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DOLLARIZATION AS AN ASYMMETRIC MONETARY UNION.. THE CASE OF ARGENTINA

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Resumen:

Presentamos un esquema no tradicional para el análisis de los efectos de una asociación monetaria asimétrica (como la dolarización) desde el punto de vista del país que ata su política monetaria.

En la parte analítica discutimos la relación entre volatilidad nominal, volatilidad real y riesgo país. Dada la función de pérdida del gobierno, determinamos las condiciones necesarias para que la dolarización reduzca la pérdida social. Concentramos el análisis en dos aspectos principales: 1) el grado de sincronización entre los ciclos del país líder y el asociado y 2) el efecto y la importancia relativa de los canales comercial y financiero.

Aplicamos la metodología propuesta al caso de Argentina usando coeficientes de correlación cíclica, calculadas con diferentes metodologías, y luego calculamos la importancia de cada canal usando un modelo VEC.

Palavras chave: unión monetaria, dolarización, canales de transmisión, volatilidad, riesgo, Modelos VCE.

Abstract

This study gives a non-traditional framework for the evaluation of the convenience of an asymmetric monetary association (such as dollarization), from the point of view of the country that gives up its monetary sovereignty.

In the analytical part we discuss the relationship between nominal volatility, real volatility and country risk. Given the social loss function of the policymaker, we determine the necessary conditions for dollarization to improve social welfare. We concentrate in the analysis of two main aspects: 1) the degree of synchronization existing between the cycle of the leader and associated country, and 2) the effect and relative importance of the trade and financial.

We perform an application of our analytical framework to the case of Argentina using the coefficient of cyclical correlation, calculated for four different methodologies. The effect and relative importance of the financial channel and the trade channel were extracted from the impulse-response functions and variance decompositions of a VEC Model.

Keywords: **monetary union, dollarization, transmission channels, volatility, risk, VECModel,**

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DOLLARIZATION AS AN ASYMMETRIC MONETARY UNION. THE CASE OF ARGENTINA

1. Introduction

In a sequence of different paper we address the numerous effects of an asymmetric monetary union between a big country an a normal one. In some of them we discuss a general framework based on a game theory approach Carrera (1995) and Carrera and Lavarello (1995) and in others we discuss from a point of view of an optimal currency area (OCA), Carrera (1999), Carrera, Féliz and Panigo (1999), Carrera and Sturzenegger (2000). Using a game theory approach we demonstrated the conditions under which these association is welfare improving for each type of countries, using the OCA theory approach we evaluate cost and benefit of such arrangement.

In this paper a crucial rol are played by the exchange rate regime the symmetry of shocks, and the channels of shocks transmission We want to focus on the rol of exchange rate regime and, specifically, in the transmission of shock in an asymmetric monetary union (as dollarization) affects the real volatility.[i]

In the analytical part of the paper we discuss the concepts of real and nominal volatility, the behavior of the channels of transmission of external shocks and the relationship between real volatility and country risk. We define the objective function of the policymaker and establish the necessary conditions for dollarization to reduce the aggregate risk (that is, the sum of devaluation risk plus country risk).

In the empirical section we apply this analytical framework to the case of Argentina. To estimate the association of the business cycles we use coefficients of cyclical correlation calculated from four different de-trending methodologies. The effect and relative magnitude of the financial and trade channels were extracted from the impulse-response functions and variance decompositions of a Vector Error Correction Model (VECM). We analyze the stability of the results altering the order of the variables, re-estimating the model with rolling sub-samples and changing the deterministic component in the error correction mechanism. Finally we give some conclusions and list of possible researchs.

2. Dollarization, nominal volatility and real volatility

In the analysis of the role of the exchange rate system there are two relevant factors that we wish to highlight: its effects on the business cycle and the volatility of the economy.

With respect to the first aspect, the exchange rate regime is not a source of growth in the long run but it could reduce it if it generates excessive volatility of the economy. De Grawe (1988) shows how in a context of neoclassical growth with increasing returns to scale, it is possible that a reduction in exchange rate uncertainty, which reduces the interest rate, could increase the rate of growth. The adoption of a specific exchange rate regime could be used to: 1) reduce nominal uncertainty (or volatility), 2) control inflation (Calvo and Vegh, 1993; Fanelli and González Rozada, 1998), or 3) reduce real volatility[ii].

As it has been pointed out by Helpman and Razin (1982), changing from a monetary regime with a central bank to a monetary union implies a trade-off between the benefits of reducing excessive exchange rate volatility[iii] and the cost of reducing the number of financial assets available in the economy. With imperfect financial markets a flexible exchange rate regime is superior to a fixed exchange rate one because it increases the efficiency with which economic agents diversify risk (Helpman and Razin, op.cit.)[iv]. A typical example of an instrument for hedging that is lost with a monetary union is the possibility of devaluation to adjust relative prices in response to shocks.

When policymakers have a propensity to generate policy shocks which are expected by the population there will exist an inflationary bias whose volatility could be influenced by short run electoral objectives; in such a case a monetary rule could be optimal. Neumeyer (1998) states that a monetary union is desirable when the gains from the elimination of excess volatility generated by policy shocks ("bad" nominal volatility) exceed the costs of reducing the number of instruments available to hedge against risk.

Our paper moves a step forward and complements the perspective of works already discussed by taking into account the problem of how an exchange rate regime (dollarization) affects the real volatility of the economy. We believe that the effects of dollarization on "good" and "bad" nominal volatility as well as on real volatility should be considered.

Behind this idea is the problem highlighted by Poole (1970) in his pioneering paper on what the most convenient regime to reduce real volatility is depending on the source of the shocks. If shocks come from the monetary market (they affect the LM curve) then the fixed exchange rate regime seems better, while if shocks originate in the goods market (affecting the IS curve) a flexible exchange rate regime would reduce the volatility of output.

From this section we can conclude that the effect of the exchange rate regime on real fluctuations is relevant for two motives. First, the greater the real volatility, the greater the domestic price changes the economy will require and, thus, the greater the advantages of a flexible exchange rate regime that admits certain nominal volatility ("good" volatility in the sense expressed by Helpman and Razin, 1982).

3. How does the US' cycle transmit in the context of an asymmetric monetary union?

The business cycles of the different countries, understood as the variations of output around its trend, do not relate directly but through channels that transmit shocks from one economy to the other.

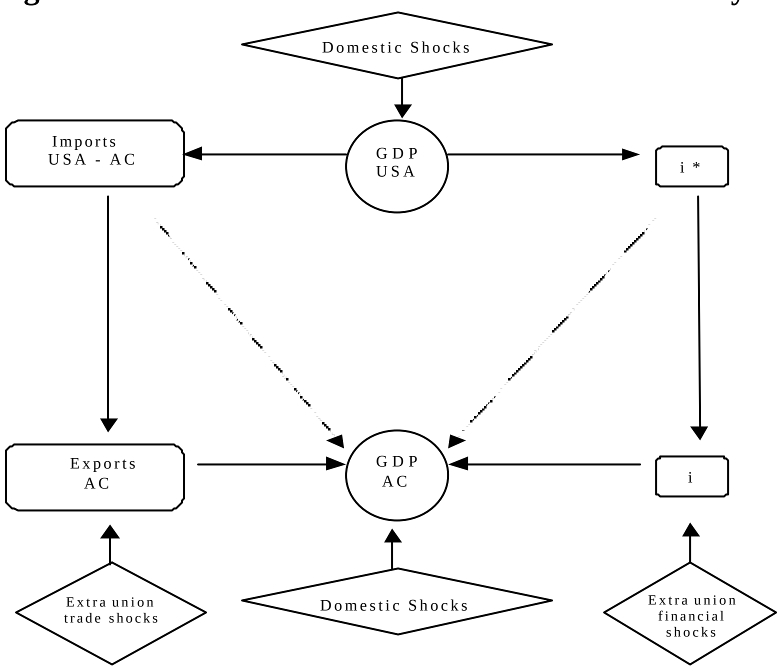
In the case of an asymmetric relationship big country-small country the transmission of the effects of the business cycle originated in the main economy to the different small countries occurs mainly through the transactions of goods (and services) and of financial assets (Canova and Ubide 1997; Schmitt-Grohé, 1998)[v]. With the aim of simplifying the theoretical and empirical analysis, we may decompose the channels of transmission into two great groups: the financial channel and the trade channel.

