XI

Volume XI, Number 1, May 2008

Journal of Applied Economics

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UNIVERSIDAD DEL CEMA
MCMLXXVIII
UCEMA

Edited by the Universidad del CEMA

Print ISSN 1514-0326
Online ISSN 1667-6726

Journal of Applied Economics. Vol XI, No. 1 (May 2008), 193-220

COMPUTING AND TESTING A STABLE COMMON CURRENCY FOR MERCOSUR COUNTRIES

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Submitted February 2005; accepted March 2007

This paper develops a stable common currency for mid-sized open monetary economies with incomplete markets in general and the Mercosur countries in particular. The proposed currency is constructed as a derivative of a dynamic portfolio of securities that proxies the nominal exchange risk factors for a set of monies and floats against the rest of the world's currencies. We find that the resulting optimal common currency is comprised of currencies with country weights that are statistically significant and fairly symmetrical with relatively equal weight (e.g., 22% Argentinean pesos, 27% Brazilian reals, 27% Chilean pesos, and 23% Uruguayan pesos). We also find that increasing the number of countries in a common currency tends to increase its stability. The willingness of Mercosur countries to participate in a monetary union is assessed from statistical moments of the density functions of the implied stable common currency and its components.

JEL classification codes: F15; F33
Key words: stable common currency, open monetary economies, regime switching models, Mercosur, currency basket

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I. Introduction

Nobel Laureate Robert Mundell (1961) and other academic researchers have long propounded the benefits of dollarization and currency unions that replicate the desirable features in welfare terms of an optimal currency area (OCA).[1,2] In an effort to avoid the economic turmoil associated with a volatile floating exchange rate regime, many countries have moved toward hard-currency pegs. For example, in recent years Ecuador and El Salvador adopted the U.S. dollar as their currency, Greece joined a currency union, and Argentina, Bulgaria, and Hong Kong implemented currency boards. In June 2003 Argentina's President Néstor Kirchner and Brazil's President Luis Ignacio Lula da Silva pledged to create a joint monetary institute to work toward the creation of an eventual common currency for Mercosur.[3] The idea of a common regional currency has been the subject of discussion for many years in South America – indeed, businesses and politicians have repeatedly called for the creation of a common currency in view of the negative economic and political effects of severe currency crises suffered by Brazil and more recently by Argentina (e.g., Eichengreen 1998, Levy-Yeyati and Sturzenegger 2000).

From a theoretical perspective Neumeyer (1998) has proposed a general equilibrium model of the role of money in open economies to show that a currency union in some cases can increase welfare. Net welfare gains are possible if the benefits from eliminating excessive volatility in the exchange and monetary markets due to future political shocks exceed the costs of reducing the number of financial instruments available in the economy necessary for allocational efficiency. In such cases, excessive fluctuations in price levels due to future political shocks are socially costly because they undermine real payoffs of nominal financial contracts, reducing their utility as hedging instruments against shocks. Of course, a practical

[1] See Buiter, Corsetti, and Pesenti (1998) for a critical survey.

[2] Dollarization is when a country uses a foreign currency in parallel or in place of its own sovereign currency. The term applies not only to the use of the U.S. dollar but to other foreign currencies also.

[3] Mercosur (Mercado Común del Sur) is a regional cooperative organization comprised of six LATAM countries. On March 26, 1991 the Asunción Treaty was signed by Argentina, Brazil, Paraguay, and Uruguay, which was later ratified on November 29, 1991. The original plan was to align the members' external tariffs by January 1, 1995, but there was little progress toward this goal until the signing of the Protocol of Ouro Preto in December, 1994. In recent years Bolivia and Chile joined the common market organization as associates. Venezuela recently joined as a regular member by political decision on December 2005.

issue is implementability, as determined by the existence a priori of minimum economic incentives to justify shifting to the new monetary rule. In this regard, anecdotal evidence would suggest that sufficient incentives exist in the Mercosur region to support a gradual transition towards a new, more stable monetary regime.

Our main goal is to construct a feasible common currency comprised of a basket of individual countries' currencies for mid-sized open monetary economies with incomplete markets in general and the Mercosur countries in particular. To our knowledge no previous studies propose a methodology for computing and testing a feasible common currency. As a theoretical framework, we adopt an intertemporally separable overlapping generations (ISOLG) version of Neumeyer's (1998) general equilibrium approach with incomplete markets (GEI). In this context the ideal security is defined as the common currency insulated from future political shocks yet capable of completing the markets dynamically.[4, 5] We show that a feasible ideal common currency can be computed by employing stable aggregate currency (SAC) methods recently developed by Hovanov et al. (2004). As such, our paper extends their work on major currencies of large, industrialized countries to mid-sized, open monetary economies with incomplete markets. More specifically, we construct the common currency as a minimum variance currency basket containing optimally-weighted amounts of the currencies of Mercosur countries. This optimal currency basket could be used to issue a single, common currency to which its value could be tied.

We demonstrate the computation of a common currency for Mercosur via simulation following Schmukler and Servén's (2001) broad interest rate parity decomposition of each member country's nominal exchange risk. The proposed common currency can be viewed as a derivative of an underlying dynamic hedging portfolio of securities that proxies the nominal exchange rate risk factors of a given set of currencies and floats against the rest of the world's currencies. The probability of currency depreciation is assumed to be determined endogenously in a second-generation escape clause model as in Jeanne and Masson (2000). Following the standard procedure in the second-generation literature of currency crisis, currency and country risk factors are modeled as a Markov-switching process. Our empirical

[4] Following the incomplete markets literature, an ideal security offers the best trade-off between risk reduction and an increase in the mean return among all income streams available in the marketed subspace of assets (e.g., see Magill and Quinzii 1998).

[5] Any equilibrium allocation can be reproduced with at least $H < S$ currencies, where H is the number of different types of agents, and S is the number of possible future states of nature (Geanakoplos et al. 1987, Geanakoplos and Mas-Colell 1989, and Talmain 1999).

results show that the implied Mercosur SAC satisfies the desired properties of an ideal common currency.

Finally, we assess the willingness of individual Mercosur countries to participate in the monetary union by comparing the stability of the implied Mercosur SAC to that of the individual Mercosur country currencies. In this regard, our results are consistent with Eichengreen (1998), who conjectured that sufficient incentives exist in Mercosur to adopt a monetary union. Because our model stresses the financial sector of the economy, this study constitutes a first step towards a more complete and comprehensive economic analysis of the costs and benefits of adopting a common currency in Mercosur.

The rest of the paper is structured as follows. Section II briefly reviews the OCA literature. Section III overviews theory and proposes a feasible common currency based on theoretical work by Neumeyer (1998) and analytical methods by Hovanov et al. (2004). Section IV describes the empirical methodology. Section V reports the estimation results and discusses their interpretation. Section VI concludes.

II. Literature review

For an excellent recent survey of the OCA literature, we refer the reader to Mongelli (2002). During the pioneering phase from 1960 to 1970, the desirable OCA properties were identified in terms of convergence of prices, as well as more diversification in production, consumption, and trade. The main difficulty with this initial phase is the lack of a unifying theoretical framework and, consequently, clear empirical approach. During the 1970s, a second set of theoretical contributions developed a meta-property (i.e., symmetry of real shocks) providing new insights in the analysis of the costs and benefits of adopting an OCA. With the slowdown in the process of the European monetary union (EMU), the development of a unifying theory lost momentum. In this period the discussion shifted to consideration of the benefits and costs of adopting a currency union. As such, the old OCA properties were reinterpreted leading to a new theory of optimum currency area. During the second half of the 1980s, the European report "One Market, One Money" extended the elements of the new theory of OCA to the desirable institutional features of the EMU. The current phase is empirical for the most part.

