is not true for Mercosur. Graph 6 shows exports to EU/GDP for the four biggest countries of the region. Except for Germany, all other reported countries had below average relations with the region. France and Italy were close to

7% in 1970. The United Kingdom had the lowest level in that year, 5%. Though lower than average, all these values would be considered high for Mercosur countries. At the time of the Asuncion Treaty (Graph 6), Uruguay had the highest export exposure to the region (7%). Barely 1% of Brazil's GDP depended on exports to the region. Exports to Mercosur only represented 1.5% of Argentina's GDP. It is clear that while some countries have significant ties to the region, the two largest countries of Mercosur show only marginal export exposures. Although these levels have increased with the instrumentation of the Custom Union in Mercosur, they are still much lower than those of the European Union. If we consider that the transaction cost for the EU has been estimated at 0.5% of the region's GDP, we can see that the issue of currency exchange is not relevant in the case of Mercosur. Despite the fact that this issue might be of significance for the small countries, it is certainly not of great importance for either Brazil or Argentina.

1.4.2 Exchange rate variability.

The existence of nominal and real exchange rate volatility can be a deterrent for trade and investment. Despite the fact that empirical literature has had problems identifying these effects, we cannot ignore the logic behind this kind of reasoning. This is certainly one aspect Mercosur might find important when discussing the pros and cons of a common currency area or a coordination agreement.

De Grauwe and Vanhaverbeke (1993) analyze the variability of real exchange rates in Europe. They find that the mean absolute yearly change (MAYC) is 4.4 % a year for the mean of countries in the EMS for 1977-1985. In Table 1.8 we are able to compare the levels of real exchange rate variability for Mercosur and NAFTA. Although Mexico introduces a certain degree of variability in NAFTA, real exchange rates are far less variable in this region than they are in Mercosur. [6]

Table 1.8
Real Exchange Rate Variability

	MAYC
MERCOSUR	1974-1994
Uruguay-Argentina	
Argentina-Brasil	35%
	46%
NAFTA	

[6] In the three days following the fall of plan Real in Brazil, the nominal exchange rate devalued almost 50%. After the fall of the Tablita plan in Uruguay in November 1982 the nominal exchange rate devalued more than 300%.

Mexico –US	
Canada-U.S.	19%
	4%

1.4.3 Symmetry.

Power distribution is more even among countries in the European Union than it is between Mercosur member states.

Graphs 7 and 8 compare the importance in terms of the GDP of the largest country in each region (Germany and Brazil in their respective agreements). In 1968-70, at the time of the Werner Proposal, Germany's GDP represents only .34 times of the GDP of the rest of the region. In 1990-92, at the time of the signature of the Asuncion Treaty, Brazil's GDP was 1.30 times the GDP of the rest of Mercosur. This asymmetry is not so evident in the comparison of the GDP of the biggest country of the region with its main partner's GDP; France's GDP was almost the same as Germany's in 1968-70, Brazil's GDP was only 40% higher than the Argentinean GDP for 1990-92.[7] Note however that while Mercosur accounted for only 9% of Brazil's trade, 23% of Argentina's trade was directed to the region in 1991.

Despite the fact that the levels of interdependence among the member states are quite low at the present early stage of Mercosur, the rather extreme variability of relative

[7] Comparing GDPs in US$ makes more sense for the European Union than for Mercosur. The large swings in the real exchange rates of countries in the latter makes it very hard to find a specific year that could be considered normal (that is why we work with 3 year averages). As an example: in 1995 Brazil's GDP more than doubled Argentina's GDP, while in 1988 Argentina's GDP was 12% higher in US$ than Brazil's GDP.

prices might be a source of great burden for some countries in the agreement. This is clear for the case of Uruguay, and probably Paraguay, whose geographical proximity plays a key role. Amjadi and Winters (1997) show that transport costs are much lower for Paraguay and Uruguay when they trade with their two large neighbors. In the case of Argentina and Brazil, even if the transport cost savings are not significantly lower, we cannot deny the existence of a case for the reduction of exchange rate variability. Indeed, trade bloomed when both countries fixed their exchange rates. Furthermore, low interdependence might be a result of exchange rate variability. Hence, even if it is difficult to conceive that Brazil would relinquish its sovereign monetary policy to Mercosur authorities, there are clear reasons to pursue other policies that aim at the reduction of the variability of relative prices.

1.5. Mercosur´s own reasons? Sovereignty, the cost of debt, and the cost of reserves.

Even without an evaluation of the flexibility of Mercosur's factor markets, the cost of losing the sovereign management of monetary and exchange rate policy might not be so high if its member states are seriously committed to long run inflation control.

The reduction in the margins of management of sovereign monetary policy.

On the positive side, none of the countries of Mercosur can currently implement monetary policies like the ones used by countries in Euroland. Argentina has a currency board, Uruguay has a target zone, which, since the exchange rate is almost always on

the bottom of the band, operates as an active crawling peg, and Brazil, until the recent collapse of the Real plan, had a target zone with capital controls.[8] Despite anecdotal differences, because the exchange rate plays a central role in the anchoring of prices, a country's real ability to manage this instrument is quite limited. Brazil manages domestic interest rates, but at the cost of extremely high real interest rates. Years of policy mismanagement and failed stabilization attempts have resulted in shrunken monetary aggregates, and deep dollarization and indexation technologies; these conditions have greatly limited Brazil's maneuverability with respect to monetary management.

How probable is it that, in the near future, Mercosur countries will be able to develop sovereign monetary policies similar to those of developed countries? Undoubtedly, the likelihood of this event is rather slim.

With the exception of Paraguay, the countries of Mercosur are well known for their problems with chronic high inflation, and in some cases of hyperinflation. Argentina's annual inflation rate ranged from 388% to 4145%, in sharp contrast to the stability in Europe which preceded the Werner proposal in 1970, and the achievement of convertibility in 1957 by all the members of the community.[9,10] This is not the only difference. In addition to very high inflation, countries in Mercosur have a long history

[8] On January 14 1999, the central Bank of Brazil decided to allow the currency to float.

[9] We follow Kenen (1995) in the selection of these benchmark dates: the achievement of convertibility proposed by the European Payments Union (1958), and the presentation of the Werner report (1970). Monetary cooperation started shortly after World War II.

[10] . The inflation rates used in this section are annual growth rates of end of period CPIs. CPI information was extracted from the IFS.

of failed inflation-stabilization attempts. Between 1967 and 1990, Uruguay made two attempts to implement stabilization programs, both failed. Argentina attempted four times, and Brazil five[11]. Even Paraguay, with the lowest inflation rates of the region, had higher average inflation than the least stable country in the European Union. It is clear which of the two regions has a legacy of instability and a reputation tarnished by bad inflation control.

Because of their poor track records, Mercosur countries find it necessary to make strong commitments to the reduction of the inflation rate. Argentina had to fix the exchange rate by law. Uruguay, after reaching 130% inflation in March 1990, achieved one digit inflation rates by August 1998 after seven years of gradual inflation stabilization, and the achievements of the present stabilization are seen as fragile. When the Mexican government devalued the peso in late 1994, Argentina suffered a run against its currency; this is a clear indication of the lack of confidence of private agents in the plan. The Brazilian crisis of August-October 1998 and the recent fall in the Real plan revived old ghosts and generated large fluctuations in the financial markets of the region.

In this atmosphere of strict inflation control, it is not likely that any of these countries could abandon the nominal anchor chosen, nor relax the fiscal constraints, without increasing the risk of a run against either domestic currency or public debt. If their commitment to inflation stabilization is strong, it is unlikely that Mercosur's countries

[11] The referred plans are: The 1970 plan and the Tablita for Uruguay; the Tablita, Austral, Spring, and Bonex plans for Argentina; the Cruzado, Bresser, Summer, and Collor I and II plans for Brazil. The three countries have stabilization plans in place.

will return to an independent monetary policy after the stabilization period is over. As a consequence, it is hard to see a regional monetary agreement as a relinquishment of sovereignty: there is not much, if anything at all, to give up.

New can be better.

A common currency, if drawn up in a credible fashion, could even improve the role of monetary policy at the regional level. Since a Central Bank committed to inflation control can credibly accommodate external shocks, as the German Bundesbank does, the regional Central Bank could play a role in the accommodation of that kind of shock. Licandro (1998) works out a reputation argument in which the existence of a small probability of being committed to both inflation stabilization and coordination of monetary policy, in the presence of a long run policymaker, would create a space for credible coordinated monetary policy based on inflation stabilization. Even if the possibility of accommodating regional shocks were denied, this limited role would be better than what the Central Bank of Argentina, as an example, has now. In the long run, it could even be the case that a stable currency from the fourth (or fifth) largest trading block in the world becomes an interesting option as part of a portfolio of reserves for foreign central banks.

Beetsma and Bovenberg (1997) argue that monetary unification without coordination among decentralized fiscal authorities may actually reduce the biases toward inflation and excessive public spending. The formation of a regional Bank makes the links between inflationary finance and fiscal imbalances less clear; the central bank is not able to internalize the benefits of the lack of fiscal discipline. Some spending bias may

remain as long as the regional central bank cares for the real side of the economy, and allows for some money creation.

Negotiating in larger blocks

Brazil, and even Argentina, could be interested in using the region as a base of negotiation in larger economic blocks like ALCA. Even if monetary union were not convenient in the traditional sense, relinquishing some (of the already severely limited) monetary sovereignty might not be a bad idea if it were a precondition for a country to hold the reigns as leader of the region. In international forums, rather than each member state expressing its position, it is becoming increasingly common for Mercosur to articulate its views as a region.

The cost of reserves

Joining a currency union could lower the cost of International Reserves and generate an international demand for the regional monetary sign. If Central Banks are cautious when determining the stock of foreign reserves to hold, advancing to a currency union might free some resources that could be used for other purposes. The joint management of reserves could result in an optimal level of reserves lower than the sum of reserves in power of national Central Banks; this would free up national reserves and create opportunities for investment. Furthermore, a stable currency of the fourth largest trading block in the world could be good choice for a portfolio of reserves, mainly for countries in the rest of South America. The demand for reserves would result in an appreciation of the regional currency.

The cost of Debt.

The change to a common currency with an independent Central Bank and a strong commitment to inflation control, based on fiscal stability criteria, could seriously reduce the cost of debt in international markets. In Table 1.9 we can see that the cost of debt is very high for the region according to international standards. No one can deny the great influence of the region's past monetary misconduct on these spreads. Should countries go into a common currency area (a move which would require the approval of national legislatures), the commitment assumed by the countries could improve their credit ratings and reduce the spreads paid significantly.

Since Argentina and Brazil are redirecting the issue of public debt towards international markets, the potential benefits of the reduction of spreads could be very high. Considering that Brazil had to pay up to 1400 base point spreads over U.S. national bonds, and that public debt is close to 30 percent of GDP, just halving spreads would result in savings in interest payments of almost 2% per year. Before the crisis took place, Brazil's spreads were 300 base points higher than those of Uruguay, whose high spreads were the result of its deep links to the region.

Table 1.9
External Debt Cost: Yield spreads

Mean of	Argentina 2027	Brazil 2027
1997	493,40	678,96
1998	509,98	686,66
1999	622,42	1056,26

Note: Spreads with U.S. 2027 T. bills.
Data for 1999 covers until 2/12/1999.

1.6.-Summary and Conclusion.

According to the classical Mundellian view of Optimal Currency Areas, countries in a region would find it optimal to give up their currencies whenever the exchange rate is not necessary to adjust the real exchange rate to asymmetric shocks. This might happen if shocks affecting the region are similar, if prices are flexible, and /or there is free labor and capital mobility within the region.

The paper researches the first of these conditions for three economic regions in order to obtain a ranking. Using three different methodologies, we are able to establish that even though there is no magical threshold indicating the passage to an OCA, and that in the comparison with the EU and NAFTA, Mercosur ranks a far third. The EU shows strong positive correlation of supply shocks on average, and particularly high correlation coefficients among core countries of the region. NAFTA seems to fulfill the precondition of a positive correlation between Canada and the U.S.A., making monetary integration feasible (however unlikely) in North America.

In the case of Mercosur, shocks show no significant correlation. This means that, on average, symmetric and asymmetric shocks seem to be evenly matched. Symmetric shocks like the debt crises are balanced out by asymmetric shocks like the increase in the price of beef. This result, which could correspond to intuitive notions regarding the differences between Argentinean and Brazilian productive structures, remains a puzzle

in the case of the correlation of shocks between Argentina and Uruguay, two countries with very similar productive foundations. We are able to show that, as in Talvi (1994), the business cycles of Argentina and Uruguay become more closely correlated when both countries implement stabilization plans at the same time. However, when stabilization plans overlap imperfectly, meaning that when one country is just entering the boom as the other is entering the bust, the correlation of shocks becomes negative.

The size of shocks is, however, historically much larger in Mercosur than in the EU or NAFTA, and, although we are not able to determine the role of devaluations, the real exchange rate varied greatly in the adjustment process.

Despite the fact that shocks were not highly correlated in the past, as Kenen (1995) points out, what really matters, for several reasons, is the *future* correlation of shocks. With this in mind, it is important to note that some evidence suggests an increase in the similarity of patterns of shocks in the last decade. Furthermore, we show that deeper economic integration has resulted in more intraindustry trade in the region, fertilizing the case for increasing similarity in production and consumption patterns.

Additionally, although we do not know whether Mercosur's labor markets are more able to adjust shocks than other regions in the world, or whether the degree of labor mobility is capable of making up for the potential effects of asymmetric shocks, Mercosur might have its own reasons to move to a currency union.

The following motives should be considered when contemplating a move towards Monetary Integration: the fact that, at present, each country's ability to manage exchange rates and monetary policy is greatly limited, and that the cost of debt is

elevated due to reputations of bad macroeconomic management, as well as the possibilities of, under a single currency scheme, a reduction in the cost of reserves and constituting the common currency in a reserve currency. We also suggest that, instead of losing sovereignty, the region might increase its ability to adjust to common external shocks with exchange rate policies, an alternative that is currently not available for Argentina, and is very costly to Brazil.

1.7. Appendix. The Data and its Time Series Properties.

The data on direction of trade comes from the Direction of Trade Statistics of the IMF.

Mercosur. Data on prices and wages comes from the IFS. The GDP and unemployment series come from the national statistical institutions. Data from Uruguay comes from the INE (Instituto Nacional de Estadísticas), and the Banco Central del Uruguay. Data from Argentina was extracted from INDEC and the Banco Central de la República Argentina. Data from Brazil comes from the MACROMÉTRICA database.

NAFTA. Data from the US and Canada was extracted from the IFS and the OECD database (unemployment rates only). Data from Mexico comes from the Database of the Banco Central de Mexico.

EUROPEAN UNION. Data on GDP and unemployment comes from the OECD database, while data on wage indexes and price indexes, as well as exchange rates comes from the IFS. Updates of some series was obtained from the national statistical institutions of each country.

A look at the data

The data set consists, at this stage, of series of quarterly real GDP, real wage and CPIs for countries of NAFTA, EU, and Mercosur.

We work with seasonally adjusted data. Even though it is possible to lose some information in the process of seasonal adjustment, it was impossible to proceed differently. Data on quarterly real GDP for some countries of the EU is published only in seasonally adjusted terms, and, for the sake of standardization, we chose to adjust

the rest of the series.

Our first step was to look at the time series properties of the data.

Cointegration and VAR estimation

All series are found to be I(1) at 10% confidence level, and most of them at the 5%. We computed the augmented Dickey-Fueller statistic for all series for lag-lengths from 1-4, selected the optimal lag-length for each series and found all series of output and prices to be I(1).

We then apply the Johansen likelihood ratio test to the national series to search for possible cointegration relationships. Lets first say that, in some cases like in Canada and Denmark, the graphs of the series suggested this possibility very strongly. Table 1.10 shows the results of Johansen's likelihood ratio test applied to the pairs of GDP and CPI series of each country. We see that in every region there is at least one country showing cointegrated series. In the EU France and Finland's logs of GDP and CPIs are cointegrated at the 1% confidence level, while those for Austria, Denmark, Italy and the UK are cointegrated at the 5% confidence level. In NAFTA, Canada shows cointegration at the one percent level while Mexico's log of GDP and CPI are cointegrated at 5 %. In Mercosur, Argentina's GDP and CPI series are cointegrated at the 5% level.

When cointegration is present in the sample, there are two ways to estimate

consistently a VAR. The first is to run an error correction mechanism and estimate the variables in differences; the second is to run the VAR in levels. We chose the last alternative for reasons of simplicity.

Lag length selection.

The optimal lag length was set to one in all regions. To determine the optimal lag length we proceeded in two ways. We first determine the optimal lag length for the region, and then, we run the lag selection mechanism country by country. Using this procedure, we try to determine whether we should have different lag lengths, one for each country, or a uniform criterion. We find that, for the European Union, only two countries out of eleven in the sample showed an optimal lag different from one, while in the other regions, one out of three had a different reading. The optimal lag length for all regions was one in every case. Furthermore, since exceptions to the general rule were so few, we chose one as the lag length. Although the obvious candidate for optimal lag length in quarterly data is four, in this case, since the data is seasonally adjusted, this is no longer true and a lag length of one is acceptable.

1.8. Tables and Graphs

Table 1.1.- Correlation of Shocks to National GDP equations in Regional VARs

EUROPEAN UNION

1970-1996

	Germany	France	U.Kingdom	Italy	Spain	Austria	Netherlands	Sweden	Denmark
France	0.4144	1.0000							
U.Kingdom	0.3180	0.2550	1.0000						
Italy	0.2240	0.3589	0.1176	1.0000					
Spain	0.0201	0.3998	0.1441	0.2381	1.0000				
Austria	0.3232	0.2276	0.2436	0.0161	0.1355	1.0000			
Netherlands	0.2507	0.1554	0.1167	0.0439	0.2069	0.2409	1.0000		
Sweden	0.2031	0.1370	0.1687	-0.0891	-0.1042	0.2215	0.1614	1.0000	
Denmark	0.3428	0.1549	0.2570	0.1064	0.2372	0.1871	0.1264	0.0741	1.0000
Finland	0.1729	0.2674	0.0702	0.0354	0.1242	0.1241	0.0821	0.2284	0.1875

B.- MERCOSUR

1975-1996

	Argentina	Brazil	Uruguay
Brazil	0.1442	1.0000	
Uruguay	0.0702	0.1597	1.0000

C.- NAFTA

1980-1996

	Canada	Mexico
Mexico	0.2047	1.0000
U.S.A.	0.6729	-0.0161

Table 1.2

GDP-CPI Innovation Correlation for NAFTA and MERCOSUR

Error Correction Model

GDP

	Canada	Mexico	United States		Brazil	Argentina	Uruguay
Canada	1.0000			Brazil	1.0000		
Mexico	0.1899	1.0000		Argentina	0.1302	1.0000	
United States	0.2500	-0.0897	1.0000	Uruguay	0.1867	-0.0133	1.0000

CPI

	Canada	Mexico	United States		Brazil	Argentina	Uruguay
Canada	1.0000			Brazil	1.0000		
Mexico	0.0267	1.0000		Argentina	-0.3599	1.0000	
United States	0.4120	-0.1911	1.0000	Uruguay	0.0473	-0.1167	1.0000

All series have one unit root according to ADF

Table 1.3. Critical values of correlation coefficient

Sample size	Value of the coefficient needed to be significant at 20%	10%	5%	2%	1%
20	0.3116	0.4012	0.4771	0.5587	0.6062
25	0.2741	0.3537	0.4223	0.4992	0.5481
30	0.2478	0.3195	0.3819	0.4534	0.5005
35	0.2276	0.2936	0.3511	0.4176	0.4621
40	0.2116	0.2729	0.3264	0.3886	0.4307
45	0.1986	0.2561	0.3063	0.3648	0.4046
50	0.1877	0.2420	0.2895	0.3448	0.3825
60	0.1704	0.2196	0.2625	0.3128	0.3471
70	0.1571	0.2023	0.2419	0.2883	0.3199
80	0.1465	0.1886	0.2255	0.2686	0.2981
90	0.1378	0.1774	0.2120	0.2524	0.2802
100	0.1304	0.1679	0.2006	0.2389	0.2650

Own calculations

Table 1.4.- Correlation of Supply Shocks.