The financial channel is related to the effects of the international interest rate on the level of capital flows to the emerging economies. This effect could be very significant as regards the size of fluctuations in the periphery for two reasons: 1) its determination is dominated by the economic conditions of the main center and thus they do not necessarily respond to the counter-cyclical needs of the emerging countries; 2) the high level of dependence on external savings by the emerging economies makes them very vulnerable to the perturbations in the international interest rate (Calvo, Leiderman and Reinhart, 1993).

In the trade channel, on the other hand, the effect of fluctuations in the business cycle of the leading economy (the US) is transmitted through the movements in the trade flows (due to changes in quantities as well as in the terms of trade).

The relative size of each channel will indicate the magnitude of the effect on the economy hit by the shocks. If the channel has a very small magnitude in relationship to the economy under study, shocks coming through it will have only moderate effects on the cycle. To summarize the previous analysis we present a simplified representation of the channels of transmission of cyclical fluctuations from US to the AC (Figure 1)[vi].

Figure 1 Channels of transmission of the US' business cycle



Where AC is the country associated to the dollar, i is the interest rate that prevails in AC and i* is the interest rate determined by the Federal Reserve.

Each country suffers from domestic shocks but the small associated country also receives the influence of external shocks that are transmitted from the main center (the US). The two channels of transmission are the financial channel (represented by the level of the US interest rate) and the trade channel (represented by trade between the two countries)[vii]. This effect can be decomposed into two stages represented by the complete lines: a) the impact of US' imports and of the Federal Reserve's interest rate on AC total exports and interest rate, respectively, and 2) the effect of these variables on the GDP of the associated country.

From the perspective of AC, the economic intuition behind this simplified representation of analysis for the transmission of economic shocks is as follows: the US' economy transmits its shocks through the trade channel and through the financial channel. When the US's GDP is hit by a positive shock, two simultaneous processes begin: a) US imports increase (affecting positively the GDP of AC through the trade channel), and b) the Federal Reserve increases the interest rate to slow down the economy to avoid over-heating (transmitting a shock through the financial channel that will affect negatively AC).

These hypotheses which refer to the mechanism of transmission of the business cycle may be formalized in the following expressions:

$$\frac{\partial M_{USA-AC}}{\partial GDP_{USA}} > 0 \quad (2) \qquad \frac{\partial i^*}{\partial GDP_{USA}} > 0 \quad (3) \qquad \frac{\partial X_{AC}}{\partial M_{USA-AC}} > 0 \quad (4)$$

$$\frac{\partial i}{\partial i^*} > 0 \quad (5) \qquad \frac{\partial GDP_{AC}}{\partial X_{AC}} > 0 \quad (6) \qquad \frac{\partial GDP_{AC}}{\partial i} < 0 \quad (7)$$

where X_{AC} represents AC total exports and M_{USA-AC} represents US' imports coming from the country dollarizing its monetary system.

In section 2 of the appendix we present the econometric estimations and/or bibliographic references that provide empirical support for the hypothesis of equations (2), (3) and (5). Equation (4) derives from the obvious fact that AC total exports depend positively on US imports from AC, while the hypotheses contained in equations (6) and (7) will be confronted[viii] in the empirical section of the paper when we apply this analytical framework to the case of Argentina.

4. The problem of the policymaker confronted with the alternative of dollarization

4.1. Theoretical framework

The adoption of a more rigid exchange rate system such as dollarization could reduce real volatility if it acted as an automatic stabilization mechanism of the economy. This is a very important issue since a risk averse policymaker will prefer a more stable growth rate since this reduces the country risk perceived by (also risk averse) investors.

To make an evaluation of the aggregate effect of dollarization, we use a unified framework that takes into account the different effects (from the financial point of view) that are associated with this asymmetric monetary union. We want to specify which are the necessary conditions to ensure that dollarization will increase social welfare. We assume that the policymaker wants to minimize a social loss function that represents the external and financial fragility of the country (Fanelli and Gonzalez Rozada, 1998), where the control variable is the degree of rigidity of the exchange rate system (d).

$$L_d = f\left[RD(d), H(d), RP(s_{GDP.AC}(d))\right] \qquad (\textit{Policymaker's social loss function}) \qquad (8)$$

where $RD(d)$ is the risk of devaluation, $H(d)$ represents the number of financial instruments available to compensate for (or cover against) real shocks to the economy (Helpman and Razin, 1982), $RP(s_{GDP.AC}(d))$ is the country risk (a positive function of the real volatility of domestic GDP) and d is a continuous variable representing the degree of rigidity of the exchange rate system[ix].

Differentiating the loss function with respect to d (under the assumption that, for example, this change takes the form of the conformation of an asymmetric monetary union such as dollarization) we obtain equation (9).

$$\frac{\partial L}{\partial d} = f_{RD}\frac{\partial RD}{\partial d} + f_H\frac{\partial H}{\partial d} + f_{RP}\frac{\partial RP(s_{GDP.AC}(d))}{\partial d} \qquad (9)$$

We find that the result will depend, as we expected, on the assumptions (to be tested econometrically) made about the signs of the different coefficients.

With respect to the signs of the coefficients involved we assume that:

$f_{RD} > 0$, (10) $\qquad f_H < 0$, (11) $\qquad f_{RP} > 0$. (12)

The sign of (10) is positive in as much as the social loss increases with the increase in the risk of devaluation. This risk characterizes the "bad" volatility that is related to the inflationary bias of the system when there is a discretionary monetary policy.
With respect to (11) its sign depends on the results from Helpman and Razin (1982) where a greater number of nominal financial instruments reduces the social loss since it allows for better risk diversification by allowing the fluctuations in the exchange rate that act as an instrument for the diversification of real risk.
Finally, equation (12) implies that, as with the risk of devaluation, the social loss increases when the country risk increases.
With respect to the rest of the partial derivatives from the different sources of social loss involved with respect to dollarization, we assume the following signs:

$$\frac{\partial RD}{\partial d} < 0 \qquad (13) \qquad\qquad \frac{\partial H}{\partial d} < 0 \qquad (14)$$

$$\frac{\partial RP(s_{GDP.AC}(d))}{\partial d} = \underset{(+)}{\frac{\partial RP}{\partial s_{GDP.AC}}} . \underset{(+/-)}{\frac{\partial s_{GDP.AC}}{\partial d}} \overset{>}{\underset{<}{=}} 0 \qquad (15)$$

In (13) we state that a movement towards a more rigid exchange rate regime such as dollarization reduces the space for independent policies by the central bank thus eliminating the risk of devaluation[x]. In equation (14) we simply indicate that dollarization reduces the set of available nominal financial instruments in the economy.
The central point in our analytical framework relates to the sign of equation (15) that will determine the final result of (9). The main problem is to determine the effect of dollarization on the country risk.
To find this result we need to remember our previous discussion on how the US' business cycle is transmitted through the financial channel (FC) and the trade channel (TC). Combining equations (4) and (6) we obtained the expected effect of a shock transmitted through the trade channel on the associated country's GDP:

$$\frac{\partial GDP_{AC}}{\partial M_{USA-AC}} > 0 \qquad (16)$$

In a similar fashion, combining (5) and (7) we may find the expression that summarizes the effect of the financial channel on AC's GDP[xi]:

$$\frac{\partial GDP_{AC}}{\partial i^*} < 0 \qquad (17)$$

Without loss of generality we present a functional form in which real volatility $s_{GDP.AC}$ depends on the relationship between the business cycles of the US and the associated country, and the relative importance of each channel. Thus we have the following expression:

$$\frac{\partial s_{GDP.AC}}{\partial d} = g\left[\left(VDS_{TC}\frac{IMP_{TC}}{|IMP_{TC}|} + VDS_{FC}\frac{IMP_{FC}}{|IMP_{FC}|}\right) r_{GDP_{AC/USA}}\right] \qquad (18) \quad \text{with } g' > 0 \qquad g'' < 0$$

where g is a monotonically increasing (at decreasing rates) function in the argument, VDS_{TC} and VDS_{FC} indicate, respectively, the participation of the trade channel and the financial channel in the volatility of AC's product, IMP_i represents the effect of each channel in the product of AC (thus, the ratio $IMP_i/|IMP_i|$ with i= (FC, TC) allows us to obtain the sign of the effect of a change in the variable that represents each channel of transmission[xii]) and $r_{GDP_{AC/USA}}$ indicates the correlation between the cycle of AC's GDP and the cycle of US' GDP[xiii].
Assuming the hypothesis of equations (2), (3), (16) and (17), equation (18) implies that:

1) In the case of the trade channel (TC), when the two economies are in an expansionary phase of the cycle (outputs are positively correlated), an increase in the demand in the US produces an increase in exports from AC towards the US. Since exports are a component of aggregate demand this works as an additional external positive impulse that gives an additional pull to the business cycle in AC. In this case the trade channel increases real volatility. On the contrary, if the cycles are negatively correlated, when AC is in a downward phase of the cycle the US is expanding. In this case an increase

in external demand for goods from the US implies an increase in exports from AC and, thus, a positive impulse in its GDP. In this case the trade channel reduces real volatility.