Unfortunately, empirical evidence on the welfare effects of a common currency is mixed. For example, Frankel and Rose (1998) and Rose (2001) have argued that monetary unions could become optimal ex post, even though individual countries do not meet the optimality criteria ex ante. These and other studies are backward looking and do not reflect a switch in policy regime. Thus, a crucial question is what type of expectations and forces might the monetary unification unleash? In this regard, two distinct paradigms can be distinguished – endogeneity versus specialization – with different implications in terms of benefits and costs.

The basic intuition of the endogeneity OCA hypothesis is that monetary integration reduces trading costs beyond exchange rate volatility. For example, Eichengreen (1998) and Levy-Yeyati and Sturzenegger (2000) concluded that, although Mercosur is far from having ex ante the necessary and sufficient conditions for a monetary union, its long-term ex post effects in terms of credibility gains could be potentially significant. Importantly, it could be a symbol of political and institutional commitment between countries (e.g., see Mussa 1997 and Cooper and Kempf 2000).

Krugman's specialization hypothesis postulates that, as geographical areas become more integrated, specialization in the production of those goods with comparative advantage results in net welfare gains. One problem with this argument is that specialization also entails vulnerability to exogenous supply shocks. In this respect Eichengreen (1994) contended that, in the presence of asymmetric real shocks, the case for a common currency union is significantly weakened (i.e., the cost of losing direct control over the monetary policy may be too high to obtain net welfare gains).

III. Common currency theory

This section overviews an intertemporally separable overlapping generations (ISOLG) version of Neumeyer's (1998) general equilibrium model. Due to its ability to capture complex dynamics in a parsimonious setting, the overlapping generation model is well suited to our problem of developing a stable common currency for Mercosur countries. In this regard, we should note that overlapping generations and cash-in-advance economies are equivalent in most respects (see Huo 1987). After a brief statement of the main theoretical assumptions, the concept of a feasible ideal common currency is formally proposed.

A. Mathematical preliminaries

Consider the following two-dated uncertain OLG exchange world economy with one perishable consumption good and $H \supset H_t \geq 1$ non-atomic intertemporal traders per generation, indexed in the interval [0, *h*], where H_t is the subset corresponding to each country *i* (or common purchasing power spatial unit) such that $i \in \boldsymbol{I} = \{1,\ldots, I\}$. In each period *t* there are $2H_t$ traders alive representing each country's young and old cohorts. Every young-age trader knows her present (state 0) endowment but faces at date 1 one of many *S* possible states of nature with respect to the realization of her old-age endowment with probability $\pi(s)$. Let the history of the economy at time *t* be summarized by the sequence $\eta_t \equiv [\, s_1,\ldots, s_t \,]$, where $s_c \varepsilon S$ is the realization of the state of nature in period τ. Each of the states at date 1 is determined by the realization of two types of shocks: 1) a set $\Sigma>1$ of economic factors (*fundamentals*) associated with the realization of each traders' endowment (i.e., intrinsic uncertainty); and 2) a set of $\Theta = \Theta_1 \times \cdots \times \Theta_I$ political factors (*sunspots*) generated in country *i* that influences monetary policy in country *j* (i.e., extrinsic uncertainty including the possibility of financial contagion $i \neq j$). Thus, the state space of the economy is equal to $\{0\} \cup S = \Sigma \times \Theta$, with $s = (\sigma, \theta)$ for every $\sigma \in \Sigma$ and $\theta \in \Theta$. Note that both sources of uncertainty are not necessarily independent. What matters for our analysis is the possibility of multiple rational expectations equilibria despite no intrinsic uncertainty. If these beliefs are shared by everyone, then price randomness may be self-fulfilling and will not necessarily dissipate even asymptotically, thereby leading to complex dynamics and periodic equilibria.

Assume that all traders have von Neumann-Morgenstern preferences represented by the following linear-quadratic functional:[6]

$$\forall x^h \in \Re^{(S+1)}_{++},\ U^h = u_0^h\left[\vec{x}^h(0)\right] + \sum_{s\in S} \pi(s)\left[u_s^h\left\{m_s \vec{x}^h(s) - \frac{1}{2}\alpha_h\left[\vec{x}^h(s)\right]^2\right\}\right], \quad (1)$$

where $1-\alpha_h m_s \sum_{h\in H} w^h(s) > 0$ for all $s \in S$ in order to preserve the usual neoclassical properties of monotonicity, quasi-concavity, and *C*-differentiability, with α_h denoting the idiosyncratic component, $w^h(s) \in \Re^2_{++}$ is the endowment vector of the generic trader *h* conditional on the state *s*, m_s is the common (income) component of the utility function, and $\vec{x}^h(s)$ is the trader *h* excess demand conditional on the state *s*.

Suppose that at time *t* the generic trader *h* born under η_t has access to *J* long-lived securities that are traded in the world financial markets — in particular, an

[6] Despite the well-known undesirable features of linear-quadratic preferences, they have the advantage of placing our model under the general framework of the well-known Capital Asset Pricing Model (CAPM) of financial economics, so that a closed-form with an equilibrium that has simple geometric properties can be attained.

indexed bond that pays a unit of the consumption bundle in every state (the nominal riskless asset), and a (risky) nominal bond denominated in each of the I fiat monies.[7, 8] Define the matrix $A\left[1/{}_j p(s)\right] \in \Re_+^{SJ}$, and let ${}_j p \equiv \left[{}_j p(0), {}_j \tilde{p}\right]$ be the general price level in currency j, where ${}_j \tilde{p} \equiv (p_1, \ldots, p_S) \in \Re^S$ is its uncertain component. Assuming no Ponzi schemes, a consumption plan is feasible if and only if it can be financed by a portfolio of financial assets holdings $y^h \in \Re^J$ with payoff matrix A. Provided that the matrix A has full column rank, there is a one-to-one relation between each attainable consumption allocation and asset portfolio. If traders are allowed to hold money, bonds, and goods of either country without restrictions (i.e., zero trading frictions), have identical preferences and constant foreign marginal costs (normalized to unity), then the optimal behavior of each trader only depends on the vector of prices p that holds worldwide. That is, a priori the law of one price holds worldwide for each state s and trader h such that:

$$\textit{for every } i, j, \textit{ and } k, \quad {}_j q_k = \xi_{ij}(0)_i\, q_k \tag{2}$$

$$\textit{for every } i, j, \textit{ and } s \in \{0\} \cup S, \quad {}_j p(s) = \xi_{ij}(s)\, {}_i p(s) \tag{3}$$

where $\xi_{ij}(s)$ is the nominal exchange rate of currency i in terms of currency j, and ${}_j q_k$ is the price of the asset k in currency j. In brief, for the generic trader h the budget set constraint is:

$$B^h(p,q) = \left\{ (x^h, y^h) \in \Re_+^S \times \Re_+^J : x^h - w^h = \begin{pmatrix} -q \\ A(p) \end{pmatrix} y^h \right\}. \tag{4}$$

The ISOLG economy specified so far is a member of the class of canonical general equilibrium Arrow-Debreu economies with incomplete markets (GEI) (Geanakoplos and Polemarchakis 1984). Geanakoplos and Shubik (1990) define a perfect foresight equilibrium (PFE) of the GEI as the tuple $\left(p, q, (x^h, y^h)_{h \in H}\right)$ such that the consumption allocations are attainable by transacting in the financial markets – for each trader h the consumption allocations are optimal within the set of all feasible consumption allocations, all markets clear, and a priori the law of one

[7] According to the incomplete markets literature, a long-lived security is defined as a security that can be traded in every period (see Magill and Quinzii 1998, and Talmain 1999).