A. EUROPEAN UNION

1970-1996

	Austria	Denmark	Finland	France	Germany	Italy	Netherlands	Spain	Sweden
Denmark	0.2917								
Finland	-0.2398	0.0290							
France	0.0588	0.1663	0.1879						
Germany	0.2127	0.4821	0.1637	0.5224					
Italy	0.1826	0.2906	0.0495	-0.4446	0.3511				
Netherlands	0.1512	0.2390	0.0019	0.2663	0.3780	0.2155			
Spain	-0.0322	0.0712	0.0669	-0.0667	0.0207	-0.0786	-0.0637		
Sweden	0.1400	-0.0567	0.0447	0.0460	0.0765	-0.0657	0.0624	0.0733	
U.Kingdom	0.0952	0.3655	0.1414	0.1921	0.5560	-0.0070	0.3024	-0.0985	0.1722

B.- MERCOSUR

1975-1996

	Argentina	Brazil
Brazil	0.0452	
Uruguay	-0.0476	0.1720

C.- NAFTA

1980-1996

	Canada	Mexico
Mexico	-0.0443	
U.S.A.	0.5838	-0.1201

Table 1.5. – Shock Size*

	Supply Equation	Regional VAR
I. MERCOSUR		
Uruguay	6.15%	6.42%
Argentina	4.92%	6.38%
Brazil	2.02%	2.11%
II. EUROPEAN UNION		
Germany	0.16%	0.13%
France	0.12%	0.11%
U.Kingdom	0.42%	0.37%
Italy	0.13%	0.13%
Spain	0.06%	0.03%
Netherlands	0.58%	0.51%
Austria	0.47%	0.43%
Sweden	3.59%	2.65%
Denmark	0.48%	0.40%
Finland	1.16%	1.09%

*Computed as one minus adjusted R squared

Table 1.6.-
MERCOSUR: Have Shocks become any similar?

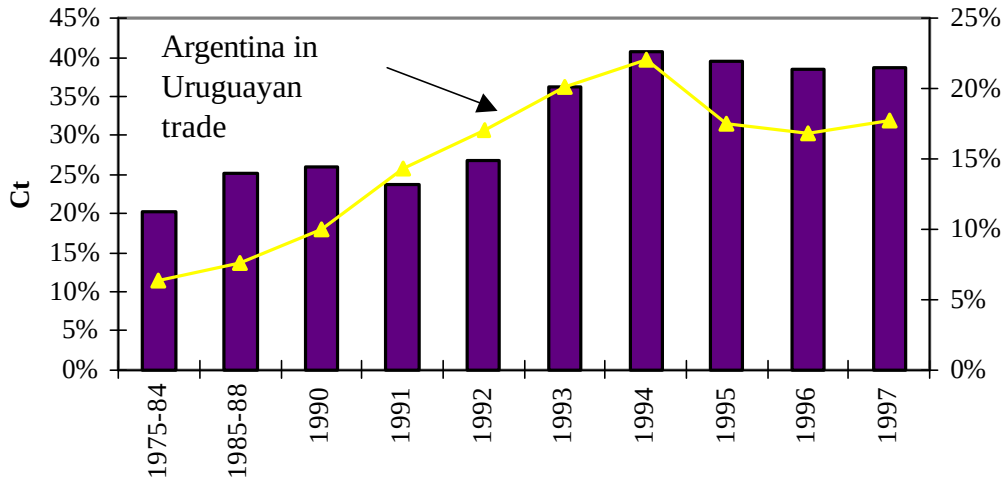
1990-1997

	GDP			CPI		
	Brazil	Argentina	Uruguay	Brazil	Argentina	Uruguay
Brazil	1.0000			1.0000		
Argentina	0.2336	1.0000		-0.4620	1.0000	
Uruguay	0.2125	0.3320	1.0000	-0.0591	0.1859	1.0000

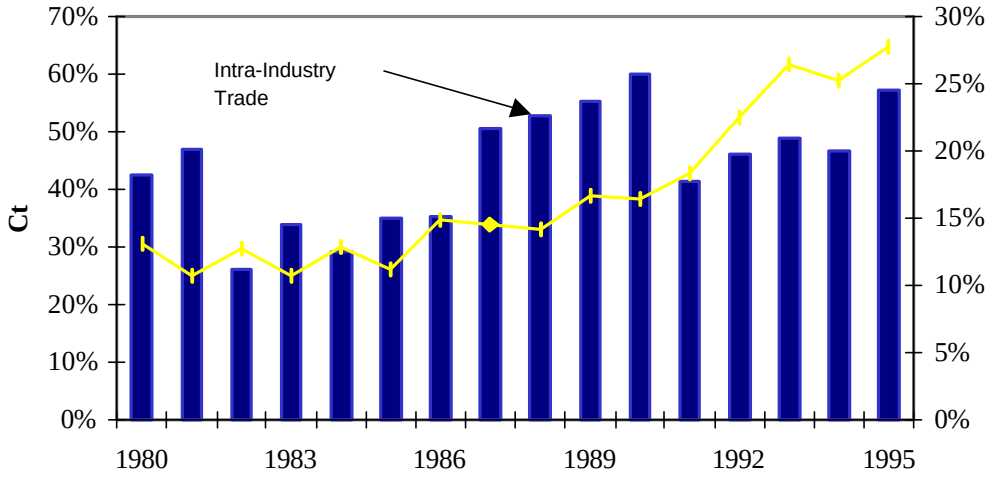
1975-1989

	GDP			CPI		
	Brazil	Argentina	Uruguay	Brazil	Argentina	Uruguay
Brazil	1.0000			1.0000		
Argentina	-0.0390	1.0000		-0.2062	1.0000	
Uruguay	0.1365	-0.0402	1.0000	-0.0588	-0.0366	1.0000

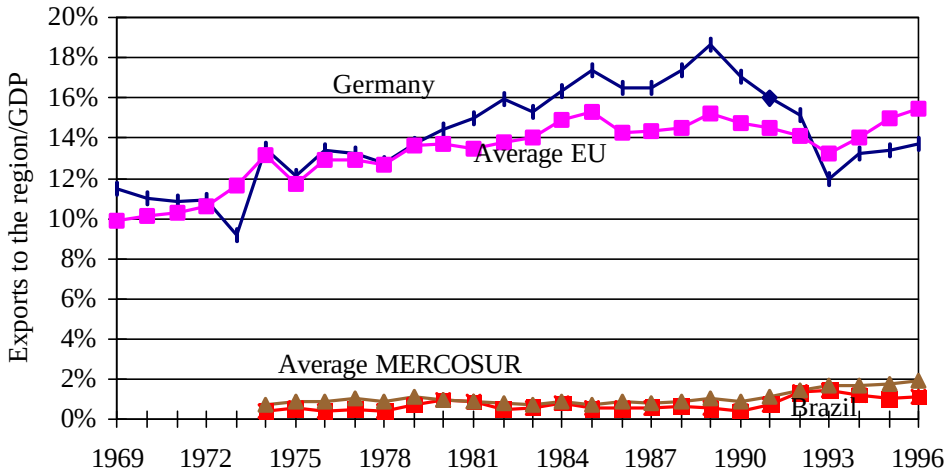
Graph 1.3
Uruguayan intra-industry trade and Bilateral trade
Argentina-Uruguay



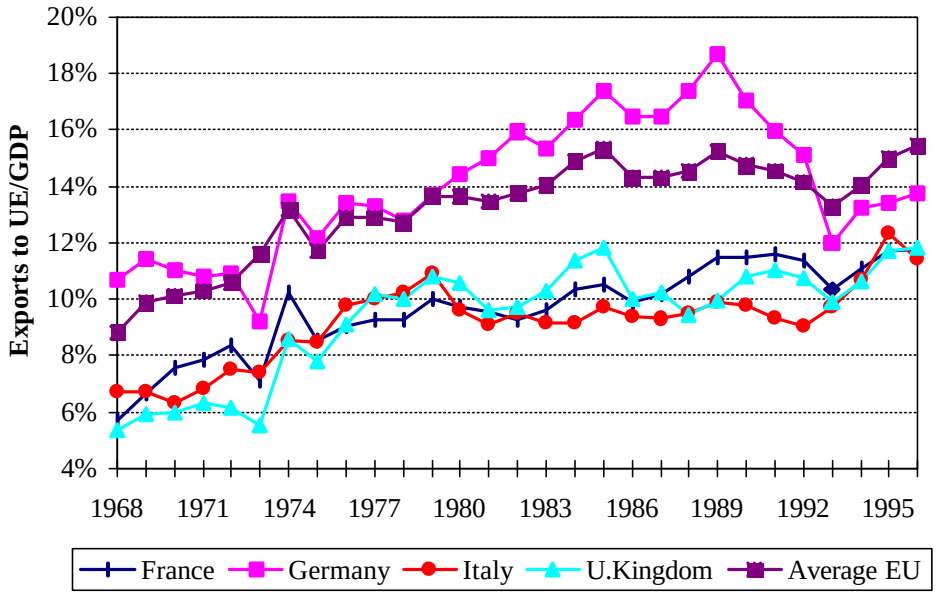
Graph 1.4
Intra-Industry Trade Argentina-Brazil and Mercosur on Argentinean Trade



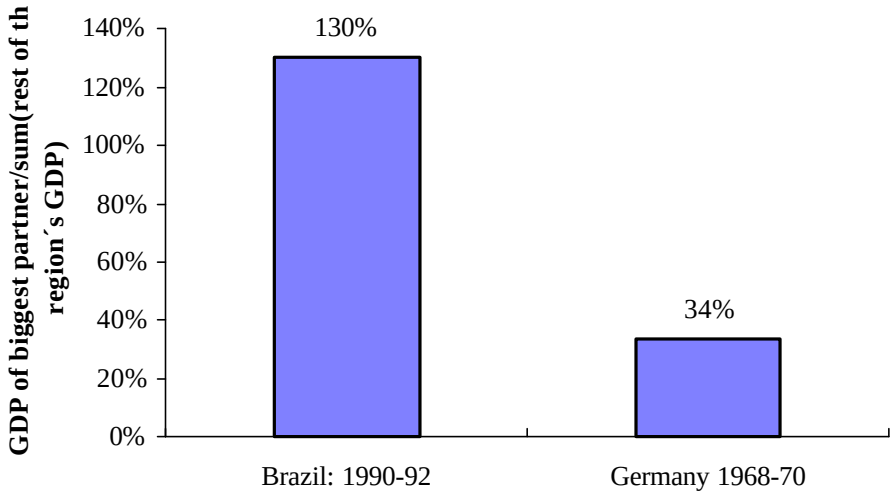
Graph 1.5
Demand Interdependence: EU and MERCOSUR
Exports to the region/GDP



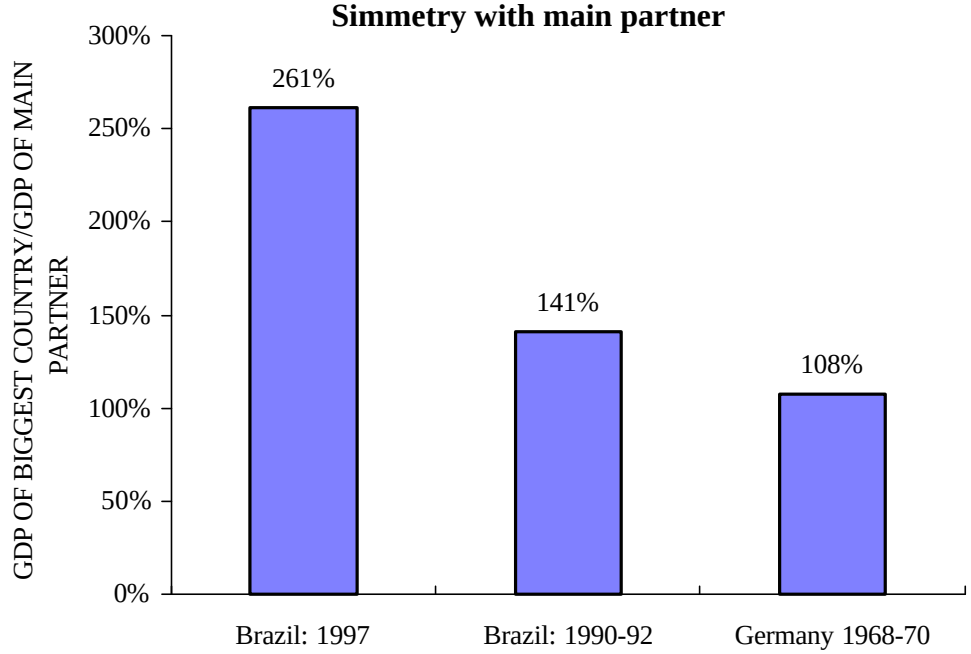
Graph 1.6
Demand Interdependence: EU
Exports to the region/GDP



Graph 1.7
Biggest Partner compared to the rest of the region



Graph 1.8
Simmetry with main partner



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Chapter 2. Coordinating to Stabilize: A Model of Monetary Policy Coordination with Reputation Spillovers.

2.1. Introduction

In 1985 Argentina, Brazil, Paraguay and Uruguay formed MERCOSUR (Common Market of the South). The first article of the Asuncion treaty[12] proposes to create a common market and the coordination of macroeconomic policies. The article reads (author's translation):

On December 31st. 1994, The Participating States decided to create a Common Market , henceforth known as "MERCOSUR".

[12] Treaty for the formation of a Common Market among Argentina, Brazil, Paraguay and Uruguay, signed in Asuncion in 1991.

This Common Market implies:

[...] The coordination of Macroeconomic [...] policies among participating States: ttrade, agriculture, industrial, fiscal, monetary, exchange rate, capital markets, services with the goal of insuring the adequate conditions of concurrence among the participating States."

Recently, the president of Argentina, Carlos Menem, launched the idea of advancing towards a common currency area. That idea was discussed in June of 1998 in Buenos Aires, where a group of experts from MERCOSUR agreed on that the proposal was premature, and on the need of achieving simpler targets before taking on such a big project. In particular there was a consensus on dealing with the possibility of coordinating macroeconomic policies first. More recently, the focus has shifted towards the achievement of a fiscal stability agreement on the same lines of Maastricht Treaty.

The existing literature on policy coordination is based on the European experience and fails to explain why countries like the ones participating in MERCOSUR would want to coordinate macro policies. Based on a two-country analysis, and in the existence of a significant policy spillover effects, this literature might help explain the motives of similar sized and highly interdependent countries like France and Germany to coordinate, but does not explain why different sized countries with low levels of trade dependence, such as those in the MERCOSUR, would want to coordinate.

How can monetary policy in Uruguay affect output in Brazil? What can Paraguay do in order to help Argentina mitigate the effects of an external shock? Can countries coordinate monetary policy in the absence of traditional motives? The literature on

monetary policy coordination, starting with Hamada (1976), points out the advantages of appropriating the externality created by monetary shocks. In a world of two countries closely linked, a change in money supply in one country will change aggregate demand in both. Optimal unilateral monetary expansions do not appropriate the externality on the foreign country, and the resulting expansion is smaller than the optimal coordinated one.

Rogoff (1985) showed that coordination of monetary policy is only beneficial when highly interdependent countries of similar size experience positively correlated supply disturbances. MERCOSUR is characterized by low levels of interdependence among the big countries of the region, the presence of a giant like Brazil, and very different productive structures across countries, a situation strikingly different from the scenario Rogoff pointed out as the right one for coordination. Furthermore, coordinating monetary policies in Rogoff's way, with countries of different sizes implies a floating exchange rate regime. The southern cone region's long history of failed stablizations is an unlikely scenario for such a regime. Since the existing literature on monetary policy coordination does not seem to explain the motives of countries in MERCOSUR to coordinate, it is necessary to look for alternative explanations.

Other arguments can give basis for coordination of monetary policies. In a first approach to be mentioned, Giavazzi and Pagano (1988) suggest that countries with low credibility would want to tie their monetary policy to a strong currency in order to gain credibility; their main message is that if there were no enough credibility inside

the home economy, a way to make monetary policy credible would be to commit to an international commitment to keep a fixed exchange rate. In this framework international arrangements operate as commitment devices, helping countries to stabilize. The second argument is a political one. In political spheres of MERCOSUR, there is the feeling that Brazil enters the agreement in order to shield its macro/growth policies against lobbying by the private sector. Brazil has a long history of policy instability, and joining MERCOSUR is a way the Brazilian government can credibly commit to a structural change, that includes inflation stabilization. Third: there is also a vast literature which investigates the importance of exchange rate uncertainty on investment[13]. Credibility tool, commitment technology, elimination of uncertainty, are just a few examples of benefits of coordination that the traditional literature does not cover.

The purpose of this paper, is to consider a situation in which the traditional benefits of monetary policy coordination are not present, and show that coordination is still viable if it provides information about the type of policymaker they are facing. Rogoff (1985) proved that when equilibria are required to be time consistent, coordination can be counterproductive. The idea of this paper is that in a model of incomplete information, even in Rogoff's environment of counterproductive policy coordination (as traditionally understood), coordination of monetary policy can still arise if there is a positive correlation between willingness to coordinate, and commitment to low

[13] See, for example, Baldwin and Krugman (1989) and Bodnar and Gentry (1993).

inflation in the definition of types.

The driving force behind the result is the presence of what Cole and Kehoe (1994) called a reputation spillover. They find that in models with incomplete information, a relationship with transient benefits can be supported in equilibrium if it causes a reputation spillover which bolsters a relationship with enduring benefits.

Unlike Cole and Kehoe's model, the reputation spillover the present paper proposes arises naturally from the structure of the game. They work an example of debt with an ad hoc spillover to a labor relationship. In our model, the committed policymaker is indifferent between coordinating and not coordinating, but the non-committed type would much rather not coordinate in time consistent equilibria. Since only the committed type would coordinate in equilibrium, cooperation operates as a signal of the policymaker's type.

The proposal for coordination is a zero-inflation fixed exchange rate regime. Lack of coordination of monetary policies tells the private sector that the government is not really committed to inflation control, and results in the return to high inflation. In our model, the private sector needs additional signals of the willingness of the government to bring down inflation. This need for extra commitment in order to lower inflation is what makes the model appealing for the case of the southern cone countries. However, we show that bad history in inflation control, policy instability, and low levels of interdependence make it harder to achieve this kind of coordination.