2) With respect to the financial channel, let us assume that the two economies were positively correlated and both expanding. In this case the increase in the interest rate by the Federal Reserve to avoid over-heating the US's economy would produce a similar effect in the economy of AC[xiv]. In this way, the cycle would be contained, reducing the range of fluctuation of the growth rates in AC. On the contrary, if the two economies were negatively correlated, that is when the US is growing the associated country is in recession, the increase in the Federal Reserve's rate would increase the downturn in the AC's economy.

Table 1 resumes the previous discussion. With synchronized cycles ($r_{GDP_{AC/USA}}$ *>0*) the financial channel (FC) reduces the volatility of the cycle and the trade channel (TC) increases it. On the contrary, with cycles negatively correlated, the FC increases real volatility and the TC reduces it.

Table 1 Change in the volatility of AC GDP

		Cyclical correlation	
Channel of transmission		$r_{GDP_{AC/USA}} > 0$	$r_{GDP_{AC/USA}} < 0$
TC	$\frac{\partial GDP_{AC}}{\partial M_{USA-AC}} > 0$	*A* - *real volatility*	*B* ¯ *real volatility*
FC	$\frac{\partial GDP_{AC}}{\partial i*} < 0$	*C* ¯ *real volatility*	*D* - real volatility

From this framework of analysis we may establish the following two propositions:

<u>Proposition 1:</u>

Assuming the usual mechanisms for the transmission of the business cycle in a center-periphery framework[xv], dollarization will reduce real volatility and thus the country risk if and only if one the following conditions are fulfilled: a) if correlation between business cycles is positive, the financial channel should dominate the trade channel. b) if the correlation between the cycles is negative, the trade channel should dominate the financial one.

In terms of equation (18) we have the following alternatives when we combine the possible results for each of the free variables of the equation[xvi]:

$VDS_{TC} > VDS_{FC}$ *and* $r_{AC/USA} > 0$ (19) $VDS_{TC} < VDS_{FC}$ *and* $r_{AC/USA} > 0$ (20)

$VDS_{TC} > VDS_{FC}$ *and* $r_{AC/USA} < 0$ (21) $VDS_{TC} < VDS_{FC}$ *and* $r_{AC/USA} < 0$ (22)

$VDS_{TC} = VDS_{FC}$ (23) $r_{AC/USA} = 0$ (24)

In the case of (19) and (22), dollarization will increase the real volatility of the GDP of AC ($s_{GDP.AC}$).

If, on the contrary, we verify that the cyclical behavior and the relative importance of the different channels correspond to expressions (20) or (21), dollarization will allow the associated country to import a monetary policy that will act as an automatic stabilizer of its economy, reducing $s_{GDP.AC}$.

Finally, if the channels have the same relative importance (equation 23) or if cyclical correlation is not significantly different from 0 (equation 24), then dollarization induces no effect on the associated country's real volatility.

The economic intuition in proposition 1 can be presented clearly through the following two examples:

<u>Case A (equation 19)</u>

If both countries were in recession when their cycles are synchronized ($r_{AC/USA} > 0$) and the trade channel dominates the financial channel ($VDS_{TC} > VDS_{FC}$), the fall in exports of AC to the US (due to reduced US's demand) would accentuate AC's domestic recession. Since the financial channel is of little importance the counter-cyclical policy that the Federal Reserve could be practicing in the US would not be enough to compensate the volatility amplifying effect of the trade channel. In this case, dollarization implies resigning an instrument (such as the exchange rate policy) that could act as a stabilizer of the business cycle reducing real volatility.

<u>Case B (equation 22)</u>

If the US' economy is expanding while AC's economy is in recession, the increase in the demand for AC's exports could smooth AC's recession. However, since the financial channel dominates, the counter-cyclical policy of the Federal Reserve increases the downturn in AC (since AC's interest rates will have to increase there too). Once again, dollarization implies losing the possibility of using a domestic counter-cyclical policy either to practice expansive policies or to compensate for the increase in the Federal Reserve's rate.

The economic intuition behind the other alternatives (equations 20, 21, 23 and 24) can be easily derived from the previous examples.

Proposition 2:

Dollarization will improve social welfare if the weight given by the policymaker (society) to the reduction in the aggregate risk (devaluation risk plus country risk) is greater than the loss of social welfare due to the reduction in the number of available instruments to cover for risk.

$$\frac{\partial L}{\partial d} < 0 \;\; si \;\; \underbrace{\underset{(+)}{f_{RD}} \underset{(-)}{\frac{\partial RD}{\partial d}}}_{(-)} + \underbrace{\underset{(+)}{f_{RP}} \left(\underset{(+)}{\frac{\partial RP}{\partial s_{GDP.AC}}} \underset{(+/-)}{\frac{\partial s_{GDP.AC}}{\partial D}} \right)}_{(+/-)} < \underbrace{- \underset{(-)}{f_H} \underset{(-)}{\frac{\partial H}{\partial d}}}_{(-)} \qquad (25)$$

The intuition is that given a certain level of loss due to the disappearance of an instrument for hedging the greater the reduction in the country risk, the smaller the reduction needed in the devaluation risk for dollarization to be welfare improving.

This framework for the analysis of the net benefits of dollarization is sufficiently general to be applied to the different countries. The only term which remains undetermined is the one that expresses the relationship between the degree of rigidity of the exchange rate and the economy's real volatility. Based on equation 18 the indeterminacy may be overcome by evaluating two central aspects of the relationship between the center and the periphery (that is established between the US and the associated country): a) Effect and relative importance of the different channels of transmission of the business cycle and b) level of coordination of the cyclical fluctuations of US and AC.

To obtain the information required in a) and b) it is necessary to put together the appropriate methodological tools for this kind of analysis. Next we present the methodological structure that we propose for the analysis of the transmission of the business cycle between a leader country and an associate one. This includes a VEC model to evaluate the sign and the magnitude the different channels of transmission, and an analysis of the cyclical correlation to verify the degree of synchronization between the associating economies.

4.2. Methodological tools

7.2.1 Vector error correction models. The way to deal with the sign and relative importance of each transmission channel.

Following the traditional methodology to analyze the structure of the different shocks that hit the economy[xvii], we build the vector error correcting model (VECM) to describe the way in which shocks are transmitted from the US to AC[xviii].

VAR models are used in the prediction of the series included in them and for the identification of the different kinds of shock, affecting the economies.

Our work makes use of the two tools derived from VAR models: impulse-response functions and variance decomposition procedure.

To use the impulse-response functions and the variance decomposition procedure it is necessary to identify the shocks for each and every variable in the system. In more general terms, n(n-1)/2 restrictions are needed to exactly identify the model (where n is the number of variables in the model).

For that purpose, one methodology that provides these restrictions is the Cholesky decomposition which imposes that the matrix A(0) (which incorporates the contemporaneous effects of the variables) be triangular inferior[xix].

Different authors have criticized the arbitrary methodology of imposing restrictions of identification on the Cholesky decomposition, indicating, for example, that the results in most cases (when there is correlation amongst the residuals of the equations) are very sensitive to the order in which the variables are included[xx].

Alternative solutions have appeared. Using the general structure of the VAR models, changes are introduced in the identification restrictions. Among them, the developments by Blanchard and Quah (1989) and Johansen (1991, 1995) stand out using long run restrictions to identify the different models.

However, there are noticeable differences as regards the reasons why restrictions are introduced in each methodology. While Blanchard and Quah (based on the supposition of a vertical aggregate supply curve in the long run) determine that demand shocks will not last, Johansen's methodology takes the long run restrictions from the data generating process without imposing ad-hoc behavioral restrictions on the different markets.

In this paper we use Cholesky decomposition to find short run identification restrictions[xxi] and Johansen's methodology to estimate long run relationships without having to impose a priori restrictions.

The structure of the model can be easily explained through the following example of a VEC with n variables and one lag for each variable[xxii].