[8] As pointed out by Neumeyer (1998), this scheme implicitly contemplates the existence of future contracts on the foreign exchange.

price holds worldwide. Let $\left(p,q,\left(x^h,y^h\right)_{h\in H}\right)$ be a PFE and preferences as in equation (1). Suppose that in equilibrium $\tilde{x}^h=\left(\tilde{x}^h;s\in S\right)$. Then an ideal security γ is the one that satisfies $Du_s^h\left(\tilde{x}_s^h\right)\times\gamma_s=I$ for each $s\in S$ and trader h (Geanakoplos and Shubik 1990).[9]

Note that, when evaluated in real terms, the matrix $A\left(p^*\right)$ is contingent on whatever determines the value of money (Geanakoplos and Mas-Colell 1989). It is now apparent that monetary policy has real effects because the price level determines the position of the market subspace. This gives rise to the well-known problem of indeterminacy of the nominal exchange rate in equilibrium, which has been extensively examined in the OLG literature (e.g., Kareken and Wallace 1981, Siconolfi 1991, King et al. 1992, and Barnett 1992).[1] Under these conditions, a fixed exchange rate is considered socially desirable if excessive price level volatility is eliminated. Furthermore, Cooper and Kempf (2001) have shown that, in a seignoriage game between governments, positive inflation is the dominant strategy. Hence, there is an incentive for the government to deviate from any pre-announced commitment rule. Consequently, in a world of forward looking agents, the ideal common currency should also constitute a symbol of political and institutional commitment between countries.

B. A feasible ideal common currency

Neumeyer (1998, pp. 256-257) shows that any monetary policy subject to political shocks supports an equilibrium that is Pareto inferior to the one corresponding to a monetary policy without such shocks. Let ${}_i\bar{M}\left(S\right)=\left\{\sum_\theta \pi\left(\theta|\sigma\right)\left[1/{}_iM\left(\sigma,\theta\right)\right]\right\}^{-1}$ be the quantity of money issued by the government of country i in the hypothetical scenario that the monetary policy is made independent of political shocks, with $\bar{M}=\left[{}_1\bar{M},\ldots,{}_i\bar{M}\right]\in\Re^s$ the vector of monetary policies in all the I countries. From Neumeyer (1998) we know that, when $\text{cov}\left[\left(1/{}_ip\right),\left(1/{}_jp\right)\right]=0$ for all i, j, the welfare gain of eliminating future political shocks reduces to:

[9] Because of the homogeneity property in equation (1), this asset is ideal by definition. Moreover, by duality, this asset gives the cheapest possible bundle given the price vector prevailing in each state and what is available in the economy at each point in time, rather than some fixed consumption bundle.

[10] The indeterminacy problem arises when each of local stationary sunspot equilibria corresponds to a consistent set of expectations.

$$\bar{u}^h - u^h = \sum_i \frac{\left[\operatorname{cov}\left(e^h, \frac{w_i}{{}_i\bar{M}}\right)\right]^2}{\operatorname{var}\left(\frac{w_i}{{}_i\bar{M}}\right)} \times \frac{\sum_\sigma \pi(\sigma)\operatorname{var}\left(\frac{w_i}{{}_iM}\middle|\sigma\right)}{\operatorname{var}\left(\frac{w_i}{{}_i\bar{M}}\right)}, \tag{5}$$

where $\bar{u}^h$ denotes the utility under $\bar{M}$, u^h the utility in equilibrium, and $e^h = w_1/H - w_1^h$ is a measure of heterogeneity across traders with w_1/H denoting the average world output for all *h*. If there is an ideal currency with constant price equal to one, then $w_i/{}_iM$ is the exchange rate between currency *i* and this benchmark currency, and $\operatorname{var}\left[\left(w_i/{}_iM\right)|\sigma\right]$ is the *i*th currency excess exchange rate volatility. Talmain (1999) also shows that, when the number of currencies is reduced to $H < S$, any allocation that could have been supported under a Pareto superior market structure can still be supported with only *H* currencies as long as the initial aggregate stocks of currencies are not identical to zero.

By assuming only the law of one price and non-arbitrage conditions, the intertemporal trader's decision problem in our CAPM economy can be reduced to a search process for the lower volatility bound of the stochastic discount factor (Hansen and Jagannathan 1991). We consider the minimum-variance, multi-currency numeraire developed by Hovanov, Kolari, and Sokolov (2004). These authors show how to compute a currency invariant value of an individual currency. By dividing the exchange rate for a currency by the geometric mean of a basket of currencies, the value of any currency is shown to be the same regardless of the base currency chosen. For example, the value of the U.S. dollar can be computed using any base currency (e.g., British pounds sterling, Japanese yen, etc.). The normalized value of a currency is useful in comparing the volatility of individual currencies and basket of currencies. It also permits the computation of a unique optimal, minimum-variance currency basket (i.e., dubbed SAC for stable aggregate currency) regardless of base currency choice. Using the same five hard currencies as contained in the International Monetary Fund's (IMF) Special Drawing Right (SDR) basket currency, these authors demonstrated that SAC has a standard deviation over the period 1981-1998 that is more than 10 times smaller than the SDR and about 40 times more stable than the U.S. dollar. Due to its stability over time, SAC is a potential candidate for the ideal common currency.

Let the currency basket be expressed as $AC(M_1,\ldots,M_I) = \{M_1[u_1],\ldots,M_I[u_I]\}$, with value $Val[AC(M);t] = \sum_{i=1}^{j} M_i Val([u_i];t) = \left(\sum_{i=1}^{j} M_i \xi_{ij}(t)\right) Val([u_j])$, following notation in Hovanov et al. (2004). After some manipulation:

$$\frac{Val\left[AC(M);t\right]}{Val\left[AC(M);t_0\right]}\sqrt[i]{\prod_{i=1}^{I}\frac{\xi_{ij}(t_0)}{\xi_{ij}(t)}}=\sum_{i=1}^{I}z_i RNVal_i\left(t/t_0\right) \tag{6}$$

where $RNVal_i\left(t/t_0\right)$ for all $i = 1,\ldots,I$ and all $t = 1,\ldots,T$ is the reduced (to one at $t = 0$) normalized value in exchange, and $z_i=\frac{M_i\xi_{ij}(t_0)}{\sum_{i=1}^{I}M_i\xi_{ij}(t_0)}$ is the vector of non-negative weights. This normalized value of any particular currency (or currency basket) is invariant to base currency choice (i.e., valuing the dollar in terms of yen or pounds or other currencies yields the same index dollar value). We employ the currency invariant value of the *i*th currency, or $RNVal_i\left(t/t_0\right)$, to later compare the values and volatility of Mercosur currencies (and a Mercosur currency basket) over time.

Given the exchange rate time series $\xi_{ij}(t)$ for all $i \neq j$ and fixed sample period $[1,T]$, the minimum variance currency basket (MVCB) $AC(M^*)$ for a fixed set of monies is calculated by searching the optimal weight vector z^* that solves the following optimal control problem:

$$\underset{z\in\Re_{++}}{Min}\left\{\mathrm{var}(z)=\sum_{i,j=1}^{I}z_iz_j\,\mathrm{cov}(i,j)=\sum_{i=1}^{I}w_i^2s_i^2+2\sum_{\substack{i,j=1\\ i<j}}^{I}z_iz_j\,\mathrm{cov}(i,j)\right\}, \tag{7}$$

such that $z_i \geq 0$ for all $i=1,\ldots,I$ and $\sum_{i\in I}z_i=1$, where $\mathrm{cov}(i,j)$ denotes the covariance between $RNVal_i(t/t_0)$ for all $RNVal_j(t/t_0)$ and s_i^2 denotes the variance of $RNVal_i(t/t_0)$ for all $i,j=1,\ldots,I$ and all $t=1,\ldots,T$. We utilize this procedure to compute an optimal, stable aggregate currency (SAC) for Mercosur that can be used as the ideal common currency.