The paper proceeds as follows: section 2.2 shows MERCOSUR has no grounds for

monetary policy coordination on the existing literature on monetary policy coordination, and compares the region with the European Union. Section 2.3 presents Rogoff's result that monetary policy coordination can be counterproductive in a standard model of monetary policy coordination based on Currie and Levine (1993). Section three also analyzes the incentives facing different types of policymakers to coordinate. Section 2.4 introduces the incomplete information model and shows that reputation spillovers can sustain coordination in a finite horizon game. Section 2.5 generalizes the previous result with more general cost functions and in an infinite horizon setting. Section 2.6 analyzes the importance of the particular characteristics of countries participating in MERCOSUR on their potential ability to sustain this kind of coordination. Section 2.7 summarizes the results.

2.2. The European Union and MERCOSUR: two different animals.

The theoretical justifications for monetary policy coordination, while appropriate for the European Union, do not help us think about the possible reasons countries in MERCOSUR think about the coordination of policies. Rogoff (1985) established that when highly interdependent countries of similar size suffer a supply shock that affects them in a similar manner (and the variance of the disturbance is high enough), then it is optimal to jointly determine monetary policy. If the shock were to result in an expansion of output in one country and a contraction in the other, there would be conflict with respect to what kind of monetary policy should be implemented. If one

country were very large and the other very small then the large country would not want to coordinate its monetary policy. If this countries were closed economies, there would not exist a policy spillover. Then, monetary policy coordination is beneficial when :

a) countries are affected by symmetric shocks,

b) countries have similar sizes, and

c) countries are highly interdependent.

We first show that this description fits better the structural characteristics of the European Union than those of MERCOSUR. Then we discuss other problems of the latter region that would be closely linked to the blueprints of coordination among those countries.

2.2.1. Symmetry of Shocks.

Supply shocks derived in Chapter I show a significant positive correlation for countries in the EU between 1970 and 1996. We could properly say that, according to these figures, most countries in the sample have the shock correlation necessary for inclusion in a currency union. All countries but Spain and Sweden seem to maintain significant positive supply-shock correlation patterns with Germany, France, Italy and the United Kingdom (the core countries). Furthermore, it seems that there is a clear positive supply-shock correlation among core countries. More importantly, since there is no significant negative correlation coefficient, we find no evidence of shock

asymmetry in the European Union. [14]

Nor do we find evidence of supply shock asymmetry in NAFTA. Even though the correlation of supply shocks hitting the U.S. and Mexico is negative in the sample, the coefficient is not noticeably different from zero. Canada appears to be the least problematic country; its supply shocks are positively correlated with Mexican and U.S. supply shocks, and the correlation coefficient is positive.

Supply shocks in Mercosur do not follow an identifiable correlation scheme. Correlation coefficients are positive all around, with a .172 correlation between Brazilian and Uruguayan Supply Shocks. Note, however, that none of them is distinguishable from zero.

2.2.2. The levels of interdependence.

Countries in the European Union show higher levels of interdependence than do those of MERCOSUR. Graph 1.5 shows exports to the region as a percentage of GDP for the average of European Union countries, Germany, Brazil and MERCOSUR'S average. At the time of the Werner report in 1970, the average weight of exports to the region on GDP is close to 9%. It has been increasing over time and reached 14% by 1992. Germany's values and evolution are close to the average. In 1991, the average level of interdependence for MERCOSUR was close to 2%, and for Brazil it was 1%.

While all countries in the European Union export a significant amount of their GDPs to

[14] The values are, in general, lower than those found by Bayoumi and Eichengreen (1994). The use of quarterly instead of yearly data would typically reduce the correlation coefficients.

the region, the same is not true for MERCOSUR. Graph 1.6 shows exports to EU/GDP for the four biggest countries of the region. Except for Germany, all the rest had below average relation with the region. France and Italy were close to 7% in 1970. The United Kingdom had the lowest level in that year, 5%. Though lower than average, all this values would be considered high for MERCOSUR. At the time of the Tratado de Asunción, Uruguay had the highest export exposure to the region (7%). Barely a 1% of Brazil's GDP depended on exports to the region. Exports MERCOSUR only represented 1.5% of Argentina's GDP. Then while some countries have significant ties to the region, the two largest countries of MERCOSUR show only marginal export exposures. This numbers have also increased with the instrumentation of the Custom Union in MERCOSUR, but the levels are quite far from those of the European Union.

2.2.3. Size Symmetry.

Countries in European Union are more evenly matched than countries in MERCOSUR. Graphs 1.7 and 1.8 compare the importance in terms of GDP of Germany and Brazil in the respective agreements. In 1968-70, at the time of the Werner Proposal, Germany's GDP represents only .34 times of the GDP of the rest of the region. In 1990-92, at the time of the signature of the Asuncion Treaty, Brazil's GDP was 1.30 times the GDP of the rest of MERCOSUR. This asymmetry is not as evident in the comparison of the GDP of the biggest country of the region with its main partner, France's GDP was almost the same as Germany's in 1968-70, Brazil's GDP was only 40% higher than

Argentinean GDP for 1990-92.[15] Note however that while MERCOSUR accounted for only 9% of Brazil's trade, Argentina directed 23% of its trade to the region in 1991.

2.2.4. MERCOSUR and chronic inflation.

With the exception of Paraguay, the countries of MERCOSUR are well known for their problems with chronic high inflation, and in some cases of hyperinflation. Argentina's annual inflation rate ranged from 388% to 4145%, which contrasts sharply with the stability in Europe which preceded the Werner proposal in 1970, and the achievement of convertibility in 1957, in all the members of the community.[16] This is not the only difference. In addition to very high inflation, countries in MERCOSUR have a long history of failed inflation-stabilization attempts. Between 1967-1990 Uruguay had two failed stabilization programs. Argentina had four, and Brazil five[17]. Even Paraguay, which had the lowest inflation rates of the region, in average had higher inflation than the least stable country in the European Union. It is clear then whose the legacy of instability and bad reputation in inflation control is.

Inherited from this past of instability is the need to incur in strong commitments to

[15] Comparing GDPs in US$ makes more sense for the European Union than for MERCOSUR. The large swings in the real exchange rate of countries in the latter make very hart to find a specific year that would be considered normal (that is why we work with 3 year averages). As an example: in 1995 Brazil's GDP more than doubled Argentina's GDP, while in 1988 Argentina's GDP was 12% higher in US$ than Brazil's GDP. The IMF is now building series of PPP based GDP measures.

[16] We follow Kenen (1995) in the selection of this benchmark dates: the achievement of convertibility proposed by the European Payments Union (1958), and the presentation of the Werner report (1970). Monetary cooperation started shortly after World War II.

[17] The referred plans are: The 70 plan and the Tablita for Uruguay; the Tablita, Austral, Spring, and Bonex plans for Argentina; the Cruzado, Bresser, Summer, and Collor plans for Brazil. The three countries have stabilization plans in place.

generate reductions in the inflation rate. Argentina had to fix the exchange rate by law. Uruguay, in five years of strict inflation management with a crawling peg, has not been able to get inflation to go down the 25% mark. Furthermore, the achievements of the present stabilization are seen as fragile. When the Mexican government devaluated the peso in late 1994, Argentina suffered a run against its currency, as a clear indication of the lack of confidence of private agents on the plan. Committing to low inflation alone is no longer enough to convince the private sector of the intentions of the authorities. It is what economists call a necessary but not a sufficient condition.

Starting in 1991, most of the countries in the region -with the exception of Paraguay- have invested in inflation stabilization. Argentina started in 1991 the Convertibility plan, and after a pair of years of strong appreciation that seriously damaged the competitivness of exports, inflation dropped below international levels in 1995. Uruguay, also in 1991, started an active crawling peg, by preannouncing the band of the exchange rate. Inflation fell from 130% to 26% by august of 1996. Brazil started the Real plan in 1994, and reduced inflation from 2669% in 1994 to 84% in 1995. It is not likely that in this scenario, as in the good case of coordination in Rogoff (1985), any of this countries or the conglomerate could credibly commit to positive inflation rates as a result of supply shocks. Should MERCOSUR include an agreement of monetary policy coordination, it would be on the basis of zero inflation.

The current literature on monetary policy coordination fits the case of the European Union better than that of MERCOSUR. Countries in the European Union are more

closely linked, more evenly matched, and more positively correlated in supply disturbances. MERCOSUR is characterized by low levels of regional interdependence, Brazil's size, and Brazil's low level of integration into the region. Another crucial difference between both regions is the bad history of inflation in Argentina, Brazil and Uruguay. Then it does not seem plausible to argue that countries in MERCOSUR are looking to appropriate the benefits of monetary policy coordination in the spirit of Rogoff (1985) or Canzoneri and Henderson (1988). Due to the fragility of stabilization programs, any proposal for policy coordination for the region should be based on a zero inflation target, not sensible to the occurrence of supply shocks.

2.3.Time Consistent Coordination of Monetary Policies

This section will first show Rogoff's (1985) result that coordination of monetary policy can be counterproductive in time consistent equilibria, and then will study the policymaker's incentives to coordinate. We first introduce the model, we then study a matching of non-committed policymakers, and finishes with the study of matches between committed and non-committed policymakers.

2.3.1. The Model

Borrowed from Currie and Levine (1993), the model follows in the spirit of the literature on macroeconomic policy coordination. The results rest on the nonneutrality of money, and on a specification of the policymaker's cost function that makes

coordination matter. Although here open economy Lucas supply curves of a policy spillover, this result can also be obtained in models with imperfect competition and nominal rigidities. Those models do not add significant insights for the purposes of the paper[18].

The demand side is given by:

(1) $y_t^d = a_1 e_t - a_2 r_t + a_3 y_t^*$,

(2) $y_t^{d,*} = -a_1 e_t - a_2 r_t^* + a_3 y_t$

The home and foreign economies produce two different goods that are consumed in either country. The variable *y* represents output, *e* is the real exchange rate of the foreign country, *r* is the real exchange rate. Foreign economy variables are in asterisks. Equation one says that an increase (appreciation) in the foreign real exchange rate, a decrease in the interest rate and an increase in foreign demand will increase home demand. Conversely an increase in e is an depreciation of the foreign currency, and therefore reduces demand for foreign output, while the foreign real interest rate and the home demand operate in a symmetric way. All variables except the interest rate are measured in logarithms and all are measured in deviation form about an equilibrium in which output is at its natural rate.

The supply side is given by:

(3) $y_t^s = -b_1 e_t + b_2(\pi_t - \pi_{,t}^e)$

[18] Modern models of nonneutrality of money are one of two types: models of imperfect competition on the input markets, or models of imperfect competition on the market for output. No matter what kind of model we refer to, nonneutrality of money obtains only if a nominal rigidity is introduced. For a detailed discussion on this kind of models refer to Dixon and Rankin (1995), or to Mankiw and Romer (1991) volume 1.

(4) $y_t^{s,*} = b_1 e_t + b_2(\pi_t^* - \pi_t^{*e})$

The actual inflation rate is represented by π, and π^e is expected inflation. An appreciation of the currency, and inflationary surprise will increase the supply of goods. A real exchange rate depreciation appears with a negative sign showing the effect on labor supply of a reduction in the wage rate caused by an increase in the price of imported goods. The unexpected inflation term is just the Phillips curve component.

Finally, the uncovered real interest rate parity condition is

(5) $e_t = r_t^* - r_t + e_{t+1}^e$

Policymaker's welfare loss function:

(6) $W_t = \sum_{i=0}^{\infty} \delta^i [(y_{t+i} - \hat{y})^2 + a\pi_{t+i}^2]$,

where δ is the discount factor.

The non-committed policymaker dislikes deviations of output from the target level and inflation[19]. The policymaker faces at the same time the other country's policymaker in the coordination game, and the home private sector in the inflation game. The private sector dislikes inflation surprises, and it is assumed to be atomistic.

The timing of the game is as follows: first the private sectors in both countries set their inflation expectations, then policymakers decide whether or not to coordinate, and set the inflation rate. Once policymakers agree on a coordinated pair of inflation rates, inflation rates are fixed

[19] The nonlinearity of the cost function is needed for two reasons: a) nonlinearity in output is required to make coordination matter; b) non linearity in inflation assures the existence of a unique optimal rate of inflation under coordination of macro policies. The usage of a quadratic form is only due to tractability.

2.3.2. Coordination of Monetary Policy can be counterproductive: Rogoff (1985)

Our first step is to analyze the one shot game with two non-committed policymakers and to show the result that coordination can be counterproductive. In order to do so this subsection begins with a derivation of the reduced form of the policymaker's objective function.

2.3.2.1. The determination of output.

The levels of output will be determined when total demand for output equals total supply of output in both markets. Since we will need to work with the aggregate output levels, when solving the coordination problem, instead of using the simple market clearing equations for home and foreign goods we will work with the sum and difference of outputs.

Adding equations (1) and (2), and solving for total demand we get:

$$(7) \qquad y_t^* + y_t = \frac{-a_2}{1-a_3}(r_t + r_t^*)$$

Adding (3) and (4), and solving for total supply we get:

$$(8) \qquad y_t + y_t^* = b_2(\pi_t + \pi_t^* - \{\pi_t^e + \pi_t^{*e}\})$$

Solving in (7) and (8) for the sum of the real interest rates, and equating gives

$$(9) \qquad r_t + r_t^* = -\frac{b_2(1-a_3)}{a_2}(\pi_t + \pi_t^* - \{\pi_t^e + \pi_t^{*e}\}),$$

This is a standard result in the Mundell-Fleming model; surprise inflation reduces the real interest rate.

The aggregated differences in supply across countries have to equal the aggregated differences in demand, then, subtracting equation (2) from equation (1) and equation (4) from equation (3), plugging equation (5) and solving for the real interest rate differential gives

$$(10) \qquad r_t - r_t^* = \frac{-(1+a_3)}{a_2+2a_1}(y_t - y_t^*) + \frac{2a_1 e_{t+1}^e}{a_2+2a_1}$$

and

$$(11) \qquad r_t - r_t^* = e_{t+1}^e - \frac{y_t - y_t^*}{2b_1} - \frac{b_2}{2b_1}[\pi_t - \pi_t^* - \{\pi_t^e - \pi_t^{*e}\}]$$

Equating (11) and (10), and solving for the differences in outputs we get

$$(12) \quad y_t - y_t^* = \frac{b_2(a_2+2a_1)[\pi_t - \pi_t^* - \{\pi_t^e - \pi_t^{*e}\}] - 2b_1 a_2 e_{t+1}^e}{a_2+2a_1+(1+a_3)2b_1}$$

We now can obtain $y_t = \frac{1}{2}[(y_t + y_t^*) + (y_t - y_t^*)]$, then equilibrium domestic output is given by

$$(13) \qquad \begin{aligned} y_t = {} & [b_2 + \frac{(a_2+2a_1)b_2}{a_2+2a_1+(1+a_3)2b_1}](\pi_t - \pi_t^e) + \\ & [b_3 - \frac{(a_2+2a_1)b_2}{a_2+2a_1+(1+a_3)2b_1}](\pi_t^* - \pi_t^{*e}) - \\ & [\frac{b_1 a_2}{a_2+2a_1+(1+a_3)2b_1}]e_{t+1}^e \end{aligned}$$

2.3.2.2. Time Inconsistency of Pareto Optimal Policies.

If we substitute the derived expression for equilibrium output into the non-committed policymaker's utility function, it is clear that the best perfect foresight equilibria is at zero inflation. If the policymaker were able to commit to any level of inflation, the best inflation rate would be zero. However we next show this equilibrium is not time consistent.

Lets now analyze the incentives of the policymaker when both the log of the next period real exchange rate, and expected inflation are zero. In that case the objective function of the domestic policymaker for the one shot game can be written as

$$(14) \qquad Z = \frac{1}{2}[\{\frac{1}{2}(\alpha+\beta)\pi_t + \frac{1}{2}(\alpha-\beta)\pi_t^* - \hat{y}\}^2 + a\pi_t^2]$$

where

$$\alpha = b_2, \text{ and}$$
$$\beta = \frac{b_2(a_2 + 2a_1)}{a_2 + 2a_1 + (1+a_3)2b_1}$$

Since all parameters are positive then $\alpha > \beta$, and unanticipated foreign inflation increases domestic output.

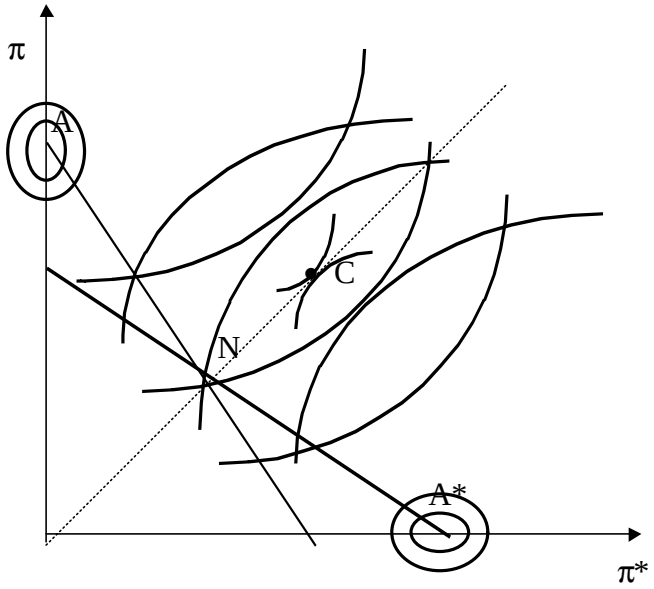
The first order conditions of the home and foreign policymaker are

$$(15) \qquad \frac{\partial Z}{\partial \pi_t} = \frac{1}{2}[(\alpha+\beta)(y_t - \hat{y}) + 2a\pi_t] = 0$$

$$(16) \qquad \frac{\partial Z^\circ}{\partial \pi_t} = \frac{1}{2}[(\alpha+\beta)(y_t^* - \hat{y}) + 2a\pi_t^*] = 0$$

and the symmetry conditions $\pi_t = \pi_t^*$, and $e_{t+1}^e = 0$. Conditions (15) and (16) determine the reaction functions of both countries, and the Cournot-Nash equilibrium looks like the following graph. A and A* are the autarkic equilibrium with static expectations, while N is the Nash outcome. The area between indifference curves above N is the set of feasible coordination outcomes.

Figure 1[20]



Cournot-Nash strategies are not able to internalize the policy spillover, and as a result are less expansionary than coordination strategies. The Cournot-Nash inflation rates are:

$$(17) \qquad \pi_t^N = \pi_t^{*N} = \hat{y}\frac{\alpha+\beta}{\alpha(\alpha+\beta)+2a}$$

[20] The indifference curves should be orthogonal to own reaction curves.

Definition: Coordination regime.- We define coordination of monetary policies as the joint minimization of the average cost of the two countries: $\bar{Z} = \frac{1}{2}[Z + Z^*]$.

The coordinated inflation rates are

(18) $$\pi_t^C = \pi_t^{*C} = \hat{y}\frac{\alpha}{\alpha^2 + a}$$

Once the private sector sets an arbitrarily low level of inflationary expectations, the government has an incentive to further increase the inflation rate in order to reduce the output cost. As we said earlier, since in the coordinated regime there is full appropriation of the policy spillover, the increase under coordination would be higher than if the policymakers were behaving as Cournot-Nash competitors. The private sector can solve the government problem and then they will set the expected inflation rate equal to the effective inflation rate. In the graph above, point N is the inflation rate that a non committed government would generate by acting as a Cournot-Nash competitor in the international setting of monetary policies, C shows the coordination outcome under fixed expectations.