Let:

$$z_t = \Gamma_1 z_{t-1} + e_t \qquad (26)$$

where z_t = the (nx1) vector $[z_{1t}, z_{2t}, z_{3t}, z_{4t}, ..., z_{nt}]$ of variables in the model

e_t = the (nx1) vector $[e_{1t}, e_{2t}, e_{3t}, e_{4t}, ..., e_{nt}]$ of gaussian errors

Γ_1 =an (nxn) matrix of parameters.

Subtracting z_{t-1} from each side of (26) and letting I be an (nxn) identity matrix, we get,

$$\Delta z_t = -(I - \Gamma_1) z_{t-1} + e_t, \qquad \text{or} \qquad \Delta z_t = p z_{t-1} + e_t \qquad (27)$$

where p is the (nxn) matrix $-(I-\Gamma_1)_t$ and p_{ij} denotes the element in row i and column j of p.

If each p_{ij} is equal to 0, the rank of the matrix p is 0 and (27) is equivalent to an n-variable unrestricted VAR in first differences.

On the other extreme if p is of full rank the long run solution to the system is given by the n independent equations:

$$
\begin{array}{l}
p_{11} z_{1t} + p_{12} z_{2t} + p_{13} z_{3t} + \cdots + p_{1n} z_{nt} = 0 \\
p_{21} z_{1t} + p_{22} z_{2t} + p_{23} z_{3t} + \cdots + p_{2n} z_{nt} = 0 \\
\quad . \qquad . \qquad . \qquad . \qquad . \qquad . \\
\quad . \qquad . \qquad . \qquad . \qquad . \qquad . \\
\quad . \qquad . \qquad . \qquad . \qquad . \qquad . \\
p_{n1} z_{1t} + p_{n2} z_{2t} + p_{n3} z_{3t} + \cdots + p_{nn} z_{nt} = 0
\end{array}
$$

In this case none of the series has a unit root, and the VAR may be specified in terms of the levels of all of the series.

If there are r<n vectors of cointegration, the VAR should be re-expressed in first differences with the inclusion of the r independent error correction mechanisms that establish the long run relationships between the variables.

Assuming that r=1, each sequence $\{z_{it}\}$ can be written in error correction form. For example, we may write Δz_{1t} as:

$$\Delta z_{1t} = p_{11} z_{1t-1} + p_{12} z_{2t-1} + p_{13} z_{3t-1} + \cdots + p_{1n} z_{nt-1} + e_{1t}$$

or, normalizing with respect to z_{1t-1}:

$$\Delta z_{1t} = a_1 (z_{1t-1} + b_{12} z_{2t-1} + b_{13} z_{3t-1} + \cdots + b_{1n} z_{nt-1}) + e_{1t} \qquad (28)$$

where a_1 determines the speed of adjustment to a long run dis-equilibrium, while the b_{1i} give us the coefficients which determine the long run relationship.

These results remain unchanged if we formulate a more general model by introducing the lagged first differences of each variable into each equation. In such fashion we obtain the following expression that includes the n equations of the model (assuming that there exists only one vector of cointegration, that is r=1):

$$\Delta z_{it} = a_i (z_{1t-1} + b_{12} z_{2t-1} + b_{13} z_{3t-1} + \cdots + b_{1n} z_{nt-1}) + \sum_{i=1}^{n} \sum_{j=1}^{k} y_{ij} \Delta z_{it-j} + e_{1t} \qquad (29)$$

where y_{ij} is a (nx1) vector of parameters for equation i and lag j.

Equation (29) represents a VEC model with n variables, one cointegrating vector and k lags for the variables in first differences.

We can use this type of VECM to evaluate the effect and relative importance of the financial and trade channels in the transmission of the business cycle from the US to an Associated country (AC).

7.2.2 Cyclical correlation analysis. ¿How synchronized are the GDP's of the US and AC?

The second element to be taken into account to determine why it is convenient for AC to undertake a process of dollarization is, according to the analytical framework we have presented in the previous sections, the association between the business cycle of AC and the cycle of the US.

There are numerous ways of empirically calculating the cyclical component of a series but the literature has not found a definition that is usually most adequate (Canova, 1995b; Crivari-Neto, 1993).

Given this theoretical disagreement we opt for presenting 4 different alternatives:

a) The cycle from the first difference of the series.
b) The cycle from the de-trending through the Hodrick-Prescott (1980) filter.
c) The cycle assuming a linear trend.
d) The cycle from a linear trend with an endogenous structural break (Perron, 1994).

In the following section we develop an empirical application of the analytical framework presented in this paper. We will use the methodology discussed above to assess the potential impact of dollarization on the real volatility of Argentina's economy.

5. An application to the case of Argentina

The selection of Argentina as a case of study relates to the fact that, in this country, dollarization has been subject to intense debate in political as well as academic spheres lately

For these motives, the analysis of the impact of dollarization on the real volatility of the Argentinean economy constitutes an empirical application of great relevance to the decisions of economic policy that relate to the monetary system of this country.

The empirical analysis consists of two stages. First, we present a vector error correction model (VECM) to examine the effect and relative importance of the trade and financial channels in Argentina.

Second, we examine the correlation between the business cycle of Argentina and the cycle of the US. The objective of this second part is to obtain an appropriate estimation of the coefficients of cyclical correlation to determine (together with the effects and relative importance of the different channels) the impact of dollarization on social welfare through its effect on country risk (which is a positive function of real volatility)[xxiii].

5.1. VEC model. Assessing the transmission channels.

We develop a vector error correction model with three variables[xxiv] (Federal Reserve Interest Rate (FEDRATE), imports of the US from Argentina (IMPOUA)[xxv] and the Industrial Production Index of Argentina (IPIARG)), and an intercept in each equation.

The variables are in logs, seasonally adjusted[xxvi] and in first differences[xxvii]. FEDRATE and IMPOUA represent the financial and trade channels respectively[xxviii].

The IPIARG is taken as an approximation of Argentine GDP. As we can see in the section 1 of the appendix, we use the Industrial Production Index instead of the actual GDP because there are no reliable estimations for Argentina's GDP on a monthly basis and because the correlation coefficients between these variables is extremely high.

The model is thus defined as follows:

$$\Delta z_t = \sum_{i=1}^{k} \Psi_i \Delta z_{t-i} + \Pi . z_{t-1} + m_t + e_t \qquad (30)$$

where: z_{t-1} = the (3x1) vector , Δz_t = the (3x1) vector , e_t = the (3x1) vector $[e_{1t}, e_{2t}, e_{3t}]$ of uncorrelated, homocedastic, gaussian errors, m_t = the (3x1) vector of the deterministic components, Ψ_i =an (3x3) matrix of parameters, and Π

is the (3x3) matrix of rank r (to be tested) which contains the parameters of the cointegrating vectors.

The next step consists in verifying the conformity of the model with the data generating process evaluating the order of integration of each variable, the rank of Π and the optimal lag length.

Unit root test

For each variable (in levels and in first differences) in the model we perform the ADF (Dickey and Fuller, 1979)[xxix] and Phillips-Perron (1988)[xxx] tests to detect the presence of unit roots in the series[xxxi].

In table 7 in section 4 of the appendix we present the results of the different tests for a confidence level of 95%.

We verify that almost all variables are I (1) (integrated of first order). There is a certain contradiction for the variable IPIARG[xxxii]. However, the results that indicate that the series is I (1) seem more robust since 83% of the tests for this variable (5 out of 6 different specifications for the ADF test and the Phillips-Perron test) state that its data generating process would be correctly represented by a random walk.

Since every variable can be considered I (1) we fulfill the first necessary condition for the construction of a VECM[xxxiii]. The second necessary requisite to build the model is that the rank of the matrix of the cointegrating vectors should be greater that 0 (zero) and less than n. For our model the rank of the matrix should be equal to 1 or 2.

Tests for the optimal lag length.

According to Canova (1995a) "*the trade-off between over-parametrization and oversimplification is at the heart of the selection criteria designed to choose the lag length* ".

There are different selection criteria to determine the optimal number of lags in VEC models. In this paper we use some of the more traditional such a Akaike criterion (Akaike, 1973), Schwarz criterion (Schwarz, 1978) and the Modified Likelihood Ratio Test (MLR test) (Sims, 1980)[xxxiv].

In all cases, the criteria select the number of lags that minimize a loss function that has implicit the trade-off described by Canova (1995a) in the previous reference. The main distinction between the different criteria is the relative weight given to the explicative power in relation to the degrees of freedom.

In tables 8 and 9 (included in section 5 of the appendix), we present the results of these tests[xxxv]. The optimal number of lags for our model is 2, 4 and 7 for Schwarz criterion, Akaike criterion and the MLR test, respectively.