Proposition 1: *Given a GEI economy with PFE, let the measure of gain in welfare be defined as in equation (5). Then for each trader h solving the optimal control problem in equation (7)* $AC^*=AC(M^*)$ *is an ideal (Pareto efficient) security.*

Proof: It follows immediately from our previous analysis. **Q.E.D.**

IV. Empirical methodology

In this section we describe the empirical methodology used to construct SAC for three of the Mercosur countries (i.e., Argentina, Brazil and Uruguay) and one associate country (i.e., Chile). We do not include Paraguay (a member) and Bolivia (an associate) because of data limitations. The analysis starts by computing the

SAC for the two biggest economies of Mercosur: Argentina and Brazil. Then we add the other member Uruguay and associate country Chile. This procedure permits us to answer the following question: if the Mercosur countries decide to build a stable basket currency, does the stability of the basket increase with the number of countries included in the basket?[11] The sample period covers the major financial crises of the 1990s and early 2000s (including Argentina's technical default). Details of the dataset are presented in the Appendix. Summary statistics are presented in Table 1.

One problem that we face in constructing SAC for Mercosur countries is that some currencies were floating and others pegged during the sample period. Also, different exchange rate regimes were used by some countries over time. Consequently, we seek to construct a time series of implicit exchange rates that reflect the risk factors involved in the currencies. For this purpose we follow Schmukler and Servén's (2001) broad version of interest rate parity, in which the change in the forward exchange rate can be expressed as:

$$m_{f,t} = i_{i,t} - i_{j,t} = \textit{currency premium}_t + \textit{country premium}_t, \tag{8}$$

where

$$\textit{currency premium}_t = \Delta e_{ij,t} + s(e_{ij})_t \quad \forall i \neq j, \tag{9}$$

$$\textit{country premium}_t = EMBI_t + \textit{onshore premium}_t, \tag{10}$$

$\Delta e_{ij,t}$ denotes the expected depreciation of currency *i* with respect to currency *j*, $s(e)_t$ is the exchange risk premium for currency *i* in terms of currency *j* (i.e., the compensation demanded by risk averse investors due to innovations in exchange rate), and the *i*th *country premium* is decomposed into a pure sovereign default premium (proxied by some sovereign bond equivalent yield, or $EMBI_t$) and the *onshore premium* or liquidity cost (i.e., Engel's 1992 risk and liquidity premiums, respectively). The *onshore premium* reflects the risk and cost derived from shifting assets across jurisdictions. Conceptually, the total differential between interest rates on domestic-currency loans issued by domestic borrowers and those on foreign-currency loans issued by foreign borrowers reflects both currency and country risk premia. The latter refers to the gap between borrowing costs of domestic and foreign borrowers in a common currency because of the jurisdiction of issue.

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[11] We thank an anonymous referee for this recommendation.

Table 1. Summary statistics for the currency and country risk premiums

Country	Sample size	Mean (%)	Standard deviation	Min (%)	Max (%)	Skew-ness	Excess kurtosis	Standard error	Jarque-Bera test	Ljung-Box test
$\Delta e_{ij,t}$										
Argentina	101	-2.29	13.30	-18.15	80.00	4.28	20.30	0.0995	2042	65
Brazil	84	8.88	31.80	-21.31	163.77	3.16	11.17	0.1098	570	54
Chile	101	0.53	2.96	-5.08	11.19	0.52	0.69	0.0995	6	79
Uruguay	101	20.99	15.67	1.99	87.51	1.33	2.74	0.0995	62	250
Log $EMBI_t$										
Argentina	101	1111	1201	294	6802	3.03	8.93	0.0995	490	253
Brazil	101	846	281	360	1579	0.34	-0.39	0.0995	3	241
Chile	101	220	81	87	489	0.87	0.95	0.0995	16	272
Uruguay	101	195	166	21	1344	4.38	24.51	0.0995	2851	112

Currency Premium

Correlation Matrix (sample period 01/1994 - 06/2002)

	Argentina	Brazil	Chile	Uruguay
Argentina	1	-0.03	0.06	0.16
		(0.34)	(0.62)	(1.58)
Brazil		1	0.37	0.19
			(3.94)	(1.98)
Chile			1	0.36
				(3.85)
Uruguay				1

Correlation Matrix (sample period 10/1994 - 12/2000)

	Argentina	Brazil	Chile	Uruguay
Argentina	1	-0.33	0.01	-0.38
		(2.96)	(0.13)	(3.48)
Brazil		1	0.12	0.71
			(1.00)	(8.55)
Chile			1	0.34
				(3.13)
Uruguay				1

Table 1. (Continued) Summary statistics for the currency and country risk premiums

Country Premium

Correlation Matrix (sample period 01/1994 - 06/2002)					Correlation Matrix (sample period 10/1994 - 12/2000)				
	Argentina	Brazil	Chile	Uruguay		Argentina	Brazil	Chile	Uruguay
Argentina	1	0.34	-0.04	0.80	Argentina	1	0.81	0.74	0.16
		(3.65)	(0.42)	(13.32)			(11.94)	(9.43)	(1.36)
Brazil		1	0.82	0.31	Brazil		1	0.95	0.44
			(14.20)	(3.30)				(27.13)	(4.21)
Chile			1	0.01	Chile			1	0.53
				(0.10)					(5.32)
Uruguay				1	Uruguay				1

Notes: This table reports the summary statistics for: 1) the monthly currency premium or expected depreciation of currency *i* with respect to currency *j*, annualized, and continuously compounded; and 2) the monthly country premium measured in basis points. The sample period is 01/1994 to 06/2002, except for Brazil, which starts from 07/1994. The interest rate differentials are calculated as the log difference between the home country short-term interbank bond equivalent yields and the equivalent U.S.dollar-denominated LIBOR. The Jarque-Bera normality test follows follows a χ_2. The Ljung-Box autocorrelation test follows a χ_{12}. The $t_{(0.05/2)}$-values are in parentheses.

The former refers to the gap between the domestic-currency and foreign-currency interest rates faced by a given borrower because of currency denomination.

Consistent with the escape clause models literature (see Jeanne and Mason 2000 for details), we use a regime-switching E-GARCH model to estimate the variance-covariance matrix Σ for both the currency and country risk components of the implied exchange rate. This model can be generally written as the following AR(q) process (Hamilton and Susmel 1994, Susmel 2000, and Klaassen 2002):[12]

$$e_t = f(x_t|\beta) + v_t \text{ with } v_t|\Psi_{t-1} \sim D(0, h_t), \tag{11}$$

$$\ln h_t = \sum_{i=1}^{q} a_i |u_{t-i}| / \sigma^2(s_{t-i}) + \mu\, u_{t-1} / \sigma^2(s_{t-1}) + E_t[\ln h_{t-1}|s_t] \text{ with } u_t = \sigma(s_t) h_t^{1/2} \varepsilon_t, \tag{12}$$

where $f(x_t|\beta)$ denotes the mean dynamics of the stochastic process, x_t denotes the vector of M explanatory variables, including the order-q lagged values of the dependent variable, β is an M x 1 vector of parameters, Ψ_{t-1} is the information set at time $t-1$, v is the error term which follows some conditional distribution on Ψ_{t-1}, and $\varepsilon_t \sim i.i.d.(0,1)$. The conditional errors have zero mean and a time-varying variance h_t, which follows a general regime-switching E-GARCH (K,q) process with K given states and q autoregressive lags.[13] The terms σ^2, a's, and μ are the regime shift, autoregressive, and asymmetric scale parameters of the GARCH structure, respectively, with the state variable s_t described by the following Markov chain:

$$\Pr(s_t = j | s_{t-1} = i, s_{t-2} = 1, \ldots, y_{t-1}, y_{t-2}, \ldots) = \tag{13}$$

$$= \Pr(s_t = j | s_{t-1} = i) = p_{ij} \quad \forall i, j = 1, 2, \ldots, K$$

Since s_t is a hidden layer, the best way to make an optimal inference about the current regime of the observed process is through the implementation of Hamilton's (1989, 1990) nonlinear expectation maximization (EM) algorithm.