Rogoff (1985) pointed out that if there were no commitment technology available, the private sector would be able to perfectly predict the government's action, which introduces the restriction that $\pi^e = \pi$ for all π. A Cournot-Nash policymaker would minimize

(19) $$Z = \frac{1}{2}[(y_t - \hat{y})^2 + a\pi_t^2]$$

where y_t is given by equation (13). The equilibrium conditions of the problem in a

symmetric time-consistent equilibrium are

$$(\alpha+\beta)(y_t-\hat{y})+a\pi_t=0, \text{and}$$
$$\pi_t=\pi_t^*=\pi_t^e=\pi_t^{*e}, \text{and}$$
$$e_{t+1}^e=0, \text{then}$$

(20) $\pi_t^{NCNR}=\dfrac{(\alpha+\beta)\hat{y}}{a}$, with corresponding cost $Z^{NCNR}=\dfrac{(\alpha+\beta)^2\hat{y}^2}{2a}$.

If governments **coordinate** without commitment technologies, they minimize the average of their cost functions, subject to (10). In a symmetric time-consistent equilibrium

$$\pi_t=\pi_t^*=\pi_t^{*e}=\pi_t^e, \text{and}$$
$$e_{t+1}^e=0$$

and ,

$$\alpha(y_t+y_t^*-2\hat{y})+a(\pi_t+\pi_t^*)=0,$$

then,

(21) $\pi^{CNR}=\dfrac{\alpha\hat{y}}{a}$, with the corresponding cost $Z^{CNR}=\dfrac{(\alpha\hat{y})^2}{2a^2}$

Notice that the lowest inflation rates possible (and therefore the cost minimizing choices), are the commitment inflation rates, with and without coordination. When governments are not committed, Cournot-Nash behavior is better than coordination. According to our assumptions about the parameters, $\beta > 0$, and therefore $\pi^{NCNR} < \pi^{CNR}$. Since in both cases output is zero the cost of Nash policies is lower than the cost of coordination policies. As Rogoff (1985) pointed out, coordination without commitment

can be counterproductive. The result arises because coordinating governments can internalize the policy spillover. That creates an incentive for governments to drive up inflation rates, a fact which the private sector recognizes. Two non-committed policymakers, when matched to play the present game would rather not coordinate.

2.3.2.3. Alternative policymaker matchings.

Up to this point we have analyzed only the particular case in which two non committed policymakers face each other. We have shown those policymakers would prefer to find a way to commit to zero inflation, but cannot in a one shot game. What happens in the other matchings? Would a committed country coordinate? Does Germany have an incentive to coordinate with Greece?

A committed country strictly prefers coordinating when matched with a non-committed country in the short run. Given our definition of coordination, once a pair of countries decide to coordinate, they set their inflation rates, eliminating the possibility of cheating between countries. Furthermore, since no committed government would agree on positive inflation rates, any agreement that includes a committed government will credibly produce zero inflation rate in the committed country. The minimization of the average cost function will result in higher foreign unanticipated inflation when countries coordinate than when they behave as Cournot-Nash competitors. In summary for the committed country the inflation cost would be zero no matter what, while the inflation cost is decreasing in foreign inflation surprise, and since the higher inflation

surprise outcome arises under coordination, the committed country strictly prefers to coordinate when matched with a non committed country.

The non-committed type does not want to coordinate when matched with a committed type. Clearly given that the other country sets inflation to zero the best the non-committed policymaker can do is the autarky outcome. If this country coordinates, by the mechanism previously described, then the inflation rate under coordination will be higher, and therefore suboptimal. In this framework, coordination is not a disciplinary tool as in Giavazzi and Pagano (1988), on the contrary coordination will permit the exploitation of the spillover created from the non-committed country to the committed one.

We have then proven

Proposition 3.1. In any matching of policymaker types, the type committed to inflation stabilization would be at least as well off when coordinating monetary policy as when she behaves as a Nash competitor. The non-committed type would rather not coordinate.

Note that a direct result of the previous proposition is that, in time-consistent equilibria, the only way a policymaker would want to coordinate is if she has reputation of being committed, and this fact suggest the idea of the existence of a certain kind of reputation spillover.

2.3.2.4. Coordinating with fixed exchange rates.

Coordination of monetary policies has generally taken the form of a fixed exchange rate regime. Our definition of coordination only generates this kind of agreement when two identical policymakers are matched, i.e. a two non-committed or two committed policymakers. In asymmetric matchings our definition allows for different inflation rates, and therefore, constitutes a system of floating exchange rates.

If we restrict our definition of coordination to a regime with fixed exchange rates, then the incentives of policymakers in asymmetric matchings change. Now neither policymaker wants to coordinate. The only inflation rate the committed policymaker will subscribe to in an agreement with fixed exchange rates is 0%. However the private sector of the country of the non committed policymaker would not believe their government will stick to that agreement. If the governments coordinate on the basis of zero inflation, unanticipated inflation in the country of the non-committed policymaker would be negative, and would create recessions in both countries. Coordinating with fixed exchange rates is counterproductive for both the committed and non-committed policymaker in time-consistent equilibria.

In the rest of the paper we want to concentrate on the case of the two non-committed policymakers, because the model best fits MERCOSUR. These countries have a history of lack of commitment to stabilization plans. So we will concentrate on interactions between two non-committed policymakers with their respective private sectors and among themselves. Our aim is to show that even in this, worst case scenario, coordination will arise in a dynamic framework if it provides a signal of the

policymaker's type.

2.4. Coordination with Reputation Spillovers in a Finite Time Setup.

2.4.1. Reputation Spillovers.

The traditional literature on incomplete information and reputation assumes that different types of interaction between the government and the private sector have distinct reputational effects. In that sense the government has a distinct reputation related to debt contracts, to wage contracts, to inflation control, and to other areas. Government's actions in one sphere do not affect its reputation in other areas. Reputational separability, though convenient in some situations, does not seem very plausible in the real world. Should firms ignore the conduct of the government in debt financing when deciding whether to invest in physical capital? Should unions disregard government's behavior with respect to inflation control when deciding wages? It seems clear that makes more sense to work with a more general concept of reputation.

Cole and Kehoe (1994) introduce the concept of reputation spillovers. In their model whether or not the government commits to a policy will influence not only its reputation with regard to that policy, but also in other areas. Focusing on a model of debt, they show that if reputation in the debt arena spills over to another relationship with enduring benefits, then it would be possible to recover the feasibility of positive debt

even in a Bulow-Rogoff environment (government has means to save).[21] If the government is not definitely excluded from the credit market, Bulow and Rogoff show that it is optimal to renege on debt in the second period, and finance investment with period 2 savings. Cole and Kehoe show that with reputational spillovers from a relationship with enduring benefits it is possible to sustain relationships with transient benefits. Cooperation in a relationship worth nothing to a player is supported because cooperation in the worthless relationship is a requirement for getting the benefits of the relationship with enduring benefits.

The model we develop in the next section applies Cole and Kehoe's reputation spillovers to a model of coordination with time inconsistency. As we showed in the previous section the only government that will be willing to coordinate, is the committed government , since non committed governments incur higher costs coordinating. In Cole and Kehoe's paper unions look at whether the government fulfills a debt agreement or not to determine whether they can trust them on the wage contract. In our model the reputation spillover derives from the structure of the game.

We will work with two types of government, the committed-coordinator and the non-committed-coordinator. The committed-coordinator will always fulfill the agreements she is involved in , since defaulting in any relationship has prohibitive costs for her.

[21] The model they propose is one in which whether the government fulfills its debt obligations or not gives a signal to unions about the type of government they are facing. Since defaulting on debt will reveal a bad type government, then the unions will enter punishment stages even if the government does not default in their own contract (something that does not happen in an equilibrium path, where if the government were to default in one relationship, it would default in the other too).

The non committed type has a cost function as defined by (6). According to what we saw in the previous sections, coordination is worthless for the committed type, and is costly for the non committed type in subgame perfect (time consistent) equilibria. Cole and Kehoe will characterize coordination of monetary policies as a relationship with transient benefits. On the other hand, controlling inflation has enduring benefits.

2.4.2. Coordination in an incomplete information setup.

We will show coordination of monetary policies is sustainable in the short run when it helps to build a reputation of being tough on inflation control. Assume there are two possible types of policymakers: committed to inflation control-coordinators (the "good" type), and non committed to inflation control-non coordinators (the "bad" type). The policymaker's type is only unknown to the private sector in each country.[22] Let p_0, the prior probability of a policymaker being of the committed-coordinator type, be known to the private sector. In the one shot game the non-committed policymaker will set inflation optimally given inflation expectations. However, with the incorporation of additional periods, there is an incentive to improve the public's perception of the government in order to obtain a better default payment in the future. In a dynamic setting there is an incentive for the bad type to mimic the good type, which implies setting inflation to zero for some periods in order to build reputation.

[22] Given the timing of the game in which the policymakers get together to set inflation rates after the private sector formed inflation expectations, whether the type of a country's policymaker type is revealed to the other country's policymaker or not is not relevant, since in the negotiations the type will be revealed. This is so because since inflation is a positive policy spillover, revealing each other's type is the best way of appropriating the gains from inflation surprise under coordination.

In the Bayesian equilibrium here considered, the private-sector's beliefs about the government are summarized by a conditional probability that the government is committed-coordinator. This conditional probability denoted p_t is the government's reputation. In this equilibrium the conditional probability p_t summarizes the history of past events at the beginning of period t. Agent's strategies depend on p_t and the history of actions which have already occurred that period. At every possible state, each agent acts optimally, given the strategies and beliefs of other agents, and updates beliefs according to Bayes' rule wherever possible. Since the committed government never defaults, Bayes' rule implies that the probability that the government is committed-coordinator in t + 1, conditional on coordinated zero inflation at t (and all previous periods) is

$$(22) \qquad p_{t+1} = \frac{p_t}{p_t + (1 - p_t)q_t},$$

where q_t is the probability of a non-committed government setting a zero inflation rate and coordinating.

If the committed government sets zero inflation, and the non-committed government does so with probability q_t , then expected inflation is

$$(23) \qquad \pi_t^e = p_t \times 0 + (1 - p_t)q_t 0 + (1 - p_t)(1 - q_t)\pi^C,$$

where π^c is the coordination inflation rate with parametric inflation expectations.

The non-committed type government will either cooperate and set inflation to zero, or default in both relationships: first in inflation control coordinating the default inflation rate to maximize the gains from inflation surprise, and in the next period in

coordination of macro policies. Even if the non-committed government decides to default in inflation control it would coordinate in the defaulting period. We found in the previous sections that since coordinating without commitment is costlier than Cournot-Nash behavior, governments prefer not to coordinate monetary policy once reputation is lost. In the default period the private sector's inflation expectations are static, then the government's reputation is intact, and it is still optimal to coordinate in order to fully appropriate the benefits of surprise inflation. What are the non-committed government's choices? At any point in time it can either comply with the two relationships, and then face the same decision next period, or default in inflation control, reveal its type, earn the coordination payoff and receive the punishment payoff from the next period up to T. [23] The value function of this kind of government at time zero can then be written as

(24) $V_0^T(p_0) = \min\{V_0^{T,C}(p_0), V_0^{T,NC}(p_0)\}$, where the value of complying is

(25) $V_0^{T,C}(p_0) = Z(0, \pi_0^e) + \delta V_0^{T-1}(p_1)$, and the value of defaulting is

(26) $V_0^{T,NC}(p_0) = Z(\pi_0, \pi_0^e) + \delta \frac{1}{1-\delta} Z^{NCNR}(1-\delta^{T-1})$

$Z(0, \pi^e)$ is the one period cost when the policymaker sets inflation equal to zero to build a reputation, and $Z(\pi, \pi^e)$ is the one period cost when generating positive surprise inflation (default).

To look at the process of reputation building we have to allow for mixing behavior in

[23] .- Notice that since inflation expectations are given, the government will fully exploit the benefits of inflation surprise when coordinating. Since this is a very symmetric model, both governments will coordinate in the defaulting period, and from then and on they will not coordinate any more.

the case of the non committed government. If the non committed government is not mixing then q_t would be either zero in the case of a government that revealed its type, or one whenever the bad type pretends to be committed-coordinator, and Bayesian updating would not be possible. It is only possible to update p_t when the dishonest government is playing a mixed strategy. This occurs in an indifference situation, i.e. when the cost of sticking to the commitment strategy equals the cost of defaulting. The next equation shows the mixing condition for period T-t:

$$V_t^{T-t,NC}(p_t) = Z(\pi_t, \pi_t^e) + \delta \frac{1}{1-\beta} Z^{NCNR}(1-\delta^{T-t-1}) = V_t^{T-t,C}(p_t) =$$
(27)
$$= Z(0, \pi_t^e) + \delta Z(\pi_{t+1}, \pi_{t+1,t+1}^e) + \delta^2 \frac{1}{1-\beta} Z^{NCNR}(1-\delta^{T-t-2})$$

For this example we use the following specification of the period cost function, proposed by Barro and Gordon (1983):

$$(28)\ Z_t = \frac{a}{2}\pi_t^2 - by_t$$

As suggested earlier, governments dislike inflation, and like output.

With this cost function the values of the Nash inflation rate, the coordinated inflation rate and their corresponding costs become:

$$\pi^{NCNR} = \frac{b(\alpha+\beta)}{a},$$
$$Z^{NCNR} = \frac{b^2(\alpha+\beta)^2}{2a}$$
$$\pi^{CD} = \frac{2b\alpha}{a},$$
$$Z_t^{CD} = b\pi_t^e - \frac{2b^2\alpha^2}{a}$$

where π^{NCNR} is the inflation rate a non committed-coordinator will achieve once its type is revealed, Z^{NCNR} is its corresponding one period cost, π^{CD} is the coordinated inflation rate of default and Z^{CD} is the cost in the period of default. The cost of sticking to inflation control-coordination of monetary policies is

$$Z(0,\pi_t^e) = b\pi_t^e$$

The indifference condition after operating and rearranging terms becomes

$$(29)\ \pi_t^e = Z^{NCNR} - \frac{2b\alpha^2(1-\delta)}{a\delta} = \phi$$

Since none of the terms in (29) depends on t, the referred equation implies that expected inflation is constant, but expected inflation should also satisfy (23) at every point in time, therefore we can get an expression for the mixing probability of the policymaker[24]:

$$(30)\ q_t = \frac{2\alpha b(1-p_t) - a\phi}{2\alpha b(1-p_t)}$$

from where we get that

$$(31)\ p_{T-t} = \left(1 - \frac{a\phi}{2\alpha b}\right)^t$$

The policymaker's value function is:

$$V_0(p_0) = Z^d + \delta/(1-\delta)Z^{NCNR}[1-\delta^{T-1}], \text{ if } p_0 < \left(1 - \frac{a\phi}{2\alpha\beta}\right)^T$$

[24].- Since the policymaker does not care about the actual value of q_t, we get the q_t that comes from the private sector problem.

$$\delta Z^d + \delta^2/(1-\delta)Z^{NCNR}[1-\delta^{T-2}], \text{ if } \left(1-\frac{a\phi}{2\alpha\beta}\right)^T < p_0 < \left(1-\frac{a\phi}{2\alpha\beta}\right)^{T-1}$$

$$\vdots$$

$$\delta^{T-1}Z^d + \delta^T/(1-\delta)Z^{NCNR}, \text{ if } \left(1-\frac{a\phi}{2\alpha\beta}\right)^2 < p_0 < \left(1-\frac{a\phi}{2\alpha\beta}\right)$$

$$\delta^T Z^d \qquad \text{, if } \left(1-\frac{a\phi}{2\alpha\beta}\right) < p_0$$

We have completed the demonstration of

Proposition 4.1.- In the game analyzed in this section, coordination of monetary policies arises together with inflation stabilization in a Bayesian equilibrium for a number of periods t(p_o) if p_o is high enough.

Given the mixing path (31), the value of the prior probability of the good type, p_0 will determine whether or not the policymaker would cooperate in any period. We have shown then that coordination-stabilization may go together in this case.

We next show for the most general case of a nonlinear cost function on inflation, that in an infinite horizon setting, coordination-stabilization will be achieved with the reputation spillover, no matter the value of p_0 , if the policymaker's discount factor is close enough to one.

2.5. The infinite horizon case.-

Repeated games implies having to face the problem of multiple equilibria. Since the analysis of the infinite number of equilibria involved is impossible to deal with, the literature has taken the shortcut of analyzing the dimensions of the equilibrium set, in what we know as the Folk theorems. The purpose of this section is to establish the conditions for the existence of a coordination equilibrium, to apply the equilibrium selection argument of Fudenberg and Levine (1988) and show that the coordination equilibrium satisfies it.

Definition: Coordination -Stabilization equilibrium. We define a coordination stabilization equilibrium as one in which zero inflation and coordination occur from time zero, and inflation expectations are set to zero unless there is a deviation from zero inflation in the past

Proposition 5.1 establishes the conditions for the existence of this kind of equilibrium.

Proposition 5.1.- In the infinite horizon game, if p_0 is strictly positive, no matter how small, then a coordination-stabilization equilibrium exists if the policymaker is patient enough, i.e. her discount factor is close enough to one. Furthermore this result is independent of the form in which the cost function of the policymaker depends positively on inflation and deviations from target output

Proof.-Over an infinite horizon the long run player faces the same decision every period. Is it worth coordinating on a zero inflation rate to earn the coordination payoff? If it is optimal to coordinate in one period then it is optimal to coordinate in all periods. If defaulting on both relationships is better, then the payoff becomes the

default payoff in zero plus the high inflation payoff after revealing the government's type.

$V = \min\{V(\text{coordination}), V(\text{default})\}$, where $V(\text{coordination}) = \frac{\hat{y}^2}{2(1-\delta)}$, and

$V(\text{default}) = Z^d + \frac{\delta}{1-\delta} Z^{NCNR}$.

The value of ZNCNR is the one in equation. (20),

$Z^d = \frac{\hat{y}^2(a^2 + 4\alpha^2 a)}{2(4\alpha^2 p_0 + a)^2}$, then coordination will occur if and only if , $V(\text{coordination}) > V(\text{default})$, or

(32) $\rho > \frac{Z^0 - Z^d}{Z^{NCNR} - Z^d}$

In other words, if governments are patient enough then they will choose to coordinate on the basis of a zero inflation policy to capture the enduring benefits of the inflation-stabilization relationship.

Note that we have not used a precise functional form for the condition (32). This condition depends only on the default cost being lower than both the coordination-stabilization cost, and the punishment cost, i.e. on the existence of an incentive to create surprise inflation. ♦

As we previously said, even though we have shown that coordination stabilization is an equilibrium, it is only one of a infinite number of them. We then need then to address why this equilibrium and not any other.

For infinite horizons, Fudenberg and Levine (1988) have shown that reputation is a

mechanism of equilibrium selection. In repeated games with incomplete information, the existence of reputation effects allows the long run player, in this case the government, to assure themselves on average the payoff which corresponds to the Stackelberg equilibrium (the strategy they would like to commit to). Since the posterior probability p_t is increasing over time, it would take a finite number of periods to convince the private sector that the government is playing like a committed-coordinator type, and therefore it would take a finite number of periods to get the private sector to set their inflation expectations to zero. Then even if forced to fight for reputation, the governments, if patient enough would be able to ensure themselves in average their Stackelberg payoff, which in our example would be the payoff of the zero inflation coordinated equilibrium. We can conclude that the government would select among strategies that ensure him that payoff.[25,26]

2.6. Some Comparative Statics.

This section studies the impact of the special characteristics of MERCOSUR, as compared to the EUROPEAN UNION.