To overcome this contradiction we perform an exhaustive analysis of the residuals through the joint evaluation of tables 10, 11 and 12 (also presented in section 5 of the appendix), which show the results for autocorrelation, heterocedasticity and normality tests on the errors.

Clearly, the best specification includes 7 lags in each variable, since it presents residuals that are less autocorrelated, with a distribution function that is closer to a normal distribution.

Establishing the number of cointegrating vectors

The third step in the construction of the VECM is to identify the number of cointegrating vectors (the rank of the Π matrix) to establish the long run relationships between the variables.

Postulating linear trends for the series, the results of the Johansen trace test (1988) (when we assume the existence of an intercept in the error correction mechanism) show the existence of 1 (one) cointegrating vector[xxxvi].

Table 2. Cointegration Analysis

	Trace Test for cointegrating vectors			
H_0 (number of cointegrating vectors):	Eigenvalue	Likelihood Ratio	5% Critical value	1% Critical Value
None *	0.173	33.47	29.68	35.65
At most 1	0.120	13.79	15.41	20.04
At most 2	0.005	0.57	3.76	6.65

Note: *denotes rejection of the hypothesis at 5% significance level

Having determined the specification for the model that best adapts to the joint data generation process, we proceed to evaluate the long run relationship and to obtain the impulse-response functions and the variance decomposition.

Analysis of the long run equation

From the estimation of the autorregresive vectors model in an error correction representation, with one cointegrating vector and 7 lags, we obtain the following long run relationship between the variables (normalized for IPIARG):

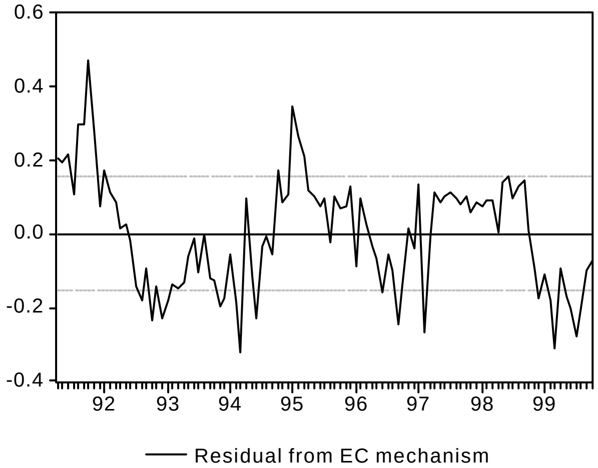
$IPIARG_t = 2.40 + 0.70*IMPOUA_t - 0.77*FEDRATE_t + \varepsilon_t$ (31)

(t-values) *(3.39)* *(2.94)* *(-2.20)*

As we can see, every coefficient is significative at a 95% confidence level and have the expected signs, according to equations (16) and (17) in our analytical framework.

However, to test the robustness of this long run relationship, it is necessary to evaluate two additional elements. First, the residuals of the error correction mechanism, presented in Figure 2, are stationary[xxxvii]. Second, the coefficients that represent the speed of adjustment for each equation with respect to the long run error are negative and less than 1 (one) in absolute value. This implies that the system will not be explosive.

Figure 2. Residuals of the Error Correction Mechanism included in the VECM



In table 13 (included in section 6 of the appendix) we present the results of the ADF and Phillips-Perron tests (with three different specifications for the deterministic component used in the equation of each test) according to which the residuals of the error correction mechanism are I (0).

Analyzing the different coefficients of the VECM we find that the coefficients that pre-multiply in each equation of the error correcting mechanism (which may be interpreted as the a_i in equation 29) fulfill the second requisite established above. More precisely, the coefficients of adjustment with respect to the deviation of the long run relationship for the equations of FEDRATE and IPIARG are -0.072 and -0.056, respectively. For the equation of IMPOUA the coefficient of adjustment is not significantly different from 0 at a 95% confidence level.

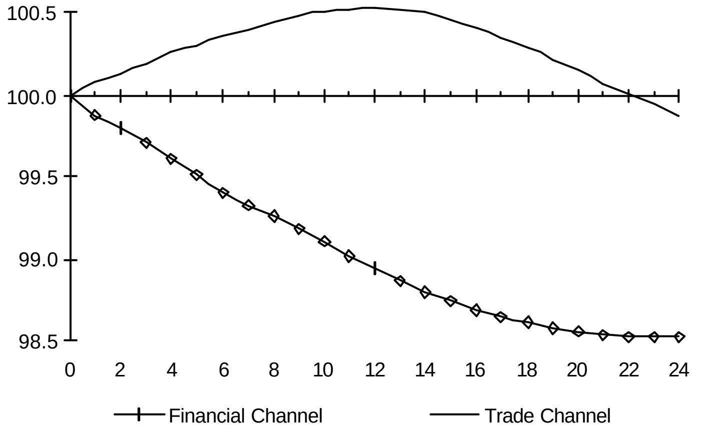
These results show the robustness of the long run relationship between IPIARG and the different channels of transmission of the business cycle and, at the same time, they present preliminary evidence in favor of the hypothesis established in equations (16) and (17) which will be tested in the next section, with the analysis of the impulse-response functions.

<u>Analysis of the effects of the trade and financial channel on IPIARG through impulse-response functions</u>

Examining the response of IPIARG to a shock of one standard deviation on FEDRATE and on IMPOUA we find the signs needed to determine the impact of the financial channel and the trade channel on Argentina's economy.

In figure 3 we see that the different channels affect IPIARG according to the hypothesis established in equations (16) and (17). The financial channel has a negative effect on IPIARG, while the trade channel has a positive effect on it.

Figure 3. IPIARG response to one standard innovation in:



Note 1: For better illustration we present the results normalized at 100 in i=0. Note 2: The standard deviation in the trade channel is of 13% (approximately U$S300 million) while in the financial channel the shock is of 2.5% (approximately 13 basic points).

It is important to highlight, the fact that there are important differences as regards the intensity and duration of these effects. As it can be seen in the previous figure, while the effect of shocks transmitted through the trade channel tend to disappear in the long run, shocks transmitted through the financial channel have a permanent effect.

This difference can be expressed more clearly by means of the following calculation:

Knowing that the monthly value added by Argentina's industry is slightly more than U$S 3,200 million and using a monthly effective rate of 0.5%[xxxviii], we calculate (for a 24 month period) the accumulated loss resulting from a shock of one standard deviation in FEDRATE and the accumulated gain of a shock of one standard deviation in IMPOUA. In both cases, we calculate for each period the difference between the value of IPIARG after the shock and the value that IPIARG would have had if the shock had not occurred. Then we capitalize these differences to obtain that accumulated loss and gain respectively. A shock in FEDRATE results in an accumulated loss of U$S 1,200 million while a shock in IMPOUA produces a U$S 440 million dollar gain[xxxix].

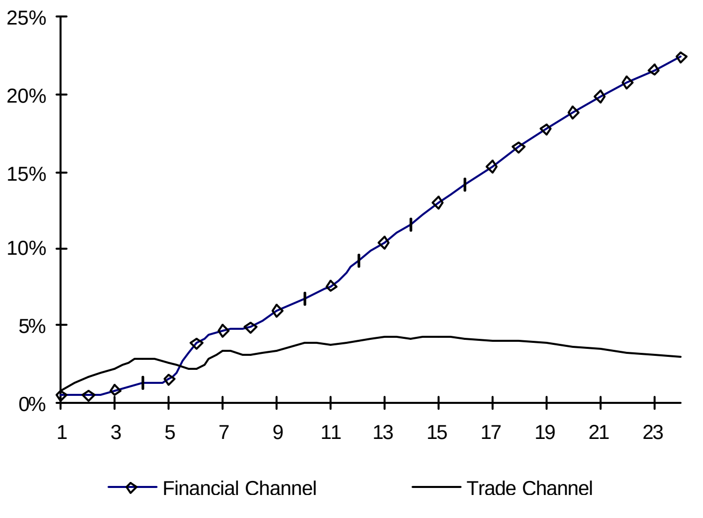
Next, we analyze the variance decomposition of a shock on IPIARG to obtain further results as regards the relative importance of the different channels of transmission of the business cycle from the US to Argentina.

Relative size of the different channels. A variance decomposition approach

The variance decomposition will allow us to estimate the relative importance of the trade and financial channels.

Figure 4 shows that the results of the variance decomposition are similar to those coming from the analysis of the impulse-response functions. The financial channel dominates the trade channel and the differences in explicative power between both channels increases in the long run.