[12] The autocorrelation coefficient allows for the nonsynchronous trading effect in the market instruments that make up the currency invariant index.

[13] As shown by Klaassen (2002), this approach has the advantage over the E-SWARCH model that it is nested in the general class of GARCH models.

With the key output variables parameterized as regime-switching RS/E-GARCH (K,q) processes, the final step in the empirical construction of an implied SAC is to simulate different price paths for the variables solving simultaneously the stochastic optimal control problem in equation (7) via a structured Quasi-Monte Carlo numerical approach.[14] The controls are the weights of the ex ante misalignments of the implied exchange rates calculated as the log difference of the total exchange risk and its geometric mean. The implied forex series (per U.S.dollar due to measuring interest rates and sovereign debt yields in dollar terms) are simulated by limiting the correlation effects to the country risk component of the total exchange rate risk. The intra-temporal correlation matrix is obtained from the residuals of the RS/ E-GARCH estimates. The inter-temporal correlations are recovered from the AR component of the GARCH structure. The jumps between high and low volatility regimes are approximated by a binomial distribution.

V. Empirical results and discussion

First, we present stylized facts. Following work by Engel and Hamilton (1990) on exchange rates, our starting point is to test the null hypothesis of a unit root with drift versus the alternative hypothesis of nonlinear trend stationarity (or segmented trends). For this purpose we use Bierens' NLADF test on the eight time series (i.e., the currency and country risk premiums for each of the four countries). In order to correct for the size distortion problem, we progressively increase the order of the AR(q) term in the Chebychev polynomial of the ADF regression. Also, to improve the power of the NLADF test, we simulate the *p*-values. In unreported results we find support for Engel and Hamilton's (1990) "long swings" hypothesis.

Tables 2 and 3 provide the best econometric specification for the currency risk and country risk factors. Consistent with the nonlinear trend stationary hypothesis, the presence of a switching structure in the mean of the conditional variance equation reduces the significance of the GARCH effect. Figure 1 plots the smoothed transition probabilities of visiting the high probability regime of a currency depreciation. Figure 2 plots the smoothed transition probabilities of visiting the

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[14] Because the standard Monte Carlo method asymptotically becomes a deterministic quadrature scheme (see e.g., Judd 1998), we use a sampling technique known as Latin square or Latin hypercube to generate sub-random number sequences to fill more uniformly the exceedingly sparse *n*-dimensional space at a very low computational cost. Optimal control problems of the type at hand are known to be NP-hard, especially if the deterministic component is assumed to be highly nonlinear and the number of variables under analysis is very large.

high sovereign's debt default risk regime. We find a statistically significant asymmetric GJR-type effect of (negative) news concerning the conditional volatility of the currency factor risks in Argentina and Brazil. During the sample period, the results also suggest that, besides market integration, Mercosur countries were subject to some form of financial contagion.

Table 2. Quasi-maximum likelihood estimates for the currency risk premiums

$$\Delta y_t = \alpha_0 + \phi \Delta y_{t-1} + v_t, \; v_t | \Psi_{t-1} \sim D(0, h_t)$$

$$\ln h_t = \sum_{i=1}^{q} a_i |u_{t-i}| / \sigma^2(s_{t-i}) + \mu u_{t-1} / \sigma^2(s_{t-1}) + E_t[\ln h_{t-1} | s_t], \; u_t = \sigma(s_t) h_t^{1/2} \varepsilon_t, \text{ and } u_t = \sigma(s_t) h_t^{1/2} \varepsilon_t$$

	Argentina	Brazil	Chile	Uruguay
α_0	0.0906 [0.6100]	-0.3203 [0.2540]	0.0088 [0.9640]	-0.4028*[0.0810]
SE	[0.1773]	[0.2791]	[0.1961]	[0.2288]
ϕ	0.0792**[0.0000]	0.0043**[0.0000]	-0.1085[0.5020]	-0.0971*[0.0510]
SE	[0.0076]	[0.0000]	[0.1610]	[0.0493]
$\sigma^2(1)$	0.9439**	10.0525**	2.5031**	1.2496**
SE	[0.3117]	[1.7464]	[0.4140]	[0.2118]
$\sigma^2(2)$	6.2487**	5.7430**	0.6554**	5.9564**
SE	[0.9048]	[0.7314]	[0.2511]	[0.4788]
a_1	1.1580** [0.0000]	1.1036* [0.0690]	0.1521 [0.5830]	0.2274 [0.2950]
SE	[0.1987]	[0.6013]	[0.2767]	[0.2162]
μ	0.2381**[0.0020]	-0.6718**[0.0000]	0.9826 [0.7660]	0.4136 [0.4900]
SE	[0.0776]	[0.0727]	[3.2952]	[0.5975]
p(1,1)	0.9731	0.8632	0.9219	0.9423
p(2,2)	0.8531	0.9354	0.9468	0.7294
Log - likelihood	-271.8190	-351.3990	-228.7580	-278.3920
Distribution	Student-*t*	Student-*t*	Normal	Student-*t*
Jarque - Bera test	19.8424 [0.0000]	9239.27 [0.0000]	1.3883 [0.4990]	198.3450[0.0000]
Ljung-Box Q(12) - ε	15.3819 [0.2210]	41.5294 [0.0000]	34.2541[0.0000]	8.2810 [0.7620]
Ljung-Box Q(12)- ε^2	19.1741 [0.0840]	14.7344 [0.2560]	10.6987[0.5540]	0.8059 [0.9990]
LM-test	1.6242 [0.2020]	0.0774 [0.7800]	1.8985 [0.1680]	1.3139 [0.2510]

Notes: This table reports the quasi-maximum likelihood estimates of a regime-switching E-GARCH (2,1) model for the currency risk factors for Argentina, Brazil, Chile, and Uruguay. The sample period is 01/1994 to 06/2002. Asymptotic standard errors (SE) are in brackets below the parameter estimates. The pvalues are shown in brackets beside the parameter estimates. The CM test follows a $\chi 1$ with null H_0 nonlinear functional form is adequate for the DGP. Distribution denotes the distribution of the conditional errors. The Jarque-Bera normality test follows a χ_2. The Ljung-Box autocorrelation tests follows a χ_{11}. Asterisks indicate significance at the following levels: ** 5% level and * 10% level.