2.6.1 Changes in the impact of foreign demand on local output.

[25] In a game in which the governments do not deterministically set the inflation rate they would be able to ensure themselves at least the zero inflation, zero expected inflation payoff, since the introduction of a disturbance would allow them to default a finite number of times without revealing their true type.

[26] Actually some perverse behavior on the private sector side can preclude the government from reaching the coordination-stabilization equilibrium. If the private sector systematically sets high inflation expectations, then the government will be forced to choose between sticking to zero inflation and creating a recession, and fulfilling the private sector expectations keeping output at its natural rate and creating positive inflation. For more on the

In the model proposed, the key to the policy spillover is the impact of foreign demand on domestic output. An unexpected surge of inflation in the foreign country will exacerbate foreign output, boosting home demand. We have established that the degree of interdependence between countries is a stylized fact that differentiates MERCOSUR, from the EUROPEAN UNION, the latter being the more exposed to regional demand.

How would changes in the level of regional interdependence change our results?

Proposition 6.1.-Countries with high levels of interdependence (measured by the parameter a_3) will be able to obtain coordination-stabilization with lower prior probability of being of the good type.

Proof.- In the finite horizon example, a reduction of a_3 will reduce β, the Nash inflation rate and the cost of the Nash regime Z^{NCNR}. That will impact the composite parameter ϕ, and shift up the trajectory of Pt. ♦

So high levels of interdependence imply high levels of punishment costs, and that helps deter default. That has a twofold meaning: on one hand, lower prior probabilities of the good type will sustain coordination-zero inflation, and a given p_0 will sustain coordination-zero inflation for more periods. In the infinite horizon case, the reduction in a_3 will increase the required discount factor. Then low interdependence in the case of MERCOSUR is a minus in terms of the joint management of the coordination and inflation stabilization relationships.

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importance of expectation traps see Chari, Christiano and Eichembaum (1996).

2.6.2. The policymaker's time horizon.

Countries in MERCOSUR have a long history of inflation. There are two ways to characterize this kind of behavior in the present model: either considering that the region's policymakers are short-sighted, or that they have a bad reputation in inflation control. Being short-sighted implies having a discount factor close to zero. What is the importance of this factor in the process of reputation building? We will show

Proposition 6.2.1- The closer the discount factor of the non-committed policymaker to one, the easier it is to sustain coordination-stabilization.

Proof.- In the infinite horizon setting, condition (32) ensures the above. In the finite horizon example, an increase in the discount factor increases ϕ, and therefore determines a lower value of p_t for all t, meaning that the same prior probability will support more periods of coordination-stabilization. ♦

The planning horizon of the policymaker is another indicator of its patience.

Proposition 6.2.2- As T tends to infinity, the number of periods of coordination-stabilization tends to infinity too.

Proof. - Let $\tau(T)$ be the number of periods in which coordination-stabilization occur for T. At $\tau(T)$ the policymaker would be indifferent between coordination-stabilization and default.

Lets now say that the time horizon goes to T'. Is the policymaker still indifferent between coordinating and defaulting in $\tau(T)$? The answer is no. Notice that if the policymaker still defaults in the same period, the increase in the time horizon

represents a increase in the number of punishment periods, meaning that the cost of defaulting is now larger than its benefits. Then it has to be true that $\tau(T') > \tau(T)$, and this is true for all T.♦

We have shown that far-sighted stable governments will find it easier to reach coordination-stabilization than unstable ones.

2.6.3. The inflation-output tradeoff.

The more output oriented a government is in a model like the one in this paper, the more inflation it will produce. Clearly as either the cost of inflation (a) decreases or the benefits from output increases goes up (b), the incentive to inflate go up in the one shot game. In our example, π^d, and π^{NCNR} go up. However, in the repeated game this implies that changes in the inflation-output preferences affect both the benefits and the costs of defaulting. As a increases the one shot benefits from deviating increase, but at the same time the cost of deviating increases too, that results in a subset in the parameter space in which there is no clear message about the increase in a on the possibility of achieving coordination-stabilization. In the end the increase in a will make reputation unnecessary, and coordination-stabilization will be the natural outcome. This suggest the following:

Proposition 6.3- As a tends to infinity, the discount factor needed to get coordination-stabilization goes to zero.

Proof.- Define the expression on the right hand of (32) as $\eta(a)$. Lim $\eta(a)$ as a tends to

infinity is zero.♦

The reputational spillover proposed in this paper is an example of the type of extra cost economies in MERCOSUR have to incur in order to achieve stabilization. As we said in section 2.2, the long history of very high inflation and failed stabilization attempts, forces this chronic inflation countries to create additional signals of their commitment to inflation stabilization. However, being this a pertinent proposal for the southern cone region, this kind of coordination does not result easier for countries with those structural characteristics. Low discount factors, low T, low interdependence, and strong output orientation are a description of this characteristics in our model, and we have shown that the more intense those attributes are, the more difficult coordination-stabilization becomes.

2.7.-Summary and Conclusions

The traditional proposal for policy coordination is not suitable for MERCOSUR. In section 2.2 we showed that the dominant presence of Brazil, which also has a very low of exposure to the region in terms of GDP, together with the all around low levels of interdependence and the lack of significant correlation in supply shocks make MERCOSUR's an unlikely case of monetary policy coordination as thought of in the traditional literature. The long history of failed stabilization attempts, and the resulting skepticism about monetary policy, constrains the possibilities of southern cone countries to participate in an agreement that would generate positive inflation.

Furthermore, most of the countries of the region have invested in inflation stabilization in the last years. Then any proposal for monetary policy coordination has to be based on zero inflation, and therefore fixed exchange rates.

We have shown in the paper that coordination of macroeconomic policies can be obtained when there are no enduring benefits to the participating countries. The literature on Macroeconomic Policy Coordination initiated by Hamada (1976), and further developed and summarized by Canzoneri and Henderson (1988) and Currie and Levine (1993) shows us that coordination of monetary policy occurs because it has value on itself. In those models the existence of policy spillovers creates a space for coordination to appropriate the consequences of macro policy, or to minimize the costs of external shocks. In the model presented on the paper, coordination renders no benefits in equilibrium, other than creating the appearance that the policymaker in office is office is the "good" type, using Cole and Kehoe (1994)'s terms, coordination has transient benefits, and can only be sustained by a reputation spillover to a relationship with enduring benefits, in our case the inflation stabilization game.

Giavazzi and Pagano (1988) argued that low credibility countries will look for international commitment technologies. In their setup, a low credibility country can gain reputation by pegging its nominal exchange rate to a "strong" currency, meaning the currency of a country with a government with reputation of the good type. An institutional arrangement with this strong country would give as a result an inflation rate equal to some kind of weighted average of the partner's autarky inflation rates. In

the model analyzed above a matching between a non-committed policymaker and a committed policymaker occurs only when the inflation rate of the committed type is set to zero and the inflation rate of the other policymaker is set to a value typically higher than the one the policymaker would have wanted given that the other country set its inflation to zero. Our result also differs from Giavazzi-Pagano in that the coordination partner need not to be a committed type to obtain inflation stabilization. In fact the model is symmetric, and therefore the foreign country has the same set of incentives than the home country. Credibility arises as a result of reputation building, and both countries start with the same levels of reputation, and share the same reputation path.

The main characteristics of the coordination agreement in the model are compatible with the blueprints for coordination on the MERCOSUR. The agreement is based on a zero inflation rate, and therefore, in the setup of the model, constitutes a fixed exchange rate agreement. Also, any deviation from coordination or zero inflation results in a return to the high inflation equilibrium, result that shows the fragility of stabilization in this kind of formulation.

Finally we have shown that being this a pertinent proposal for the southern cone region, this kind of coordination does not result easier for countries with their structural characteristics. In fact the traditional populist policymaker of the southern cone, with bad reputation in inflation control, with unstable policies, and a strong orientation to the reduction of unemployment and output will have more problems to stabilize, in the sense of this paper, than a policymaker that is suffering a once in a lifetime surge of

inflation.

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Chapter 3: Optimal Currency Composition of Uruguayan Public Debt.

3.1. Introduction

In the 90's, after almost two decades of a clear bias towards foreign-currency variable-rate papers in the domestic market, the Uruguayan public debt policy entered into a different pattern, upon Uruguay's having gained access to the main international bond markets (Japan, Europe, and, mainly, the American market) and to the possibility of issuing fixed-rate papers. This change may be explained by the improvement in general funding conditions at the international level, a strong availability of capital for underdeveloped countries in the first half of the 1990s, and the opening of new funding options for the so-called "emerging markets"; but this change may be also mostly associated to a deliberate attempt by the last two Administrations to improve debt management on the basis of economic efficiency criteria.

It should not be surprising to find that this change in trends encompasses the increasing importance assigned to public debt policy management by academics, national governments, and international financial organizations. Recent financial crises, in particular those in Mexico, Southeast Asia, and Brazil, are clear illustrations of the risks to which a country is exposed when debt is concentrated in very short horizons or one single currency.

In the late 1980's and early 1990's, academics started questioning the practice of holding one-currency debt portfolios, on the basis that different kinds of debt have

different cyclic properties. In particular, Bohn (1988) has built a justification for the placement of nominal local-currency public debt. Yet, in a later work (Bohn 1990b), he emphasizes the positive role of foreign-currency debt. On the other hand, the significance of indexed debt has been recently emphasized by Barro (1997), Blanchard and Missale (1997), and Missale (1998). The optimal taxation literature indicates that, if governments are willing to facilitate an inter-temporal smoothing of consumption through a leveling of the tax burden, the debt portfolio must be chosen taking the stochastic properties of the yields of the available instruments into consideration.

This paper deals with the debt management problem from a very wide standpoint, contemplating not only issues referred to a minimization of the debt's financial cost for the country but also the basic allegations contained in the literature on optimal taxation. From this latter standpoint, the government should choose debt instruments associated to low costs in low-revenue periods (i.e., economic recession) and whenever the country faces a high public expenditure level (due, for instance, to the growth of real wages or a rise in international interest rates).

This paper examines the currency mix of the Uruguayan public debt in the light of the theoretical models and empirical evidence available on the stochastic behavior of several variables in the Uruguayan economy[27]. The core issue underlying this research is whether the bias towards foreign-currency debt chosen by Uruguay is warranted in the light of the budget risk inherent to US Dollar-denominated instruments.

[27] This paper makes part of a wider project carried out by the Central Bank of Uruguay, designed to develop general guidelines for a more effective management of the Uruguayan public

Traditionally, an evaluation of the optimal mix of a debt portfolio has been based on the assumption that investors are neutral to risks. This implies that all instruments have the same anticipated cost (i.e. real interest rate). Within this context, the purpose of minimizing debt costs *ex ante* is equivalent to minimizing budget risks. In the Uruguayan case, financial instruments are associated to very different *ex ante* yields. A more realistic problem for the debt manager will be likely to imply a trade-off between the minimization of financial costs and budget risks. Unfortunately, the instruments that may be desirable in terms of their cyclic properties are not always the "cheapest" for the government. One of the contributions of this paper is to explicitly introduce risk premiums in a standard debt-portfolio selection model. In addition, this paper also examines a higher number of stochastic variables having an impact on the governmental budget restraint and their correlation with the return of different debt instruments.

This paper has allowed us drawing the following main conclusions:

- The strong concentration of foreign-currency-denominated instruments in the current and past structure of the Uruguayan public debt may be only explained by the assumption that the government was trying to minimize the financial cost of debt but was not contemplating an *ex ante* minimization of the volatility of its budget.
- From an optimal taxation standpoint, the share of foreign currency debt is not adequate, as such debt is not only associated to an extremely volatile

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sector's debt.

yield but also involves a cost which is negatively correlated to the GDP growth rate. Thus, a fall in revenues associated to an economic recession will be simultaneous to a rise in the service of foreign currency debt.

- Since at present the costs associated to the issue of indexed debt should not be extremely high as compared to those of US Dollar debt, we may conclude that the Uruguayan public debt portfolio might include CPI-indexed instruments. These instruments would help reducing the variability of public account results and, would be, thus, an appropriate means to reduce fiscal vulnerability.
- Local currency nominal debt should be disregarded under the present situation, not only because of its extremely high cost but also because these instruments have undesirable stochastic properties. The evidence available for the last 20 years clearly shows that, in the Uruguayan case, there is no significant correlation between inflation and the exogenous variables having the most important impact on fiscal results.

The rest of the paper is organized as follows. Section 3.2 contains a description of the model, a description of the optimal mix of different debt instruments for several interesting cases, and an examination of the role of risk premiums. Section 3.3 includes an examination of the stochastic structure of the shocks having an impact on public accounts using a VAR methodology. In addition, the model is gauged, and an examination is made of the costs incurred by the government in connection with its

having held a fully Dollarized debt over the 1978-1998 period. Section 3.4 includes our findings and several recommendations of debt management policy for the next years.

3.2. A Theoretical Approach to the Optimal Currency Mix of Public Debt

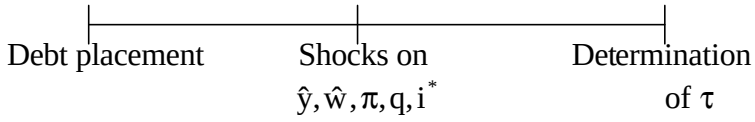
3.2.1 The Model

Our theoretical approach is mainly based on the papers by Calvo and Guidotti (1992), Goldfajn (1997), and Missale (1998). We used a two-period model similar to the one used by these authors. In Period 1, the government must make a decision on the mix of public debt that will be settled in full as at the close of the period. With a view to being able to focus on the currency selection problem we assume that the stock of debt to be funded in Period 1 is exogenously given. The debt manager may use three kinds of instruments: local-currency bonds, CPI-indexed bonds, and foreign-currency bonds. This model assumes that these instruments are similar in terms of both their horizon and the associated default risk.

The governmental budget restraint suffers the impact of stochastic shocks in several macroeconomic variables. In particular, the random variables having an impact on the consolidated fiscal results of the public sector (primary deficit plus debt service) are as follows: real devaluation rate, GDP growth rate, real wage growth rate, international interest rate, and inflation rate.

In Period 2, once the shocks have taken their toll, the government must pay the debt service and the primary expenditures accrued over Period 1. The only way to balance public accounts is to adjust the tax rate. The taxable base, i.e. the level reached by the GDP as at the close of Period 2, is also considered as a random component of the budget equation. Thus, the temporal sequence of the problem may be expressed by the

following time line:



The budget restraint for the government in Period 2 is shown as:

$$t_2 Y_2 = G_2 + B_1\left(q\frac{1+i_1}{1+p_2} + q^*\frac{(1+i_2^*)(1+e_2)}{1+p_2} + (1-q-q^*)(1+r_1)\right),$$

where τ is the tax rate; π, the inflation rate; *e*, the devaluation rate; *G*, the public expenditures level; *B*, debt; *Y*, the GDP; *i*, the nominal rate of the local-currency bond; *i**, the foreign-currency rate; and *r*, the real rate of the indexed instrument. The variables showing sub-index 2 are considered to be random variables as at the time of decision-making on the debt mix. It is worth noting that the nominal interest rate in local currency, *i*, is a fixed rate, and thus it is known for Period 1. The same applies to the real interest rate of the indexed instrument, *r*, on the additional assumption that there is a daily indexing unit, whereby the yield of the indexed instrument precisely reflects inflation for the period on which such yield prevailed. As regards the rate of foreign-currency papers, *i**, we assume a floating rate, and thus that its value is unknown as at the time when the instrument is issued. The foreign-currency paper involves the commitment of paying the rate prevailing in the international market in Period 2, adjusted for a country-risk spread. Finally, θ and θ^* are the decision variables, representing the respective shares of local-currency bonds and foreign-currency bonds.

We are dealing with risk-averse investors, and thus we assume that there is no non-hedged parity of interest rates. The arbitrage condition for the different financial assets is shown as:

$$1+i=(1+i^{*})(1+e^{e})(1+p_{1})=(1+r)(1+\pi^{e})(1+p_{2}),$$

where p_1 and p_2 are the risk premiums required by agents to respectively invest in a local currency bond rather than in a foreign currency or an indexed bond. We assume that both p_1 and p_2 have a positive sign, and that $p_1 > p_2$. This means that, as at the time the debt is incurred, the local currency instrument is more expensive and the foreign currency instrument is cheaper[28].

All of Goldfajn (1997), Calvo and Guidotti (1992, 1994), and Missale (1998) have chosen to work on the assumption that investors are neutral to risk, (i.e., they assume that $p_1 = p_2 = 0$). Thus, they emphasize the role of the debt currency choice as a means to smooth the tax burden over time[29]. In these models, the *ex ante* minimization of the debt service is not a relevant purpose for the debt manager, since he considers *a priori* that all instruments are associated to the same cost[30].

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[28] In general, based on currency risk considerations, p_1 will obviously have a positive sign in a country having a floating rate of exchange or a poor reputation as regards monetary policy control. This is not so obvious in the case of (p_1-p_2). In a stable country such as the USA, the UK, or the countries in the Euro area, investors will be likely to prefer indexed debt to foreign currency debt, in which case (p_1-p_2) would have a negative sign. In countries having long-lasting inflation, the US Dollar is a refuge asset and most financial assets are denominated in this currency; thus any new assets, even if indexed, might be likely to pay a risk premium over similar US Dollars instruments. In addition, the existence of an index lag creates the risk of a mismatch in the index when the economy negotiates an inflation process, and this might also result in (p_1-p_2)'s having a positive sign.

[29] Both Calvo and Guidotti (1992) and Goldfajn (1997) include also other considerations related to the temporal consistency literature, whereunder it would not be appropriate to issue local currency papers. This paper only deals with the aspects involving smoothing fiscal cycles since this is, in our opinion, the most important issue for Uruguay.

[30] The *ex post* minimization of the debt service cost is implicitly considered in the loss function.

Perfect assets substitution does not seem to be a realistic assumption, at least in the case of many countries having poorly developed capital markets. A quick glance to public debt management experiences throughout the globe clearly shows that governments are not indifferent to the financial cost of instruments but rather that they are reluctant to being indebted in "cheaper" instruments. In particular, in countries such as Uruguay and its partners in the Mercosur, the risk premiums paid, based on the currency choice, are extremely significant, and thus they may not be disregarded when a decision must be made regarding the selection of an optimal portfolio. These risk premiums are usually positively correlated to the duration of the underlying instrument. Although this paper does not take the term of the instrument into consideration, we are implicitly assuming a high share of long-horizon papers (as both theoretical models and empirical evidence show that long-term instruments represent a significant share of the optimal debt structure), whereby the existence of risk premiums becomes a particularly relevant issue.

To the effects of further simplifying the model and being able to only work with growth rates, we must make an additional assumption on the behavior of primary public expenditures. Since we are mainly interested in the endogenous component of expenditures, i.e. the portion of primary expenditures which may not be affected by the government's discretional decisions, we have chosen to establish a link between the development of expenditures and the behavior of an exogenous macroeconomic variable. We are, thus, assuming that:

$$G_2 = G_1(1+\hat{w}_2),$$

where $\hat{w}_2$ is the (stochastic) growth rate of the real wage in Period 2 and G_1 is the expenditure level in Period 1, a known datum for the problem. This assumption is based on the findings of Borchardt, Rial, and Sarmiento (1998) for Uruguay, i.e. that the payment of social security allowances is the only endogenous component of Uruguayan public expenditures, apart from interest payments. In recent years, these allowances have proved to be highly sensitive to the real wage[31].