Figure 4. Percent IPIARG variance due to:



While the trade channel can never explain more than 5% of total IPIARG variance, the financial channel explains almost 25% of this variance in the long run.
The joint analysis of the impulse-response and the variance decomposition indicate that in the event of a positive shock to the economy of the US, the negative impact of the increase in FEDRATE on IPIARG dominates the positive effect of the increase in IMPOUA.
In terms of equation (18) the final result of dollarization on real volatility will now depend on the sign of the coefficient of correlation between the cycles of Argentina and the US.
Given the previous results, if such coefficient is positive, dollarization could reduce real volatility. On the contrary, if the correlation between the cycles is negative, dollarization will increase the magnitude of cyclical fluctuations.
Sensitivity analysis
To evaluate the robustness of the results from the VECM, we implemented an analysis of sensitivity in three stages. These stages consist on examining the variability of the results of the model when we modify:

1) The short run restrictions (the order in which the variables are introduced in the VECM).
2) The specification of the deterministic component of the long run restrictions (the EC mechanism).
3) The sample used for the estimation of the model.

In the first case, the analysis responds to the criticism of some authors such as Leamer (1985) and Bernanke (1986) to the semi-automatic identification mechanism known as Cholesky decomposition. The criticism relies on the fact that the inferior triangular matrix that results from Cholesky's decomposition is unique only until it is pre-multiplied by an orthogonal matrix (Hamilton, 1994). This implies that there could exist up to n! (the number of possible permutations if the number of variables in the model is n) different results depending on the order in which the variables are included in the model.
If the covariance matrix of innovations is diagonal (that is, if shocks are not correlated), the ordering of the variables is irrelevant. In the opposite case, as indicated by Canova (1995a) and Enders (1995), one should check the sensitivity of the results estimating the impulse-response functions and the variance decomposition for every possible ordering, evaluating the dispersion of the results.
The second stage of the analysis has two parts. First we check once again, through Johansen's trace test, the number of cointegrating vectors for different specifications of the deterministic component. Secondly, we re-estimate the VECM with the different specifications for the deterministic component and evaluate the variability of the results of the impulse-response and variance decomposition of IPIARG.
In the last stage of the analysis of sensitivity we evaluate the temporal stability of the results using a rolling procedure[xl] similar to the one developed by Banerjee, Lumsdaine and Stock (1992) to analyze the shifting root hypothesis.
As a whole, the sensitivity analysis (presented in section 7 of the appendix) indicates that although there is a certain variability in the results (especially, the temporal instability of the trade channel effect on IPIARG from the impulse-response function[xli]), we can conclude that the results from the original VEC for the effect and relative importance of the different channels are strong and consistent.

5.2. Correlation between the cycles

According to our findings thus far (the financial channel, which affects negatively IPIARG, is relatively more important than the commercial one, which affects it positively) if the cycles are synchronized (positively correlated) dollarization would reduce the volatility of Argentina's business cycle (real volatility), reducing the country risk. This would be leaning the balance towards a position where the benefits of leaving the Peso would outweigh its costs (see equations 20 and 25).
Following the methodology presented in 7.2.2, we analyze the cyclical correlation between Argentina and US business cycle for the period 1991:1-1999:10
In table 3 we present the contemporaneous coefficients of correlation of the cycles of IPIARG and IPIUSA according to the 4 different specifications.

Table 3 Argentina's cycle - US's cycle
Contemporaneous correlation coefficients

		Industrial production index (ARGENTINA)			
		First difference	Linear trend	Linear trend with Endogenous Structural Break*	Hodrick-Prescott filter
Industrial production index (US)	First difference	0.088	0.035	0.018	0.030
	Linear trend	0.043	0.304	0.473	0.375
	Linear trend with Endogenous Structural Break*	-0.017	0.538	**0.568**	0.453
	Hodrick-Prescott filter	-0.142	0.478	0.334	0.329

Note: Overall mean 0.24. Specific mean 0.32 * For Argentina the structural break was detected in 95:2. For the US the break appeared in 93:8

In general, we find that for the period under analysis (1991:4 1999:10) the contemporaneous correlation between the business cycles of these countries is important and positive. The average value of the coefficient of contemporaneous correlation for the different specifications of the cycle is 0.24 (overall mean). Meanwhile, if we only take into account the combinations that belong to the principal diagonal on table 3 (that is, we analyze the correlation coefficients of the cycle calculated with the same specification for both countries) the average coefficient is even higher, 0.32 (specific mean).

It is necessary to take into account that the coefficients from table 3 result from the analysis of the data of the complete sample period. However, it is possible that the correlation between the cycle is not constant in time. If the correlation were unstable the results should be taken with care.

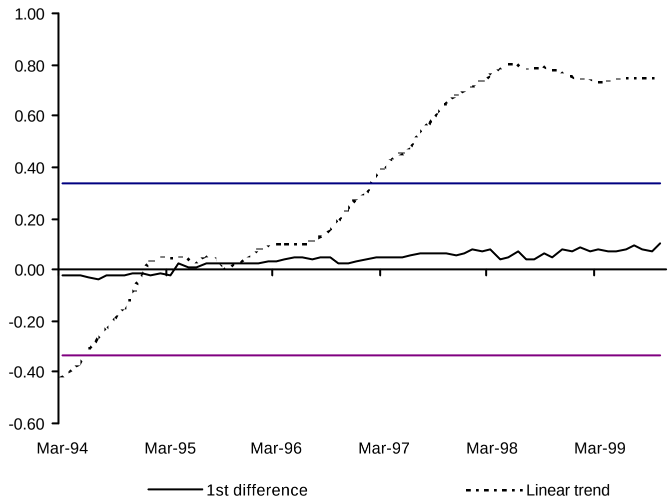
To evaluate the temporal evolution of the correlation between the business cycles we calculated the coefficients of correlation with a "rolling" methodology. Keeping the sample size fixed in 36 months (3 years), we calculated the coefficients of correlation changing the first and last element of the sample successively. Thus, the "rolling" coefficient of correlation associated with 94:3 includes data from the period 91:4-94:3, that associated with 94:4 includes data from 91:5-94:4, and so on[xlii]. Keeping the sample size fixed allows us to avoid the reduction in the weight of the marginal data point.

We calculated the "rolling" coefficients for all crossed-correlations for $-3 \le i \le 3$, that is for the contemporaneous period and for the combinations that go from having IPIUSA lead in 3 months IPIARG to having IPIUSA lag in 3 months IPIARG. The results are presented as the average of the series calculated for each specification of the cycle.

We analyze only two specifications: a) the first differences and c) assuming a linear trend. This allows us to establish extreme bands for the estimation of the cyclical correlation. The first one resulting from assuming a completely random trend in the series, and the other assuming, on the contrary, a completely deterministic trend for the series. These two specifications are presented in Figure 5.

Figure 5 Rolling crossed correlation coefficients

IPIARG - IPIUSA



Note: The horizontal lines indicate the upper and lower limits of significativity of the coefficients at a 95% confidence level.

While the "rolling" coefficient based on the first difference shows a relatively stable behavior in the period and very close to 0, the estimations based on assuming a linear trend show extreme volatility, although on average the coefficients are positive. This would confirm the previous results that indicate the existence of a significantly positive contemporaneous correlation between the business cycles of Argentina and that of the US.

The extreme volatility showed by the "rolling" coefficients in the short period under analysis raises serious doubts with respect to the usefulness of the most common specifications of the cycle (linear trend, for example) to define, with a certain degree of certainty, the question relating to Argentina's convenience to leave its domestic currency in favor of the dollar.

6. Conclusions

This study provides a non-traditional analytical framework for the evaluation of the convenience of an asymmetric monetary union (such as dollarization) between a leading country and another one which imports its monetary policy from the former, from the point of view of the country that resigns its monetary sovereignty.

The main objective of this paper is to evaluate how dollarization affects the real volatility of the country associating with the US, and thus, how the loss of the exchange rate instrument impacts on its country risk (which depends positively on real volatility). Bearing that in mind, we analyze the characteristics of the business cycles in both countries (the leader and the associated country) and the behavior of the trade and financial shocks transmission channels from the US.

There are two complementary visions in the literature to evaluate the convenience of a monetary union. The theory of optimal currency areas (OCA) states that, under conditions of symmetry of shocks, factor mobility, and price flexibility (amongst other conditions) it is efficient to resign the exchange rate instrument.