Table 3. Quasi-maximum likelihood estimates for the country risk premiums

$$\Delta y_t = \alpha_0 + \phi \Delta y_{t-1} + v_t, \; v_t | \Psi_{t-1} \sim D(0, h_t)$$

$$\ln h_t = \sum_{i=1}^{q} a_i |u_{t-i}| / \sigma^2(s_{t-i}) + \mu u_{t-1} / \sigma^2(s_{t-1}) + E_t [\ln h_{t-1} | s_t], \; u_t = \sigma(s_t) h_t^{1/2} \varepsilon_t, \text{ and } \varepsilon_t \sim i.i.d.(0,1)$$

	Argentina	Brazil	Chile	Uruguay
α_0	-11.0222[0.3980]	-11.4515[0.2500]	-5.1214**[0.0400]	0.8851 [0.8000]
SE	[12.9968]	[9.9115]	[2.4647]	[3.4930]
ϕ	-0.0203 [0.9020]	-0.1214 [0.3030]	-0.0288 [0.8260]	-0.0123 [0.9520]
SE	[0.1647]	[0.1172]	[0.1309]	[0.2068]
$\sigma^2(1)$	12.2485**	8.8446**	8.2741	6.63214**
SE	[0.8871]	[0.7115]	[0.4991]	[0.3447]
$\sigma^2(2)$	8.8913**	11.0591**	5.7993	6.63214**
SE	[0.7075]	[0.5198]	[0.3546]	[0.3447]
a_1	0.3557 [0.2420]	-0.2019 [0.4010]	0.1371 [0.5460]	0.5299 [0.2370]
SE	[0.3023]	[0.2396]	[0.2263]	[0.4452]
μ	-0.2392 [0.6930]	-0.2202 [0.7640]	-0.0304 [0.9870]	-0.6673 [0.4370]
SE	[0.6055]	[0.7323]	[1.8810]	[0.8552]
p(1,1)	0.8449	0.9409	0.9465	NA
p(2,2)	0.9406	0.9564	0.9660	NA
Log – likelihood	-608.7450	-641.6540	-488.8570	-439.9130
Distribution	Student-*t*	Student-*t*	Student-*t*	Student-*t*
Jarque - Bera test	20.2798 [0.0000]	20.9457 [0.0000]	45.2515 [0.0000]	31.6137 [0.0000]
Ljung-Box Q(12) - ε	7.9413 [0.7890]	8.9431 [0.7070]	7.7037 [0.8070]	16.5830 [0.1650]
Ljung-Box Q(12)- ε^2	16.1759 [0.2310]	10.8888 [0.5380]	18.8472 [0.0920]	5.3175 [0.9460]
CM-test	0.7683 [0.3800]	0.0424 [0.8360]	1.8985 [0.1680]	0.5008 [0.4790]

Notes: This table reports the quasi-maximum likelihood estimates of a regime-switching E-GARCH (2,1) model for the currency risk factors for Argentina, Brazil, Chile, and Uruguay. The sample period is 01/1994 to 06/2002. Asymptotic standard errors (SE) are in brackets below the parameter estimates. The pvalues are shown in brackets beside the parameter estimates. The CM test follows a χ_1 with null H_0: nonlinear functional form is adequate for the DGP. Distribution denotes the distribution of the conditional errors. The Jarque-Bera normality test follows a χ_2. The Ljung-Box autocorrelation tests follows a χ_{11}. Asterisks indicate significance at the following levels: ** 5% level and * 10% level.

Figure 1. Transition probabilities of being in the high regime of expected probability of depreciation of the local currency for each Mercosur country (excluding Uruguay)

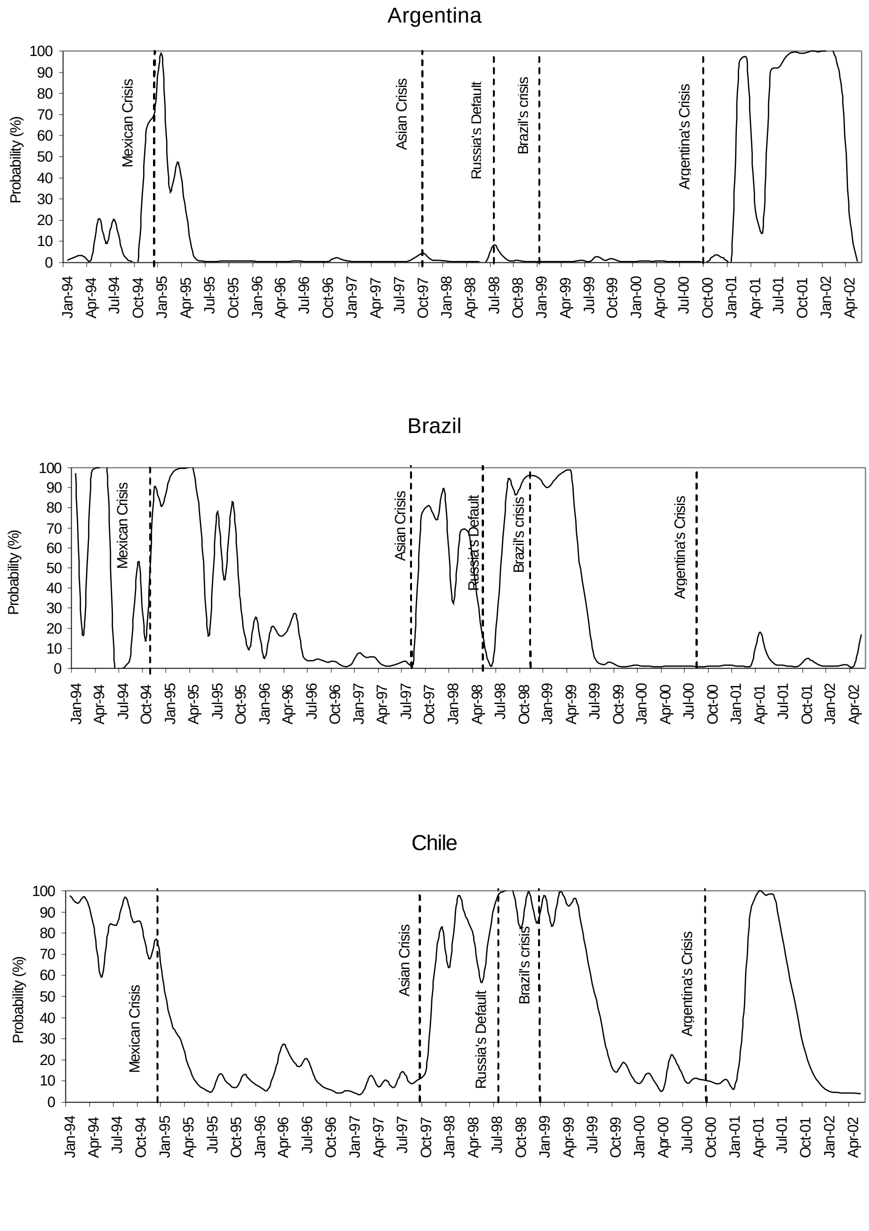
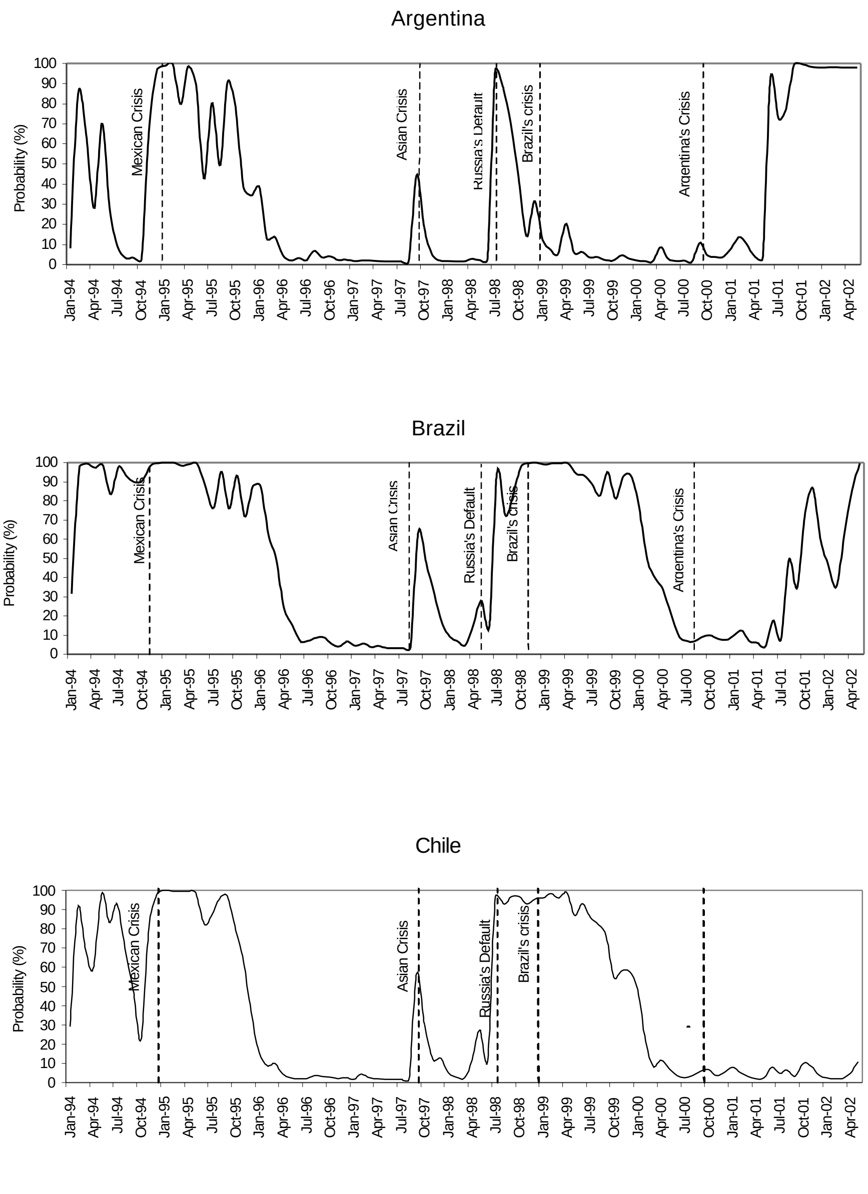