The problem faced by the government in Period 1 may be expressed as follows:

$$\text{Min}\, V(\theta, \theta^*) = E_1\left[\frac{\tau_2^2}{2}\right],$$

subject to the following constraints:

(i) $\tau_2 = g_1 \frac{1+\hat{w}_2}{1+\hat{y}_2} + b_1 \frac{1}{1+\hat{y}_2}\left(\theta \frac{1+i_1}{1+\pi_2} + \theta^* \frac{(1+i_2^*)(1+e_2)}{1+\pi_2} + (1-\theta-\theta^*)(1+r_1)\right),$

(ii) $1+i = (1+i^*)(1+e^e)(1+p_1) = (1+r)(1+\pi^e)(1+p_2),$

(iii) $0 \leq \theta \leq 1$, and

(iv) $0 \leq \theta^* \leq 1,$

where $\hat{y}_2$ is the (stochastic) GDP growth rate in Period 2, g_1 is the expenditures/GDP ratio for Period 1, and b_1 is the debt/GDP ratio for Period 1. The above constraints (iii) and (iv) eliminate the possibility of active positions in governmental instruments, and thus allow us to concentrate on the cases which are relevant for the Uruguayan

[31] Their study considers the 1989-1996 period.

economy. In this sense, it is worth noting that, as in the optimal taxation literature, we are working with a quadratic cost function. We are thus assuming that a change in the tax rate will cause the government to face growing marginal costs. The existence of a growing marginal dis-profit allows debt management to be aimed at stabilizing the budget equation.

By dividing (ii) into $(1 + \pi)$ and carrying out a linearization operation, the real financial cost of each of the instruments after the shocks may be approximated using the following expressions:

nominal bond: $r_1 + (\pi^e - \pi) + p_{2,}$

foreign currency bond: $r_1 + (q - q^e) + (p_2 - p_1)$,

indexed bond: r_1,

where $q_t = e_t - \pi_t$ is the real devaluation rate. The real cost of the indexed debt is constant, and independent of the actual development of random variables, and in particular of the inflation rate. The debt cost in Peso terms will depend not only on the risk premium, p_2, but also on the inflation prediction error, $\pi^e - \pi$. Thus, the cost of local currency nominal debt will increase when anticipated inflation is higher than actual inflation. In turn, the US Dollar-denominated instrument will be more expensive for the government when the real devaluation rate actually recorded in Period 2 is higher than the devaluation rate that had been anticipated by investors. It is worth noting that if $q = q^e$, US Dollar-denominated debt will be cheaper than indexed debt, since we have assumed that $p_1 - p_2 < 0$.

The quadratic form of the loss function ensures that the government is interested in tax smoothing at all nature states. If all instruments had similar *ex ante* financial costs ($p_1=p_2=0$), in Period 1 it would be advisable to use those papers whose yield involves the desirable stochastic properties. The minimization of the variability in the tax rate would lead to including in the debt portfolio those instruments which are associated to lower *ex post* costs (in the case of local currency bonds, when $\pi > \pi^e$, and in the case of US Dollar debt when $q < q^e$) in the nature states where tax revenues fall under the anticipated level; i.e., in terms of the model, when the GDP is lower than anticipated ($y < y^e$), when the endogenous component of primary expenditures is higher than anticipated ($w > w^e$), or when the debt cost is higher than anticipated ($i^* > i^{*e}$). In other words, local currency instruments would be particularly attractive when the stochastic structure of the economy is such that:

$$\sigma_{\pi,y} = E\left(\pi - \pi^e\right)\left(y - y^e\right) < 0$$
$$\sigma_{\pi,i^*} = E\left(\pi - \pi^e\right)\left(i^* - i^{*e}\right) > 0$$
$$\sigma_{\pi,w} = E\left(\pi - \pi^e\right)\left(w - w^e\right) > 0$$

On the other hand, foreign currency papers would be useful to mitigate the volatility of the government's budget if:

$$\sigma_{q,y} = E\left(q - q^e\right)\left(y - y^e\right) > 0$$
$$\sigma_{q,i^*} = E\left(q - q^e\right)\left(i^* - i^{*e}\right) < 0$$
$$\sigma_{q,w} = E\left(q - q^e\right)\left(w - w^e\right) < 0$$

This result, which seems to concur with our intuition, may be more formally obtained by solving the above-described problem. By expanding the $\tau_2(\pi_2, \pi_2^e, e_2, e_2^e, \hat{y}_2, \hat{w}_2, r_2, p_1, p_2)$ function using Taylor,[32] we can obtain the final expression of the budgetary equation:

$$\tau_2 = [g_1(1+\hat{w}_2-\hat{y}_2)+b_1\{1-\hat{y}_2+i_2^*+q_2^e+\theta(\pi_2^e-\pi_2)+\theta^*(q_2-q_2^e)+\theta p_1+(1-\theta-\theta^*)(p_1-p_2)\}]$$

A reading of the governmental budget restraint shows that, in terms of the GDP for Period 2, public expenditures will depend on the difference between the real wage growth rate and the GDP growth rate. On the other hand, the debt service level in terms of the GDP for Period 2 will negatively depend on the growth of the GDP and will positively depend on the cost of debt. The measurement of this cost will be based on the yield of US Dollar papers. The cost of credit may be decomposed into several factors. In the first place we have the anticipated cost associated to foreign currency debt ($i^{*e}+q^e$). As regards local currency debt, a surplus will be always paid whenever inflation expectations exceed actual inflation. The same will apply to US Dollar debt when real devaluation (US Dollar deflation) exceeds its anticipated level. The last two terms represent the additional costs associated to the existence of risk premiums. Local currency debt will pay a p_1 premium while indexed debt will pay a (p_1-p_2) premium.

[32] Taylor's expansion lies around (0,0,0,0,0,0,0,0,0), which proves to be reasonable if we recall we are working with variation rates.

The above Lagrange problem is shown as:

$$L = E_1\left[g_1\left(1+\hat{w}_2-\hat{y}_2\right)+b_1\left\{1-\hat{y}_2+i_2^*+q_2^e-\theta\left(\pi_2-\pi_2^e\right)+\theta^*\left(q_2-q_2^e\right)+\theta p_1+\left(1-\theta-\theta^*\right)\left(p_1-p_2\right)\right\}\right]^2 + \lambda_1\theta+\lambda_2\theta^*+\lambda_3\left(1-\theta\right)+\lambda_4\left(1-\theta^*\right)$$

The first-order constraints underlying the problem are as follows:

$$(5)\ \frac{\partial L}{\partial \theta} = E_t\left[b_1\left(p_2-\left(\pi_2-\pi_2^e\right)\right)\left[\tau_2\right]\right]+\lambda_1-\lambda_3=0$$

$$(6)\quad \frac{\partial L}{\partial \theta^*}=E_t\left[b_1\left(\left(q_2-q_2^e\right)-\left(p_1-p_2\right)\right)\left[\tau_2\right]\right]+\lambda_2-\lambda_4=0$$

$$(7)\quad \frac{\partial L}{\partial \lambda_1}=\theta\geq 0, \qquad \lambda_1>0, \qquad \theta\,\lambda_1=0$$

$$(8)\quad \frac{\partial L}{\partial \lambda_2}=\theta^*\geq 0, \qquad \lambda_2>0, \qquad \theta^*\lambda_2=0$$

$$(9)\quad \frac{\partial L}{\partial \lambda_3}=1-\theta\geq 0, \qquad \lambda_3>0, \qquad (1-\theta)\,\lambda_3=0$$

$$(10)\quad \frac{\partial L}{\partial \lambda_4}=1-\theta^*\geq 0, \qquad \lambda_4>0, \qquad (1-\theta^*)\,\lambda_4=0$$

Our interest is focused on two particular solutions of this general Kuhn Tucker problem. In the first place, we will examine the case where all three kinds of bonds are issued $(\theta>0,\theta^*>0,1-\theta-\theta^*>0)$. In the second place, we will examine the case when the cost of the local currency debt is so high that such debt has no positive share in the debt portfolio and thus the left-hand side of restraint (iii) is operative; in other words, when

$$\theta = 0,$$
$$\theta^* > 0,$$
$$1 - \theta^* > 0$$

3.2.2 The Optimal Portfolio, with Three Kinds of Debt

We shall try to establish under which conditions it will be possible for a debt portfolio to include the three kinds of instruments under consideration. In terms of the above-described problem, this holds when $\lambda_1 = \lambda_2 = \lambda_3 = \lambda_4 = 0$. The first-order restraints underlying the problem may be summarized using the following two equations:

(12)

$$\theta\left(\sigma_\pi^2 + p_2^2\right) = \theta^* b_1\left(\sigma_{\pi q} + p_2\left(p_1 - p_2\right)\right) + g_1\left(\left(\sigma_{\hat{w},\pi} - \sigma_{\hat{y},\pi}\right) + b_1\left(\sigma_{\pi,i^*} - \sigma_{\pi,\hat{y}}\right) - p_2 k\right)$$

(13)

$$\theta^*\left(\sigma_q^2 + (p_1 - p_2)^2\right) = \theta b_1\left(\sigma_{\pi q} + p_2\left(p_1 - p_2\right)\right) + g_1\left(\left(\sigma_{\hat{y},q} - \sigma_{\hat{w},q}\right) + b_1\left(\sigma_{q,y} - \sigma_{q,i^*}\right) + (p_1 - p_2)k\right),$$

where

$$k = g_1\left(1 + \hat{w}_2^e - \hat{y}_2^e\right) + b_1\left(1 + i_2^{*e} + q_2^e - \hat{y}_2^e + p_1 - p_2\right).$$

Although the system might be theoretically solved for two unknowns, θ and θ^*, this effort would not yield any significant additional result. The impact of the correlation on the optimal values of θ and θ^* may be directly examined departing from the above two expressions.

Constraint (11) indicates, in the first place, that the share of local currency debt is a decreasing function of the variability of inflation. This derives from the budget risk aversion inherent to the government's loss function. The more volatile the inflation

rate, the wider the fluctuation in the debt service in Peso terms; whereby, the government will be more reluctant to incur in debt in these instruments.

On the other hand, local currency debt may operate as a risk insurer if the debt's *ex post* yield is associated to unexpected values in other macroeconomic variables. If the correlation between inflation and these variables is zero, local currency debt would not operate as a fiscal risk insurer. Among the factors favoring local currency debt it is worth noting the following:

(i) the existence of a negative correlation between the inflation rate and the GDP growth rate - In this model, when the GDP falls below the anticipated level, so does tax revenue, thus resulting in a fall in the endogenous funding of the government. If there is a high negative correlation between inflation and the GDP, actual inflation will exceed anticipated inflation, and thus the service of local currency debt will be lower. In other words, when $\sigma_{\pi,y} < 0$, a local currency instrument will operate following an anti-cyclic pattern.

(ii) Similarly, a positive correlation between inflation and the international interest rate, where $\sigma_{\pi,i^*} > 0$, will ensure that when the actual cost of interest payments rises, non-anticipated inflation will tend to reduce the service of local currency debt.

(iii) When we find a positive correlation between the wage growth rate and inflation, i.e. $\sigma_{\pi w} > 0$, the local currency instrument will become

> attractive, insofar as it allows mitigating the unexpected rise in expenditures through an unexpected fall in debt service payments. This is an optimal alternative from the tax-smoothing standpoint: as the primary surplus falls, there will also be an endogenous fall in debt interest payments.

In summary, local currency debt may be included in a debt portfolio if the premium payable in connection with the issue of the corresponding instruments is small, if inflation variability is low, and if inflation shows desirable stochastic properties, i.e. if inflation is anti-cyclic as regards the GDP and pro-cyclic as regards the international interest rate and the real wage.

In the literature, several temporal consistency allegations have been used to dismiss local currency debt. Barro (1997), for instance, states that the issue of local currency papers creates a moral hazard problem. The government may be tempted to liquefy the real value of the Pesos debt through monetary expansion or an unexpected devaluation. This element, which has not been taken into account in the theoretical formulation of this paper, increases the cost of local currency debt, since agents will internalize the government's incentives and require a higher interest rate in local currency. This problem will exist when the central bank is free to introduce changes to the monetary/exchange policy, and it is particularly significant in countries with a long tradition of monetary/exchange instability. Experience shows, however, that the governments of most developed countries issue debt in their respective local

currencies, which suggests that once the economy is stable, once the country has established a reputation in terms of inflation control, it is likely, and even desirable, to issue this kind of instruments.

As in the case of debt denominated in Pesos, the use of foreign currency debt will negatively depend on its yield variability, determined in this case by the volatility of the devaluation rate. Based on the argument of tax smoothing through nature states, we may conclude that issuing debt denominated in US Dollars will be desirable in the following events:

(i) If there is a negative correlation between the unanticipated evolution of the real price of the US Dollar and the real wage, i.e. $\sigma_{q,w} < 0$, so that if the cost of foreign currency debt suffers an unanticipated rise, the endogenous component of public expenditures will tend to fall;

(ii) If we find a positive covariance between the real devaluation rate and the GDP growth rate, i.e. $\sigma_{q,y} > 0$, in which case foreign currency debt will be more attractive, since the above correlation implies that in the periods when revenues are low this debt will be cheaper and the contrary will hold in the periods where revenues are high;

(iii) If the covariance between the real price of the US Dollar and the real interest rate is negative, i.e. $\sigma_{q,i^*} < 0$, since a negative covariance between these two variables implies that the cost of foreign currency debt will increase when international interest rates are falling.

Given the complexity of equations (11) and (12), it is impossible to find an explicit solution for the impact of risk premiums on the optimal values of θ and θ^*. Thus, we have chosen to reduce the problem to a choice between two different instruments. In the case of Uruguay, given the prohibitive cost of Peso-denominated medium- and long-term instruments, and considering, in addition, that local currency debt does not have the desirable ensuring properties[33], our comparison involves foreign currency debt and indexed debt.

3.2.3 US Dollar-Denominated versus CPI-Indexed Debt

If the cost of local currency debt is too high, its share in the debt portfolio will disappear. In this case, the tax-smoothing role through nature states will be only played by foreign currency debt.

In terms of the Kuhn Tucker problem, we are dealing with the following case:

$$\theta = 0,$$
$$\lambda_1 > 0,$$
$$\lambda_2 = \lambda_3 = \lambda_4 = 0$$

The first-order conditions of the problem described in the preceding section are reduced to the following:

$$\theta^* = \frac{(\sigma_{q,\hat{y}} - \sigma_{q,\hat{w}})g_1 + (\sigma_{q,\hat{y}} - \sigma_{q,i^*})b_1 + (p_1 - p_2)k}{b_1\left(\sigma_q^2 + (p_1 - p_2)^2\right)} \quad (14)$$

[33] Please refer to the empirical section of the paper.

The above expression shows the keys for the selection of either debt indexed to the evolution of the CPI or debt denominated in foreign currency. As already stated, the variability in the real price of the US Dollar is an allegation against this kind of debt and in favor of indexed bonds. This feature has already been noted in the papers by Missale (1998), Barro (1997), and Bohn (1990).

The pro-cyclic nature of foreign currency debt service cost, resulting from a negative covariance between the real devaluation rate and the GDP growth rate, is another strong argument in favor of indexed debt.

On the other side, the existence of a positive premium in the interest rates of indexed bonds would operate in favor of foreign exchange debt; this premium is mainly explained by the poor development of instruments denominated in indexed units. In addition, the existence of a negative correlation between the real wage growth rate and inflation in terms of the US Dollar is a property favoring the issue of debt denominated in US Dollars.

3.2.4. The Role of Risk Premiums

Based on Equation (14), we may proceed to make an analytical derivation of the relationship between the optimal debt mix and the size of the risk premium.

To the effects of this analysis, we must regroup the terms in (14) as follows:

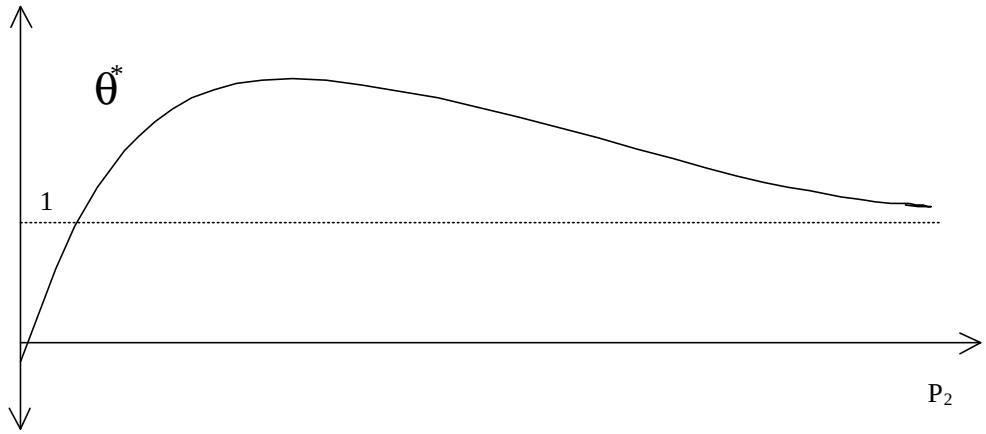
$$\theta^{*}(\phi)=\frac{b_1\phi^2+\Delta\phi+\Psi}{b_1\left(\sigma_q^2+\phi^2\right)}$$

where $\phi = p_1 - p_2$ is the premium payable on the indexed instrument as compared to the US Dollar instrument, and

$$\Delta = b_1\left(1+i_2^{*e}+q_2^e-\hat{y}_2^e\right)+g_1\left(1+\hat{w}_2^e-\hat{y}_2^e\right)$$
$$\Psi = \left(\sigma_{q,\hat{y}}-\sigma_{q,\hat{w}}\right)g_1+\left(\sigma_{q,\hat{y}}-\sigma_{q,r}\right)b_1$$

are the model parameter functions.

Exhibit 1 shows that function θ^* behaves as follows:



We may notice that when the *ex ante* cost of indexed debt is low, a rise in the premium will result in a rise in the desired amount of foreign currency debt. As from a certain point, the government will start incurring in US Dollar debt to grant loans in indexed money. In spite of the above, since we will hardly find supply of indexed papers at these interest rates and considering that no government will incur in debt in one currency to grant loans in another[34], we have eliminated this theoretical possibility through the imposition of sign restraints.

[34] It is worth noting that any reference in this paper to the government's debt implies in fact a reference to the

We can thus conclude that, in the relevant section of the cost function (i.e., when $0 \leq \theta^* \leq 1$), the higher the premium paid on indexed debt, the higher the optimal share of foreign currency debt. This is a particularly significant result, as it shows that the development of capital markets, and in particular those operating with indexed instruments, is likely to result in a fall in the premium associated to such instruments, and this, in turn, would create the necessary conditions for such instruments to be included in the optimal debt portfolio of Uruguay.

3.3. The Uruguayan Case

This section of the paper examines the stochastic features of the shocks having an impact on the budget equation of the government. The core issue dealt with in this paper is that both the correlation between these shocks and the yields of the different financial instruments and the volatility inherent to the returns of such instruments should be contemplated by Uruguayan public debt managers when making a decision on the optimal currency mix of the government's liabilities.