The complementary vision relies on a financial analysis, and highlights that a monetary union is efficient when the cost of losing an instrument for covering against risk (such as the possibility of making use of exchange rate policy) is smaller than the gains derived from reduced exchange rate volatility resulting from discretionary policies.

In this paper, we have found a more general expression for the analysis of dollarization from a financial point of view:

"Dollarization will improve social welfare if the weight given by the policymaker (society) to the reduction in the aggregate risk (devaluation risk plus country risk) is greater than the loss of social welfare due to the reduction in the number of available instruments to cover against shocks".

The main contribution of this paper has been to include in the analysis the effect of dollarization on country risk, through the impact of this asymmetric monetary union on (the economy's real volatility.

This relationship will depend on two central aspects: 1) the degree of synchronization between the cycles of the leader country and the associated one (AC), and 2) the effect and relative importance of the different shocks transmission channels from the leader to the AC.
Under a usual assumption regarding the way of transmission of the business cycle[xliii] the loss of monetary sovereignty of a country associating to the dollar will reduce real volatility if one of the following conditions is fulfilled:
a) That the business cycles of the US and of the associated country are positively correlated and that the financial channel is the main shocks transmission channel that has its origin in the US, or b) That the business cycles are negatively correlated and that the trade channel dominates the financial one.
In both cases the clue relies on that dollarization of the economy implies importing from the US a counter-cyclical policy which is adequate to reduce real volatility (one of the main determinants of country risk).
If, on the contrary, the cycles are negatively correlated and the financial channel dominates the trade one, dollarization implies adopting a monetary policy that increases real volatility, augmenting the probability of default and thus, resulting in a higher country risk. In such circumstances, it is advisable to keep a national currency that allows policy makers to use (albeit partially) a policy of automatic stabilization of the business cycle. The same recommendation applies to the case in which the correlation between the cycles is positive but the trade channel dominates the financial one.
In the empirical section of the paper we apply the model to evaluate the case of Argentina in the 1990's. The signs and magnitudes necessary have been estimated using a number of econometric tools that included several cyclical correlation coefficients and the development of a VECModel.
The main results have been :

1) The financial channel has a negative impact on Argentina 's output;
2) The trade channel impacts positively on Argentina 's output.
3) The financial channel dominates the trade channel (the financial channel is the main means of shocks transmission from the US).
4) These results are robust to several stability tests for the VECM: a) changes in short run restrictions, b) different specifications of the deterministic component in the long run relationships and, c) change in the sample of estimation.
5) The cycles of Argentina and the US are, on average, positively correlated.
6) The correlation between the cycles is unstable through the time and through different de-trending methodologies.
7) The correlation changes dramatically from negative to positive in the post-tequilla crisis.

In view of these results, the first impression is that dollarization in Argentina would reduce the devaluation risk and that it could also reduce the real volatility of the economy and consequently, the country risk.
However, in the case of Argentina such a strong result has to be interpreted very carefully.
First and foremost, due to cycles correlation instability, we need a strong and long term structural relationship in order to take such a hard change as dollarization. Are we sure that the present positive real correlation is a stylized fact? Could we be sure that canceling the option to escape (implicit in convertibility) we will obtain a positive correlation for ever? If correlation depends on real shocks, there is no guarantee at all. Why will we have the same idiosyncratic shock as that of the US if our productive structure is so different?
In the last recession initiated by the Asian crisis the Argentinean economy has been showing a behavior under its trend, while in the US the behavior has been above its trend. This was a typical crisis of competitiveness caused by competitive devaluations and a productivity growth smaller than that of the US. Could dollarization do anything about that? Searching examples in others dollarized economies is difficult. We cannot test the productivity growth of Panama properly since its economy is based on financial services and in a public sector with chronic deficit.
When deciding whether or not to dollarize an economy the social value attached to the loss of an instrument of risk diversification such as the exchange rate policy [xliv] has to be taken into account.
Furthermore, Argentinean policymakers should not take such an important decision without considering

other alternatives that could be even more convenient[xlv]. This issue requires, however, deeper (or further) discussion, which will be within the scope (or which will be the aim of our next research).

A list of pending topics for the analysis of an asymmetric monetary union should include at least the following lines of research: 1) The long run correlation of the shocks that affect the members of the union, 2) the distribution of shocks and their relative sizes, 3) the real exchange rate volatility in the leader country and in those countries associating to it, 4) the influence of currency substitution on the decision to form an asymmetric monetary union, 5) the determinants of the productivity evolution and the effects of the association on long run convergence, 6) comparative advantages in an asymmetric monetary union and its impact on factor reallocation, and 7) the effects of an asymmetric monetary union on the labor market.

The decision to dollarize implies a long run compromise from which it is almost impossible to retreat. There is no coming back from dollarization. For that reason, other factors (such as the previous ones) should be taken into account when taking such a decision.

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8. Appendix. The following test or figures indicated on the paper are available upom request. The extended version of this paper is available in www.finanzaslaplata.8K.com.ra

Unit Root Tests:
Table 7. ADF and Phillips Perron Tests for Unit Root
Test to determine the optimal lag length for the VEC model
Table 8. Information criteria; Table 9. Likelihood Ration Test, Table 10. P-values for Serial Correlation *LM Test on the VEC model residual*
Table 11. P-values for ARCH LM Test on the VEC model residual, Table 12. Std. Deviation, Skewness and Kurtosis of the VEC model residuals
Unit Root test for the residual from error correction mechanism.
Table 13. ADF and Phillips Perron Tests for Unit Root
Sensitivity analysis results:
Figure 6. IPIARG average response to one standard innovation in: a) Financial Channel, b)Trade Channel
Sensitivity of the variance decomposition.
Figure 7. Average percent IPIARG variance due to: a) Financial channel, b) Trade Channel
A) *Sensitivity of the results to a change in the deterministic component used to estimate the error correction mechanism*
B.1) Sensitivity of Johansen Trace test.
Table 14. Cointegration Analysis
B.2) Sensitivity of the impulse-response function.
Figure 8. IPIARG response to one standard innovation in: a) Financial channel b) Trade Channel
B.3) Sensitivity of the variance decomposition.
Figure 9. Percent IPIARG variance due to: a) Financial channel b) Trade Channel
B) *Sensitivity of the results to changes in the sample used to calculate the coefficients of the VECM*[2]
C.1) Sensitivity of the impulse-response function.
Figure 10. IPIARG average response to one standard innovation in: a) Financial Channel, b)Trade Channel
Figure 11. IPIARG Rolling average response to one standard innovation in:
a) Financial Channel b)Trade Channel
C.2) Sensitivity of the variance decomposition.
Figure 12. Average percent IPIARG variance due to Financial channel or trade channel

Endnotes

[2] For this analysis we take 44 "rolling" sub-samples with 60 observations each, beginning the estimation with the sub-sample that starts in 91:4 and ends in 96:3. The last sub-sample includes the period 94:11 99:10.

[i] The Stackelber leader-follower game is a good framework to study this kind of unilateral monetary union.

[ii] Since exchange rate changes (to modify relative prices) can help to absorb shocks in the presence of price rigidities or market imperfections (Roubini, 1999).

[iii] From the financial point of view we can make a distinction between "good" or "bad" nominal volatility of the exchange rate whether its origin is a "political" shock or a real shock (in preferences, in resources or in productivity). This last type of volatility is functional to the reallocation of factors and resources in an efficient way (Neumeyer, 1998).

[iv] An important assumption in this case is that there are adequate instruments for risk diversification within the countries but not amongst them. This is consistent with a context where there is a preference for domestic assets, or where there are no enforcement authorities at a supra-national level with fiscal institutions that could help diversify risk as national governments do.

[v] For a survey on the correlation of the macroeconomic aggregates in the countries of the OECD see Blackburn and Ravn (1991) and Backus et at. (1992) for a presentation in the context of the Real Business Cycle theory.

[vi] The signs and relative importance of the different channels will be analyzed in the empirical section of the paper using vector error correction models with cointegrating relationships, and different estimations of the cyclical correlation between the variables of interest.

[vii] The dotted lines synthesize the effects of the different channels on the GDP of the country associating to the dollar.

[viii] We will confront the hypotheses of equations (16) and (17) (to be presented in the following pages) which put together those in equations (4) and (6), and (5) and (7), respectively.

[ix] The sequence would be flexible exchange rate, "administered" or "crawling" exchange rate, flotation bands, traditional exchange rate fix, currency board and dollarization or, more generally, the use by a country of another country's currency.