Figure 2. Transition probabilities of being in the high regime of expected probability of technical default of its sovereign debt for each Mercosur country (excluding Uruguay)



Concerning financial contagion, the Tequila crisis of 1994 was a major event for all the Mercosur countries but did not culminate in a regional crisis. Brazil was the Mercosur country most affected by the Asian crisis of 1997. Interestingly, although sharing with Hong Kong a pseudo-currency board exchange rate regime, the Asian shock did not end with a depreciation of the peso in Argentina (see Galiani et al. 2003). Chile and Brazil were the most affected Mercosur countries by the Russian crisis of 1998 (Baig and Goldfajn 2000), but Chile's floating exchange rate regime contained this shock to some extent (Morandé 2001). By contrast, Brazil eventually abandoned the crawling peg regime in 1999. A striking fact is that the Brazilian crisis of 1999 had no major contemporaneous effect on Argentina, its major trading partner. But as explained by Galiani et al. (2003), it did have a major effect on Argentina's large deflation-cum-adjustment process that ended with the collapse of the pseudo-currency board exchange regime. Uruguay and Brazil exhibited some degree of financial instability after Argentina's default on its sovereign debt, but these countries seldom experienced currency crises due to international financial support (Edwards 2000).

Table 4 presents the main results of the paper. The resulting optimal country weights for the implied SAC are statistically significant and fairly symmetrical with relatively equal weight (i.e., 21.87% Argentinean pesos, 27.48% Brazilian reals, 27.41% Chilean pesos, and 23.25% Uruguayan pesos).[15] In actual currencies the Mercosur SAC contains 3.272 Argentinean pesos, 0.530 Brazilian reals, 4.083 Chilean pesos, and 2.114 Uruguay pesos, which can be divided proportionately to define a unit SAC. This currency basket would stay the same over time regardless of changes in exchange rates.

Although from a political institutional point of view the results are somewhat counterintuitive, recall that our model focuses on the financial economy. In this regard, Brazil's weight reflects its incremental risk to the group, rather than its economic importance as measured for example by GDP. For political and economic reasons the weight on the Brazilian real could be increased, but this change likely would increase the instability of the Mercosur SAC. The results shown at the end of Table 4 parallel those of financial economics with respect to the benefits of stock portfolio diversification. For example, including Uruguay to a basket currency already containing Argentina and Brazil represents a 50.53% reduction in the portfolio's risk in terms of reducing the standard deviation of the normalized currency basket value. Adding Chile to the 3-country basket represents a further 33.34% risk (or standard deviation) reduction. However, in unreported results the

[15] This result is qualitatively similar independently of the number of countries included in the analysis.

Table 4. Results for the implied Mercosur SAC

	Implied Mercosur SAC	Hard Currency SAC	RNVal Argentina	RNVal Brazil	RNVal Chile	RNVal Uruguay
Mean	0.9936	0.9998	1.1131	1.0426	0.9974	0.9461
Standard deviation	0.0120	0.0013	0.3062	0.3031	0.1381	0.1146
Coefficient of variation	1.2080	0.1333	27.5044	29.0699	13.8448	12.1142
Minimum	0.9358	0.9980	0.5926	0.4682	0.6434	0.6616
Maximum	1.0168	1.0031	3.1565	2.0511	1.3734	1.2469
Prob. $\leq$0.80	0.00%	0.00%	12.57%	22.16%	5.69%	8.67%
Prob. $\leq$1.00	70.75%	59.41%	41.64%	51.36%	56.17%	68.98%
Prob. $\geq$1.10	0.00%	0.00%	45.93%	34.31%	21.97%	8.31%
Implied Mercosur SAC weights			21.87%	27.48%	27.41%	23.25%
Mercosur SAC in countries' currencies			3.273 pesos	0.530 reals	4.083 pesos	2.114 pesos
	From a 2-country basket to a 3-country basket	From a 3-country basket to a 4-country basket				
Incremental risk reduction	50.53%	33.34%				

Notes: This table reports the results for the stable aggregate currency (SAC) for Mercosur using the Hovanov, Kolari, and Sokolov (2004) procedure. The implied exchange rate series for each country are calculated using the regime-switching E-GARCH estimates presented in Tables 2 and 3. For comparative analysis we also include the statistical moments of a hard currency SAC using the same currencies as in Hovanov et al.(2004). At the end of the table, we include the average incremental percentage risk reduction upon adding one-by-one the countries included in the analysis starting with a 2-country basket between Argentina and Brazil.

incremental gains in risk reduction as the number of countries increases may have some lower threshold representing pure (regional) non-diversifiable systematic risk.

These results raise some interesting insights about the implementation of the common currency. First, it is clear that, by assuming that the common currency's value is tied to the optimal currency basket, increasing the number of countries in a common currency tends to increase its stability. In this regard, Venezuela recently has been admitted as a member to Mercosur and the inclusion of the bolivar would likely further increase the stability of a Mersocur SAC to some extent. Second, our results suggest that the common currency could be subject to a symmetric-collective control within the agency in charge of the regional monetary policy. Third, and last, the inclusion of a member in the monetary union could be done following pure real economic considerations as dictated by OCA theory even if diversification benefits in terms of improving common currency stability have reached a limit.