Under certain circumstances, a trade-off may be the case between instruments having a lower associated financial cost and those having the desirable properties in terms of a lower volatility and an appropriate correlation between their yields and the relevant variables having an impact on public accounts.

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consolidated debt of the non-financial public sector and the Central Bank of Uruguay, leaving fully aside the positions of government-owned banks (BROU and BHU), since these entities operate as financial intermediation agents and are fully alien to the Uruguayan public debt's management.

Thus, once the corresponding variance and covariance estimates have been obtained, we shall proceed to gauge the model, using to such ends reasonable values of the risk premiums that will be obtained from an examination of the structural characteristics of the Uruguayan economy and the specific features of its capital market. These values will also allow making an evaluation of the losses the Uruguayan government suffered in the past as a consequence of its holding a fully Dollarized debt portfolio.

3.3.1 The Stochastic Structure of the Uruguayan Budget: Empirical Evidence

3.3.1.a. The Data Used

To the effects of obtaining the strongest possible results, we chose to work with a relatively long period, i.e. the last 20 years (1979-1998). We were particularly interested in covering the period when the stabilization program known as the "Tablita" collapsed (1982-83), in the understanding that, at the time, the evolution of the macroeconomic variables considered in this paper tended to dramatically worsen fiscal results.

Uruguayan series are all comprised of official data, as they were obtained from the Economic Statistics Department of the Central Bank of Uruguay and the National Statistics Institute. As regards the international interest rate, we used the 6-month LIBO rate (taken from International Financial Statistics, as published by the IMF).

We chose to work with quarterly data, as this allows having an adequate number of data to obtain econometric estimates. With the only exception of the interest rate, all the variables taken into consideration are expressed as a variation rate as compared to the preceding quarter. The LIBO rate used is the monthly simple average for each quarter.

3.3.1.b. Simple Correlations

In the first place, as a first general step, we estimated the variance and covariance matrix of the variables included in the theoretical model, i.e. the inflation rate (π), the real devaluation rate ($q = e - \pi$), the international interest rate (i^*), the real wage variation rate ($w = W - \pi$), and the GDP growth rate (y). As regards the latter, given the highly seasonal nature of the Uruguayan GDP, we de-seasonalized the series prior to computing variation rates.

The following table shows the covariance and correlation matrixes found for the 1979-1998 period[35].

[35] The temporal series moment analysis is meaningful insofar as we are dealing with stationary series. Thus, prior to examining results, we proceeded to test the existence of unit roots in the series. Using a 3-lag Phillips-Perron test, with no trend (except in the case of the LIBO Rate, where a trend was indeed included) and with a 5% significance level, we concluded that all series are stationary.

Table 3. 1

Simple Moments

A. Variance and Covariance Matrix

	LIBO Rate	*GDP*	*Real Wage*	Real Devaluation	*Inflation*
LIBO Rate	0.00100				
GDP	-0.00020	0.00090			
Real Wage	-0.00007	0.00003	0.0022		
Real Deval.	0.00008	-0.00210	-0.0016	0.03080	
Inflation	0.00007	0.00007	-0.0002	-0.00180	0.00310

B. Correlation Matrix

	LIBO Rate	*GDP*	*Real Wage*	Real Devaluation	*Inflation*
LIBO Rate	1.000				
GDP	-0.133	1.000			
Real Wage	-0.039	0.017	1.000		
Real Deval.	0.012	-0.382	-0.199	1.000	
Inflation	0.003	0.039	-0.094	-0.191	1.000

To the effects of this analysis, we are particularly interested in examining the sample values of parameters σ_q^2, σ_π^2, $\sigma_{q,y}$, $\sigma_{q,i*}$, $\sigma_{q,w,}$, $\sigma_{\pi,y}$, $\sigma_{\pi,i*}$, and $\sigma_{\pi,w.}$ The examination of the above charts allows identifying three aspects deserving special consideration:

a) The real devaluation rate variance is extremely higher than the inflation rate variance.

b) The real devaluation rate is strongly negatively correlated with the GDP variation.

c) The inflation rate has no statistically significant correlation with any of the variables in the system.

Although these results may be considered to be a starting reference point, it is evident that they should be supplemented with other more detailed studies. The second moments, estimated above using the full sample period, may prove not to be an appropriate approximation of the parameters considered in the theoretical model. In fact, using the variance and covariance matrix of the sample implicitly assumes that the expected values of the variables at each moment will be constant and equal to their average value for the whole of the period. This assumption may prove not to be satisfactory, bearing in mind that the agents' expectations are not static but are rather adjusted on ongoing bases as a function of the events taking place in the economy. It does not seem reasonable to state, for instance, that the expected value of the inflation rate by the close of the period (when the annual real inflation rate has only one digit) will be the value that was anticipated early in the decade (when the annual inflation rate was a three-digit figure).

This called for the need to consider an alternative procedure that would allow us, in the first place, to estimate the expected values of the variables at each moment and, in the second place, to compute the correlations corresponding to the above-described theoretical model.

3.3.1.c. Extracting Sample Moments with a Near VAR Procedure

As we all know, there is no single way to estimate the expectations of agents as regards a given variable. This paper follows a technique similar to those used by Missale (1998) and Goldfajn(1997), designed to obtain the expected values of each of the variables departing from the estimation of sliding auto-regressive vectors (VARs)[36]. Yet, conversely to the developments of the above authors, the innovation vector $[X_t - X_t^e]$ (where X_t represents the observed values and X_t^e, the expected values of the variables) is not directly obtained from the last residues of each VAR but is rather obtained as the difference between the values of the variables actually observed in the following quarter and the values projected by the model for such quarter ($X_{t+1} - X_{t+1}^p$).

In other words, our work considers that agents use the information available for the most recent five years to build their projections of the values of the variables in the following quarter. The model includes the five variables that were considered in the theoretical model[37]. A new VAR is estimated for each quarter, departing from a sample including the last 20 observations. In other words, each new VAR incorporates the

[36] This procedure is, doubtless, richer than the alternative of adjusting a monovariant auto-regressive process for each of the series. Anyway, it is worth emphasizing that, by its mere construction, the procedure used implies an adaptive or "looking backward" expectation-formation process. Although this may prove to be appropriate for certain variables such as the inflation rate or the real wage variation (having a major inertial component), the looking-backward expectation assumption is more questionable for the real devaluation rate or the GDP growth rate.

[37] The model also includes seasonal dummy variables in the equations corresponding to domestic variables.

most recent observations available and excludes the oldest data, corresponding to the first observation in the preceding period.

Once the VAR for the [*t-19,t*] period has been estimated, this figure is used to project the variables for the *t+1* quarter. By subtracting this projection from the value actually observed in *t+1* we obtain the innovation corresponding to such quarter. This procedure allows building innovation series for the five variables. Once all values have been obtained, in a second stage we proceed to compute the variances and covariances that are significant to the effects of choosing the debt portfolio mix.

It is worth noting that the international interest rate equation does not include any domestic variable, in the understanding that Uruguay is a small country and thus no Uruguayan variable has an impact on the behavior of the LIBO Rate. In this sense, we are estimating a model known in the literature as the "Near VAR" model[38].

Each equation includes only one lag. Although working with quarterly data might theoretically result in the introduction of four lags per equation, this would deprive us from a significant number of freedom degrees, which is not advisable given the limited number of observations included in each VAR. On the other hand, the incorporation of dummy variables allows contemplating the seasonal nature of some of the variables under consideration without the need to incorporate additional lags.

[38] A Near-VAR model allows eliminating redundant variables from the reduced VAR equations, thus restricting certain coefficients to being equal to zero.

The period from I-1979 to IV-1983 was used to estimate the first VAR. The estimated innovation series start, thus, in the first quarter of 1984. These series are presented in Figures 1-5.

3.3.1.d. Results

The following charts include the covariance and correlation matrixes of the innovation series, estimated as described above, using data for 1979-1998:

Table 3.2

Moments Derived from the VAR Model

A. Variance and Covariance Matrix

	LIBO Rate	*GDP*	*Real Wage*	Real Devaluation	*Inflation*
LIBO Rate	0.00007				
GDP	0.00002	0.00220			
Real Wage	-0.00020	0.00007	0.00290		
Real Deval.	-0.00006	-0.00250	-0.00130	0.01740	
Inflation	-0.00002	-0.00010	0.00000	-0.00001	0.00080

B. Correlation Matrix

	LIBO Rate	*GDP*	*Real Wage*	Real Devaluation	*Inflation*
LIBO Rate	1.000				
GDP	0.045	1.000			
Real Wage	-0.410	0.028	1.000		
Real Deval.	-0.049	-0.408	-0.183	1.000	
Inflation	-0.092	-0.110	0.002	-0.002	1.000

Although certain differences may be identified as compared to the results obtained using the full sample period (a logical outcome, since we are measuring different things), the main results obtained from the analysis of simple correlations are still valid. It is worth noting that when this technique is used, the difference in the real devaluation rate variability and the inflation rate variability is even higher than in the preceding case. In addition, among the covariances contained in the theoretical model, the only covariance that is still significant at a 1% level is the covariance between the real devaluation rate and the GDP variation rate. In general, the signs found with this procedure coincide with those that might be expected under economic theory (see Exhibit 2), although in most cases the estimates are not statistically significant.

It may be thus concluded that, from a tax-smoothing standpoint, given the stochastic nature of the shocks having an impact on the budgetary structure of the Uruguayan government, foreign currency debt does not offer desirable properties. This debt not only introduces "noise" in the government's budget equation (given the high variability of its *ex post* cost) but also involves a pro-cyclic behavior (a fall in revenues associated to a recession will be simultaneous to a rise in debt service resulting from the real devaluation of the currency) and cannot operate as an insurance against shocks in the international interest rate or an unexpected variation in the real wage (although $\sigma_{q,w}$ has the desirable sign, it is not significant at a 5% level). These results seem to be quite strong, and hold for different sub-periods and for different VAR specifications.

On the other hand, this study shows that issuing nominal debt in local currency would be meaningless as regards a minimization of the global fiscal risk. The *ex post* yield of this kind of debt does not seem to be correlated with the macroeconomic variables having an impact on the national budget. We might even state that in the case of Uruguay, nominal instruments denominated in Pesos do not operate as an insurance against unexpected shocks in the international interest rate, the GDP, or the real wage.

As a corollary of the empirical analysis, we see that indexed debt would be in a position to play a major role in Uruguay, given the stochastic structure of the shocks having an impact on the government's budget equation. Such debt would allow stabilizing the real debt service independently of the evolution of the inflation rate and the real devaluation rate. Using these instruments would allow achieving a more predictable pattern of real expenditures, and this would contribute to stabilizing the aliquot of taxes over time.

3.3.2. Calibrating the Model

3.3.2.a. Risk Premium Values

Departing from the above results, we must find to what extent indexed debt will be desirable if the different *ex ante* costs of these instruments are incorporated to the analysis. To such ends, we must make certain assumptions on the premium associated to local currency and indexed papers.

As regards the additional cost of the Peso-denominated debt, it is impossible to make an estimation for Uruguay, given the absence of nominal long-term instruments[39]. In this sense it is worth recalling that, even if not directly incorporated to the model, we are implicitly assuming that public debt involves a high share of long-term instruments.

A likely procedure would be to refer to empirical studies conducted in other countries. Thus, for instance, in the United Kingdom, Deacon and Derry (1994) estimated that the inflation risk premium resulting from the rate spread between conventional debt and indexed debt amounts to some 300 to 500 base points. Similar evidences seem to have been obtained for Sweden (see Penati, 1995). But we should be extremely careful when extrapolating to Uruguay results obtained in other very different economies. In countries having recorded long-lasting chronic and volatile inflation, as Uruguay, the premium would be likely to be quite higher, especially when long horizons are considered. Thus, we worked with a 400 base points premium, assuming that this value may represent a minimum reference floor ($p_1 = 0.04$).

As regards the indexed instrument, this instrument would not be likely to be associated, in the long term, to a significant risk premium, since it offers a constant real yield to the investor. In other words, these assets are free from the inflation risk. In spite of the above, in the short run an additional cost would indeed be likely to be paid upon the issue of indexed debt, mainly due to two factors. In the first place, there is no development of this kind of instruments in the Uruguayan capital market, and thus a

[39] At present, the longest-term local currency instruments in the Uruguayan financial market are one-year time deposits.

premium will necessarily result from the lack of liquidity of these instruments. In the second place, given the extremely high Dollarization of the Uruguayan economy, we might say that foreign exchange is the natural habitat of investors. In Uruguay, the US Dollar may be considered to be the account unit, and thus, from this standpoint, indexed instruments would continue to involve a risk associated to an uncertainty as to the future evolution of the real rate of exchange. Based on the above, we have chosen to work with a 100 base points premium for the indexed instrument over a similar instrument denominated in US Dollars ($\phi = 0.01$)[40].

3.3.2.b. Simulation Results

By way of summary, the following chart includes the values of the parameters used as a basis of the simulations:

Table 3.3

Base Parameters			
P_1	0.040	σ_P^2	0.001
ϕ	0.010	σ_q^2	0.018
		σ_{Pi^*}	-0.092
D/GDP	0.450	σ_{Py}	-0.110
y^e	0.035	σ_{Pw}	0.002
W^e	0.025	σ_{Pq}	-0.002
G/GDP	0.325	σ_{q,i^*}	-0.049
I^*	0.050	$\sigma_{q,y}$	-0.408

[40] This amount seems to be in line with the preferences suggested by private agents in mid 1998 when the Central Bank of Uruguay contemplated the possibility of launching Indexed Bonds in the marketplace.

Q^e	-0.010	$\sigma_{q,w}$	-0.183

For purposes of being able to draw a conclusion on the currency structure of the Uruguayan public debt in coming years, we have considered the anticipated values of *b*, *g*, *w*, *i**, and *q* rather than their historical values for 1979-1998. In addition, we assumed that the stochastic structure of the economy will be unchanged in the future, and thus we used the variance and covariance values that were estimated in the preceding section.

The optimal values of θ and θ^* are obtained by substituting the above estimates of the parameters and risk premiums in equations 12 and 13. Given the values used, we find that:

$$\theta = -30.596,$$

$$\theta^* = 0,284$$

The no-restraint solution shows that it would be optimal for the government to incur in indexed debt (and to a lower extent in US Dollar-denominated debt) and grant loans in local currency. This is a logical outcome if we take the high yield of local currency papers into consideration. If the non-financial public sector could grant "expensive" loans (at a real $r + p_2$ rate) and incur in "cheap" borrowings (at a *r* rate), it would be meaningful to have a strong active position in local currency instruments, as this would allow obtaining financial gains that would in turn allow minimizing the target function.

In other words, the benefits obtained through financial intermediation would allow the government to reduce taxes.

To the effects of examining the variation of these results if the values of the premiums were changed, several simulations were conducted. In the first place, we changed the cost of the Peso-denominated paper and kept the cost of the indexed instrument constant (100 base points above the return of the US Dollar security); in a second stage, we introduced a variation in the cost of the indexed paper but kept the yield of the local currency paper constant (400 base points above the return of the US Dollar security). By changing p_1 and ϕ, we obtain:

Table 3.4

OPTIMAL SOLUTION WITH ALL THREE INSTRUMENTS			
q	***p*₁**	***q****	**f**
0.282	0.01	0.016	0.005
-1.907	0.011	0.063	0.006
-4.079	0.012	0.113	0.007
-6.219	0.013	0.167	0.008
-8.312	0.014	0.224	0.009
-10.344	0.015	**0.284**	**0.01**
-19.194	0.02	0.349	0.011
-28.902	0.03	0.417	0.012
-30.596	**0.04**	0.490	0.013

It is enough for the premium of the local currency paper to be only slightly higher than the premium of the indexed instrument to fully dismiss the Peso security as a means of indebtedness. The logic underlying this result lies in the fact that, as noted in the previous section, local currency debt cannot operate as an insurance as desirable, and thus if local currency papers become more expensive than indexed bonds, they will fully disappear from the debt portfolio and will hold a key position in the government's assets portfolio. Although this is a theoretically possible solution, it is not viable in real life, since governments do not obtain resources from financial intermediation.

Turning now to the relevant corner solution, i.e. considering only a choice between the indexed instrument and the US Dollar instrument, given the estimated parameters and the value of the risk premium associated to the indexed instrument, the model suggests that it would be optimal for the government to hold some 20% of its debt in indexed instruments:

$$\theta^* = 0.791,$$

$$1 - \theta^* = 0.209$$

This result is, obviously, sensitive to the additional cost payable on indexed debt. By introducing changes to ϕ we obtain the following chart:

Table 3.5

Risk Premium Role: Two Instruments	
q^*	ϕ
1.276	0.0150
1.035	0.0125

0.791	**0.0100**
0.546	0.0075
0.301	0.0050
-0.190	0.0000

In this case, we clearly see that as the indexed debt cost falls, there is a rise in its weight in the optimal debt mix. In the extreme case where no premium was paid on this debt, it would be optimal for the whole debt to be held in this kind of instruments. As in the previous case, this is explained by the lack of desirable stochastic properties in the yields of US Dollar debt.

To the effects of examining the changes in the optimal values of θ and θ^* upon a change in the values of the variances and covariances, several simulations were conducted, which allowed building the following charts:

Table 3.6

Sensitivity of the Optimal Portfolio to Certain Selected Moments

q^*	s_q^2
0.622	0.0225
0.700	0.02
0.791	**0.0175**
0.931	0.015
1.116	0.0125

q^*	s_{qi^*}
0.771	0.35
0.784	0.15
0.791	**-0.05**
0.803	-0.15
0.816	-0.35

q^*	s_{qy}
0.672	-0.6
0.732	-0.5
0.791	**-0.4**
0.867	-0.3
0.925	-0.2

q^*	s_{qw}
0.887	-0.49
0.837	-0.32
0.791	**-0.18**
0.768	-0.08
0.692	0.18

These were the results that had been anticipated, to which reference was already made in the previous section. It is interesting to emphasize the high sensitivity of the optimal foreign currency share, θ^*, to a change in the variance of the real devaluation rate, σ_q^2, and in the covariance between the GDP growth rate and the real devaluation rate, $\sigma_{qy.}$

3.3.3 Costs Associated to a Dollarized Portfolio

We have established that, given the properties of the stochastic processes governing the determination of the Uruguayan fiscal deficit, there is at present room for indexed local currency debt. This section is devoted to examining whether holding a fully Dollarized portfolio has been, in the past, the optimal strategy. Even if it is not our intent to precisely quantify the costs associated to holding debt fully denominated in US Dollars, we shall try to make a comparison of debt policy performances in 1979-1985 and 1986-1998. These two periods were chosen due to the different characteristics they show. The first one involves the adoption of the stabilization program, its subsequent collapse, and the management of the ensuing crisis; the second is rather a sustained growth phase, with gradual stabilization as from 1991.

The most intuitive way to compute the additional cost in this model is comparing the costs associated to the Dollarized portfolio to those that would have been incurred if the optimal portfolio had been held in each period. Building an index of the excess

losses per period may give us an indication of the period where the portfolio mix proved to be particularly damaging.