[x] Levi Yeyati and Sturzenegger (1999) show that even dollarization could be reversed. They state certain conditions under which there are perverse incentives for the policymaker in a country that is receiving the dollars it needs to substitute its domestic money supply (sharing the benefits of senioriage). They show that under certain conditions, the policymaker may renounce the compromise and reinstate the domestic currency. However, this seems more a case of theoretical importance than of practical significance given the high punitive power of an agent such as the Federal Reserve.

[xi] In the empirical section we test the validity of the hypothesis of equations (16) and (17).

[xii] By dividing the value of the coefficient by its absolute value we exclusively keep the sign which is adequate since our objective is to isolate the result from the size of the effect.

[xiii] VDS_{TC} and VDS_{FC} will be proxied in the empirical section by the proportion of the variance of the output of AC that is explained by the trade and financial channel, respectively. The values for IMP_{TC} e IMP_{FC} will be obtained from the responses of AC's output to a shock in the trade and financial channel, respectively. Finally, $r_{GDP_{AC/USA}}$ will be proxied through different estimations for the coefficient of cyclical correlation between the United States' and AC's output.

[xiv] For an analysis of the negative association between the United States' interest rate and the level of activity in Latin American countries see Calvo, Leiderman and Reinhart (1993), Frenkel (1998), and Roubini (1999).

[xv] Hypotheses contained in equations (2), (3), (16) and (17) which will be checked and ratified in the empirical section and in section 3 of the appendix .

[xvi] It is important to remember that from the assumptions in equations (16) and (17), we already know the results for IMP_{TC} (positive) and IMP_{FC} (negative), so that the only free variables are VDS_{TC}, VDS_{FC} and $r_{GDP_{AC/USA}}$.

[xvii] See Sims (1980), Blanchard and Quah (1989), Johansen and Juselius (1992), and Amisano and Giannini (1997) for theoretical and empirical applications in which VAR or VEC models are used to identify the different shocks hitting an economy.

[xviii] In recent years there has been a great number of papers which study the transmission of the international business cycle using VAR modeling for the empirical analysis. Amongst the most interesting papers in this field of research we recommend: Calvo, Leirdeman and Reinhart (1993), Chamie, DeSerres and Lalonde (1994), Canova (1995a), Horvath, Kandil and Sharma (1996), and Schimitt-Grohé (1998).

[xix] For further detail see Hamilton (1994).

[xx] See Enders (1995).

[xxi] Knowing that under this kind of decomposition the identification of shocks is very sensitivity to the order in which the variables are included in the model, we also develop a sensitivity analysis for the results that includes 6 different orderings for the variables.

[xxii] Following the description presented by Enders (1995).

[xxiii] The empirical analysis takes as period of reference from April 1991 (91:4) to October 1999 (99:10), the last month for which data were available, with monthly periodicity, for every series used in the paper.

As a proxy for the financial channel, we use the Federal Funds Rate of the Federal Reserve of the United States (FEDRATE) from the FRED database. (using the monthly average of daily data) since amongst the available rates this is the one that best adapts to our analytical framework where the financial channel transmits the monetary policy shocks generated by the Federal Reserve when it uses the interest rate as an automatic stabilizer of the United States' economy.

The trade channel is proxied by imports of the United States from Argentina (IMPOUA) (or, symmetrically, exports from Argentina to the United States (the data come from the database of the U.S. Census Bureau, Foreign Trade Division).

As an approximation of the output we have used the Index of Industrial Production (IPI) for Argentina (the data come from the Economy Ministry of Argentina.) as well as in the United States (the data belong to the Federal Reserve Board's database (FRED database). We took as a proxy of the cycle of reference the IPI instead of the GDP because there are no trustworthy estimations of this last variable on a monthly periodicity. Anyway, both variables (IPI and GDP) present high correlation in levels as well as cycles calculated with the Hodrick-Prescott filter for de-tending, for both countries when using quarterly data . The coefficient of correlation between the cycle of Argentina's IPI and the cycle of Argentina's GDP (with quarterly data) are 0.865, while for the case of the United States the correlation between the cycle of the IPI and the cycle of the GDP (with quarterly data) is 0.876. On the other hand, the correlation between Argentina's IPI and Argentina's GDP (in levels, with quarterly data) is 0.840, whereas in the case of the United States the same correlation is of 0.991.

All the original series have been transformed through the application of the natural logarithm function. Afterwards, the series have been seasonally adjusted with the X-11 ARIMA procedure.
The series for the real volatility of Argentina's economy (ROLL_SD) results from estimating the standard deviation (SD) of the cycle of the Argentina's IPI (IPIARG) in "rolling" sub-samples of 20 data points.
For the analysis of the correlation of the business cycles in both countries we use the series IPIARG and IPIUSA, while for the construction of the VECM we work with the series IPIARG, EXPOAU and FEDRATE.
The different econometric procedures used in this paper were developed under RATS 4.3 for Windows.
[xxiv] The sample period for the model is 1991:4 – 1999:10 , with monthly data.
[xxv] Equivalently, exports of Argentina to the United States.
[xxvi] Through X-11 ARIMA method. For further details see section 1 of the appendix.
[xxvii] It is convenient to remember that in the error correction mechanism(s) the variables appear in levels and lagged one period.
[xxviii] In section 1 of the appendix we present the reasons for the sample period and for the variables included in the model. Also, we show the characteristics of the series (periodicity, transformations, etc.), the econometric software used (and the procedures) and the source of the information for each variable.
[xxix] The number of optimal lags for each specification was obtained following Akaike criterion (Akaike,1973).
[xxx] For this test we take the truncation lag recommended by Newey - West (1994) for monthly series.
[xxxi] We checked the following three specification for the deterministic component in both tests: 1) unrestricted, which includes time trend and intercept, 2) idem 1, but without the time trend, and 3) restricted, without any deterministic component.
[xxxii] Even when the variable is I (1) for almost all specifications (5 out of 6) for the ADF test as well as for Phillips-Perron test, when we include the time trend and the intercept in the equation, the Phiillips-Perron test indicates that the series is I (0).
[xxxiii] Recently, Pessaran et al. (1999) have proposed a new approximation to test the existence of long run relationships that is independent of the order of integration of the regressors.
[xxxiv] For further description of these tests, see Hamilton (1994).
[xxxv] Obtained, as usual, from an unrestricted VAR which includes the three variables of the model (FEDRATE, IMPOUA and IPIARG) expressed in levels.
[xxxvi] In section 7 of the appendix we present the results of the sensitivity analysis in which we evaluate the robustness of the estimations when altering certain assumptions of the model, amongst them the assumption of a linear trend in the series and the intercept in the error correction mechanism.
[xxxvii] Following Charemza and Deadman (1997), the existence of a cointegrating relationship between the variables requires as a necessary but not sufficient condition that the variables have the same order of integration (d). Besides, it is necessary that there exists a linear combination of these variables integrated of order d-1.Since in our case all five variables are integrated of order 1 (d=1), fulfilling the first condition, for the existence of a long run relationship we should find that a linear combination of the variables is integrated of order 0 (d-1=0).
[xxxviii] 0.5% is the approximate monthly effective rate taking into account the Federal Reserve rate was on average during the period 6%.
[xxxix] Remember that the accumulated gains and losses take into account only the effects of the trade and financial channels on wealth generated by the industrial sector.
[xl] Unlike recursive estimation (developed by Brown, Durbin and Evans,1975), the rolling coefficients are computed using sub-samples that are a constant fraction d_0 of the full sample. In this way we can keep constant the marginal weight of each observation.
[xli] See panel b) in figure 11 in section 7 of the appendix.
[xlii] We begin the "rolling" estimation in 94:3 since this is the first estimation that can be made including 36 months from the sample period under consideration (91:4 99:10).
xliii That is, a positive shock in the economy of the United States affects positively AC's GDP through the trade channel (through bigger imports for the United States) and negatively through the financial channel (due to the Federal Reserve's counter-cyclical policy). These hypotheses are analyzed and corroborated empirically in the paper.
xliv Within the Convertibility (a currency board) the instrument of risk edging is implicit in the possibility of leaving the monetary rule (temporarily or definitely) (i.e., the traditional restoration rule of Gold Standard that was the base of the controversy between Winston Churchill and John Maynard Keynes. See on this Mc Kinnon, 1996).
xlv For example integrating into a monetary union with Brazil (Argentina's main trading partner). In this alternative, Argentina would be trading off the benefits of avoiding an extreme bilateral exchange rate variability and the possibility of establishing a more leveled, symmetric union against the costs of importing Brazil's stronger domestic shocks.