We define index I, in algebraic terms, as:

$$I_t = \frac{V_t(\theta^* = 1) - V_t(\theta^* = \theta^*_t)}{V_t(\theta^* = \theta^*_t)} * 100$$

where V_t is the loss suffered in period t as a function of the portfolio's parameters. θ^*_t is the optimal value of θ^* in period t. This index will result in positive values when the losses associated to the Dollarized portfolio are higher than those that would have been associated to the optimal portfolio, and will be nil if the Dollarized portfolio proved to be optimal in the period[41].

For purposes of computing the index for the different periods, we shall use the average values of the involved variables and we shall consider the way in which these variables interacted over each period. In other words, for purposes of gauging losses we shall use the estimate variance and covariance matrix for each period. Since there is no information available on this parameter for the period under consideration, we assumed that the wider variability of the real exchange rate was linked to higher risk premiums[42]. We assumed the risk premium amounted to 3% in 1979-1985, 1.5% in 1986-1998, and 2.25% in 1979-1998.

Table 3.7

Assumptions Underlying the Computation of the Index

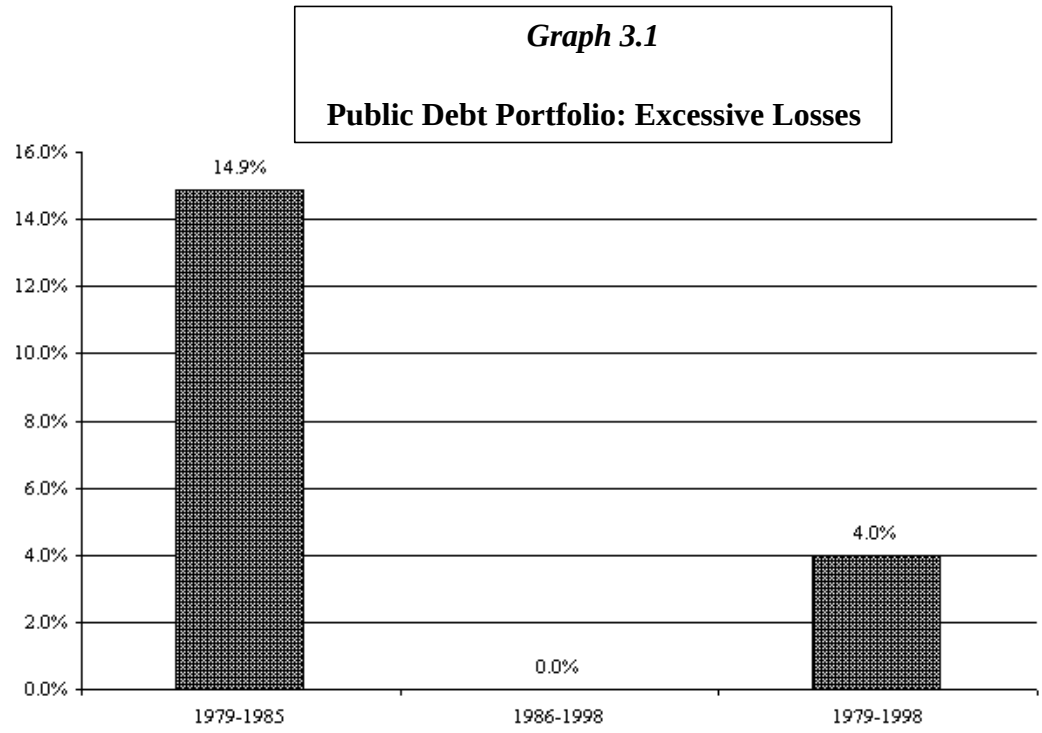
[41] In this period we find a corner solution.

[42] For purposes of obtaining innovations for the first period, we were forced to first extend our sample to include data since 1974.

	cov q,y	covq,w	cov q, i	var q	f	var w	var y	cov w y	cov i, y	cov w,i	var i
1979	-0.04738	-0.05233	0.00038	0.56114	0.03000	0.01057	0.00924	0.00476	0.00059	-0.00104	0.00114
1985											
1986	-0.00059	-0.00136	0.00008	0.01029	0.01500	0.00213	0.00099	0.00016	0.00001	-0.00003	4E-05
1998											
1979	-0.01593	-0.01870	0.00023	0.19440	0.02250	0.00519	0.00387	0.00151	0.00023	-0.00040	0.00041
1998											

	g	b	w	y	q	I
1979	35.0%	38.6%	-3.5%	-0.4%	7.3%	12.3%
1985						
1986	35.4%	41.4%	1.0%	3.9%	-9.6%	6.3%
1998						
1979	35.3%	40.4%	-0.6%	2.4%	-3.7%	8.4%
1998						

Graph 3.1 shows the evolution of index "I". We can see that the whole loss is



concentrated in 1979-1985. Over the period, the poor performance of the fully Dollarized portfolio is associated to the poor behavior of the stochastic processes governing the economy at the time. In the first place, the extremely high variability of the real exchange rate, driven by the collapse of the *Tablita*, resulted in an extremely high variability of the public budget. In the second place, the joint occurrence of a strong activity level contraction and a dramatic deflation in US Dollar terms resulted in a strong negative covariance between these two variables, which caused the debt cost to rise when the government's revenues were falling. In addition, the covariance between deflation in US Dollar terms and the LIBO rate was positive for the period, which implies that the cost of the US Dollar-denominated debt was rising when the general debt cost was also rising. The simultaneous fall in wages, a determining factor for a negative covariance over the period between this variable and deflation in US Dollars, resulted in a fall in endogenous social security expenditures and public servants' wages, which was not adequate to offset the above-mentioned negative effects of the US Dollar debt.

Conversely to the situation in the previous period, the full Dollarization of the portfolio was the optimal alternative in 1986-1998. In fact, in this period several factors were witnessed which favored incurring in US Dollar-denominated debt. In the first place, the variability of the real exchange rate was significantly lower. The fall in the covariance between US Dollar deflation and the economic activity level, together with a fall in the covariance between the economic activity level and the LIBO rate, shows

that, even if f is assumed to be lower, the US Dollar-denominated debt proved to be more attractive.

For the whole period, given the high variance of *q*, the effective debt portfolio contributed an excessive amount of volatility to the budget. In addition, it is worth noting the counter-cyclic behavior of deflation in US Dollar terms and the pro-cyclic behavior of the international interest rate.. Thus, the fully Dollarized portfolio was suboptimal in 1979-1998.

In this sense, it is also worth noting that the loss for the whole of the sample results from the loss suffered in the Period 1. Between 1979 and 1985, the excess cost of the fully Dollarized portfolio, as measured by index "I", was more than three times its level in 1979-1998.

As a summary of this analysis broken down per period two issues should be emphasized. In the first place, the stochastic behavior of the economy is essential to determine the optimal portfolio. In the second place, in spite of the moderately advantageous behavior of the Dollarized portfolio during an expansive period, full Dollarization is suboptimal. In fact, one of the most important features that may be deducted from the analysis broken down per period is the extremely poor performance of the debt portfolio in crisis years.

The current debt portfolio is bad because it is associated to a pro-cyclic service cost; but it is even worse because its worst behavior coincides with the worst times for the economy.

3.4. Conclusions

This paper clearly shows the need to create new public debt instruments, indexed bonds, as a means to improve the Uruguayan government's debt management and to reduce the global volatility of the fiscal risk.

The diversification of the debt portfolio should be given priority among public debt management policies in the coming years. The existing extremely high concentration of securities denominated in foreign currency may only be explained by a government willing to minimize *ex ante* debt costs; but this solution has proven not to be optimal if a wider objective implying the minimization of global budget risks is taken into consideration.

At present, the Uruguayan government as a whole is highly exposed to the exchange risk.. Indexed debt would allow transferring a portion of such risk to the holders of public securities. In addition, issuing indexed papers would allow stabilizing the real debt service. Under the model handled in this paper, using indexed securities would allow achieving a more predictable real expenditure pattern, and this would in turn help keeping stable tax aliquots over time.

Although some might argue that indexed papers would cause inflation to last longer, this argument does not seem to be appropriate in today's world, in particular given the economic performance of the countries presently issuing this kind of papers. The countries that have recently issued indexed debt are precisely those that have

historically had a low inflation level, like Australia, New Zealand, England, Sweden, and the USA. Issuing indexed bonds is even more meaningful in stable macroeconomic environments.

This paper has particularly emphasized tax smoothing arguments to promote issuing indexed debt. It is worth however noting, as we get to the end of the paper, that other allegations also favor issuing indexed securities. In the first place, the introduction of indexed papers may be considered as a means to complete financial markets. In theory, instruments may be said to help completing the markets if they create return patterns that could not be created by a mix of the existing papers. Thus, investors may be insured against certain nature states in a manner that was not available before. Indexed bonds do, doubtless, meet this definition, and may thus contribute to improving the general wellbeing of society.

3.5. Appendix 1 – The Role of Risk Premiums

Deriving function $\theta^*(\phi)$ for ϕ, we obtain:

$$(*)\ \frac{\delta\theta^*}{\delta\phi} = \frac{-\Delta\phi^2 + 2\phi\left(b_1\sigma_q^2 - \Psi\right) + \Delta\sigma_q^2}{b_1^2\left(\sigma_q^2 + \phi^2\right)^2}$$

The sign of this derivative is given by the sign of the numerator. It should be noted that this sign suffers two changes in the two zeroes of the numerator's polynomial. Using second-degree root rules offers us major information in this connection. In the first place, we know that the product of the roots of a second-degree polynomial of the form $ax^2 + bx + c = F(x)$ is equal to c/a. In this case the quotient is negative, which implies one root is positive and the other negative. The sum of the roots is equal to –b/a, in this case a positive number, since a is negative and b is positive (for reasonable values of the parameters). We thus know that the roots are not centered around zero, and that they are biased towards positive numbers.

We have established that the share of foreign currency debt grows in the interval between the two roots of the polynomial we are examining. We should however ask whether this is enough to state that growth will occur in the corresponding stretch of θ^* (i.e. when $0 \leq \theta^* \leq 1$). To find an answer to the above question, we shall compare the value of the premium that fully Dollarizes the debt portfolio,

$$\phi_{\theta^*=1} = \frac{b_1\sigma_q^2 - \Psi}{\Delta},$$

where the value of ϕ corresponds to the positive root of the polynomial in the numerator of (*):

$$\bar{\phi}_2 = \frac{\left(b_1\sigma_q^2 - \Psi\right) + \sqrt{\left(b_1\sigma_q^2 - \Psi\right)^2 + 4\Delta^2\sigma_q^2}}{2\Delta}.$$

The difference between these two values is given by

$$\bar{\phi}_2 - \phi_{\theta^*=1} = \frac{\sqrt{\left(b_1\sigma_q^2 - \Psi\right)^2 + 4\Delta^2\sigma_q^2}}{2\Delta} - \frac{b_1\sigma_q^2 - \Psi}{2\Delta} > 0.$$

This function clearly grows; exceeds the 1 mark; at $\bar{\phi}_2$ reaches a maximum; and then starts to fall. In the boundary, when the premium extends towards infinite, θ^* extends towards 1. This curious situation derives from the form chosen for the government's loss function. Given its quadratic form, it is indifferent for the authority to have a tax and a subsidy of the same amount. If the original problem were not subject to restraint (iv), in the interval $1 < \phi < \bar{\phi}_2$ it would be possible to cut taxes by making an additional placement of foreign currency debt and using the resources thus obtained to grant loans in indexed instruments. This would be an advantageous mechanism if the financial profit derived from such intermediation allowed reducing taxes as necessary to close the government's budget.

Once taxes are zero (at $\phi = \bar{\phi}_2$, $V(\phi)=0$), any additional rise in the risk premium will reduce the share of foreign currency debt in the optimal debt portfolio. In fact, if the premium continues to rise from $\bar{\phi}_2$, the optimal strategy to preserve fiscal equilibrium

(i.e. to keep $V(\phi) = 0$) would be to gradually cut loans in indexed currency, thus preventing the excess gains created by the mismatching of currencies from resulting in a subsidy to the private sector ($\tau < 0$). In the boundary, placing a very very small amount of credit in indexed currency would be enough to fund all fiscal needs.

3.6. Appendix 2 - The Anticipated Sign of the Model's Parameters

It is worth asking which are, pursuant to economic theory, the anticipated signs of covariances σ_{qy}, σ_{qi^*}, σ_{qw}, $\sigma_{q\pi}$, $\sigma_{\pi y}$, $\sigma_{\pi i^*}$, and $\sigma_{\pi w}$. Although in some cases the signs of these parameters seem to be clearly established, in other cases they are uncertain, as they depend on the kind of shock affecting the economy.

To the effects of clarifying the analysis, we are considering four different shocks, and we shall examine the response of each of variables *q*, *p*, *y*, *i** and *w* to each of such shocks. The shocks to be considered are as follows: capital inflows, productivity gains, an improvement in the terms of trade, and a positive demand shock (expansive fiscal or monetary policy).

Covariances whose anticipated signs are clearly established:

1) $\sigma_{qy} < 0$ – In the case of capital inflows, the GDP growth rate should rise and the real exchange rate –approximated through the US Dollar/CPI ratio- should appreciate. Domestic productivity gains would have similar results. The GDP rises under the twofold effect of a rise in productivity and a rise in the labor used, and the real exchange rate appreciates due to the productivity gain as regards our trade partners. An improvement in the terms of trade increases the available income and, thus, the demand for goods and the GDP. The effect on the real exchange rate is a little harder to identify, but insofar as there is a rise in the demand for non-tradables, the real exchange rate should be expected to fall. Demand shocks also result, in the short run,

in an expansion of the GDP and an appreciation of the real exchange rate.

2) $\sigma_{qi^*} > 0$ – A fall in the nominal international interest rate failing to be encompassed by a fall in the anticipated inflation rate would result in an outflow of capitals from developed countries towards emerging markets. This fall should be, thus, associated to a higher inflow of capitals to Uruguay. An appreciation of the exchange rate would result from the higher supply of foreign exchange. Thus, the covariance between *q* and *i** should be positive.

3) $\sigma_{\pi i^*} < 0$ – From the above, it is evident that capital inflows exercise pressures on the price of domestic goods, and thus the inflation rate would tend to rise. A fall in i* should be encompassed by a rise in π.

Covariances with uncertain signs:

4) $\sigma_{\pi y}$? – Capital inflows or demand shocks should result in a positive association between the inflation rate and the GDP growth rate. Yet, supply shocks, as for instance productivity gains, would yield the opposite sign. We are also uncertain as to the effect of the variations in the terms of trade on domestic inflation. We conclude, thus, that the sign of this covariance is uncertain, depending on the relative importance of the shocks affecting the economy.

5) $\sigma_{\pi w}$? – The same applies to the relationship between inflation and the real wage. On the one hand, if we take capital inflows into consideration, the covariance between π and *w* should be expected to have a positive sign. On the other hand, if we assume that the economy is mostly affected by productivity shocks, the opposite sign should be

anticipated.

6) σ_{qw} ? – A real appreciation is usually encompassed by a rise in the real wage. Yet, in theory, this should not always be the case. If, for instance, the government implements an unexpected expansion of the amount of money, assuming that nominal wages are predetermined, this monetary expansion would lead to a rise in inflation, a fall in the real wage, and a higher production level in the short term. In this case, the covariance between q and w would have a positive sign.

7) $\sigma_{\pi q}$? - The covariance between inflation and the real exchange rate is also uncertain under economic theory considerations. In the event of major supply shocks we would find a positive covariance, but if demand shocks prevail or if the economy faces strong foreign capital inflows, the sign of this covariance should be positive [sic].

The above comments may be summarized in the following double-entry chart:

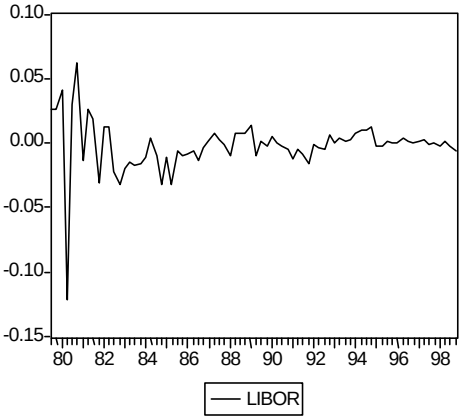
Table 3.8

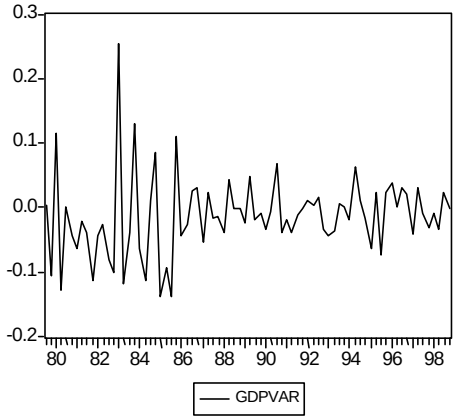
Expected signs of covariances

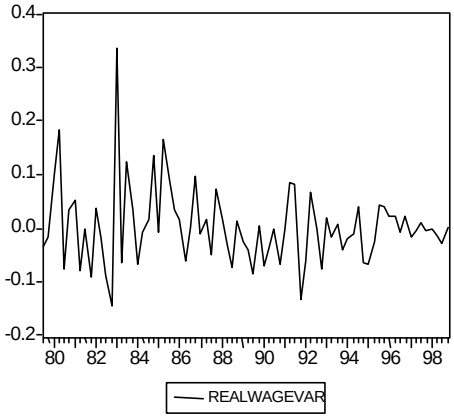
Shock/Covar.	$\sigma_{q,\hat{y}}$	$\sigma_{q,\hat{w}}$	$\sigma_{q,\pi}$	$\sigma_{\hat{y},\pi}$	$\sigma_{\hat{w},\pi}$	σ_{q,i^*}	$\sigma_{i^*,\pi}$
Capital Inflows	-	-	-	+	+	+	-
Supply Shock (Productivity Gain)	-	-	+	-	-	0	0
Improvement in Terms of Trade	-	-	?	?	?	0	0
Demand Shock (Fiscal/Monetary Expansion)	-	+	-	+	-	0	0
Average	-	?	?	?	?	+	-

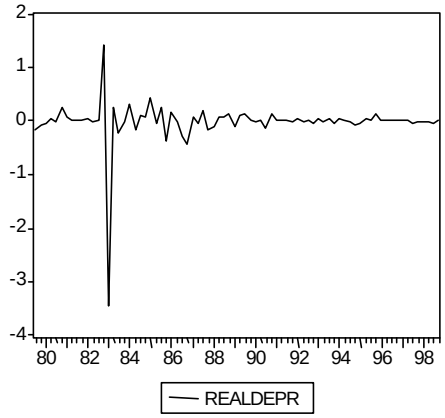
It is worth noting that theoretical correlations are likely to be diluted in actual data, due to the lags existing in the responses of the different variables in the real world.

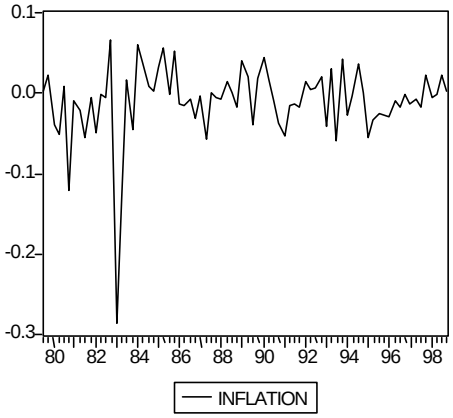
3.7. Appendix 3:Innovation Series – Sliding VARs











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