Although the success of the new institution relative to old ones cannot be guaranteed a priori from our simple exercise, we believe that SAC could provide a device that fosters cooperation and the implementation of necessary reforms (otherwise not possible for each individual country) enforced by a regional monetary authority. Regarding the use of SAC as a common currency, we should be careful to note that, as is the problem in many empirical papers in the OCA literature, our findings are based on historical data sets that cannot be projected into the future. Repeated experiments through time would be beneficial in terms of more fully understanding the sensitivity of SAC to changing exchange rate regimes. And, concerning regional monetary authority, Levy-Yeyati and Sturzenegger (2000) emphasize that the credibility gains from a monetary union with an anchor country cannot be extended to a region with no clear anchor. They point out that progress in the credibility front should arise from peer control that facilitates the necessary reforms (e.g., Mercosur has been effective in applying peer pressure to trade policies). Furthermore, the common currency might work with no additional cost in terms of giving up monetary sovereignty. Local monetary authorities could retain their flexibility to fix interest rates and intervene in the international sovereign debt markets in response to world shocks.[16] A different issue is whether governments of the member countries will have any incentive to choose not to inflate as a group. This is an interesting issue that future research could address using a common agency model approach (see, e.g., Dixit and Jensen 2003).

Figure 3 illustrates simulated outcomes for the individual Mercosur currencies and Mercosur SAC. The implicit exchange rate series have been normalized using the geometric mean formula in equation (6). Figure 4 illustrates simulated outcomes for a 2-country, 3-country, and 4-country Mercosur SAC versus the historic USD/YEN foreign exchange rate. Clearly, the Mercosur SAC is much more stable than the constituent country currencies (including Chile). Interestingly, this result is obtained despite the observed differences in terms of currency stability across the sample of countries included in our simple exercise. Also, as the number of member countries increases, the common currency is more stable.

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[16] As shown by Dixit and Jensen (2003), the final monetary rule bias will depend on the incentive scheme reflected in the contracts between the member governments of the monetary union and the common Central Bank.

Figure 3. Simulated Mercosur SAC compared to the normalized RNVal series for each Mercosur country: 3/1994 - 6/2002

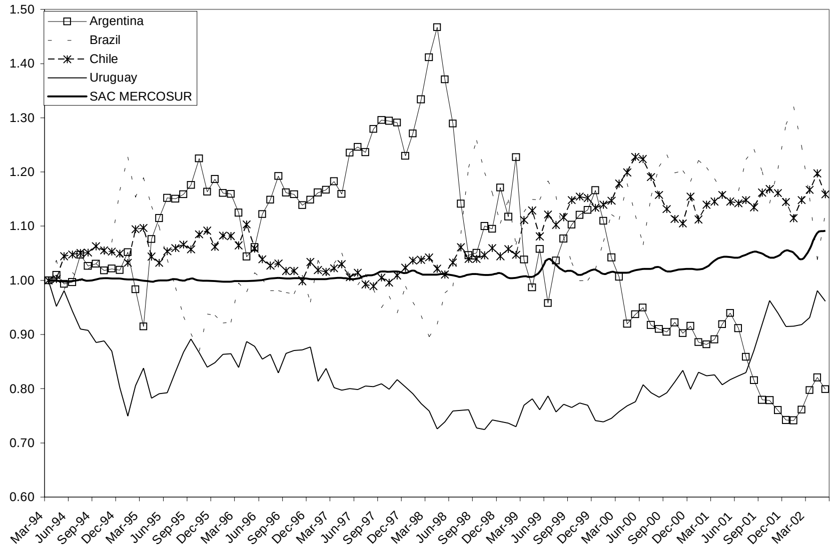
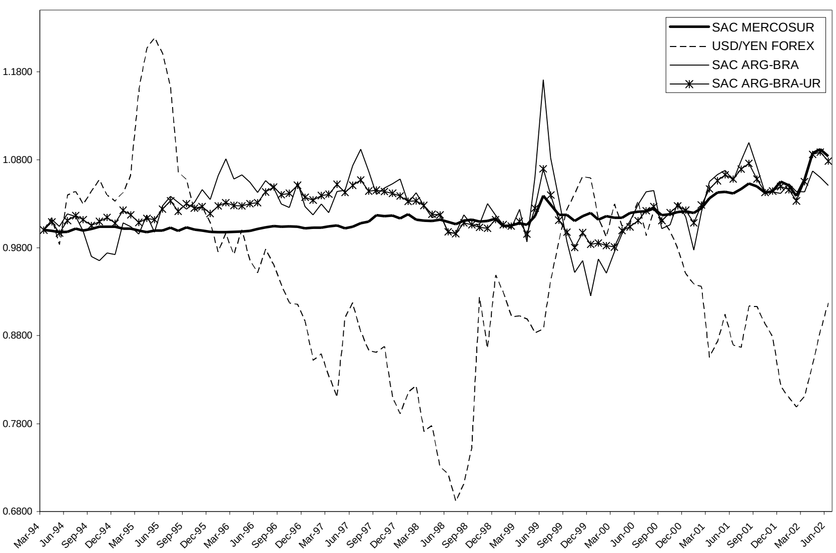
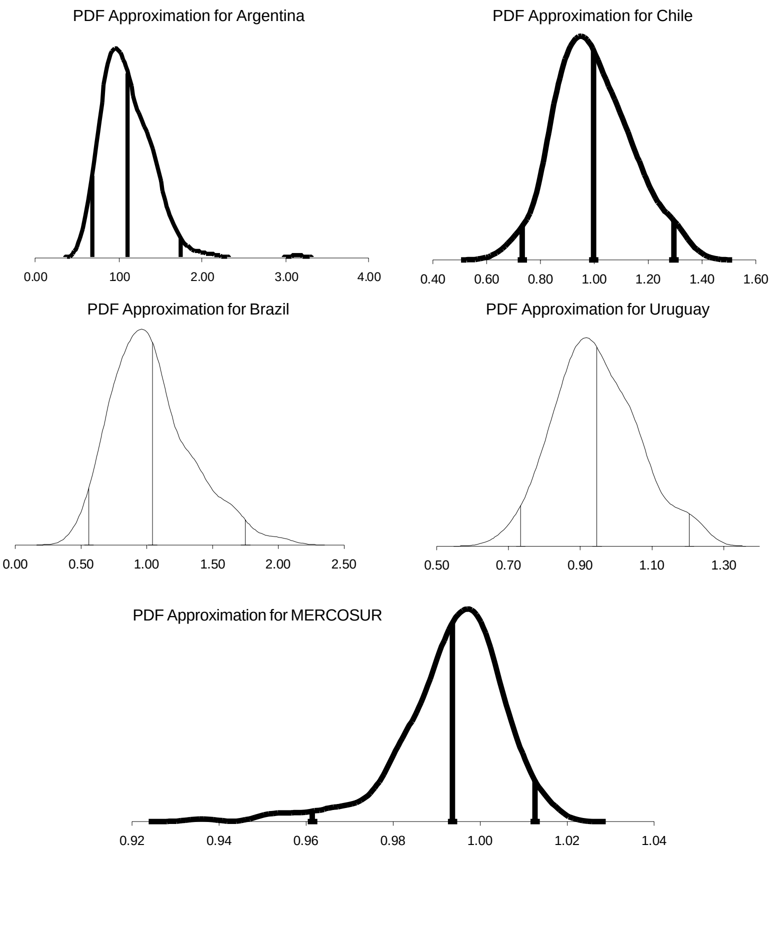


Figure 4. Simulated 4-country Mercosur SAC (Argentina, Brazil, Uruguay, and Chile) versus 3-country Mercosur SAC (Argentina, Brazil, and Uruguay), 2-country Mercosur SAC (Argentina and Brazil), and the USD/YEN foreign exchange rate: 3/1994 - 6/2002



Finally, we seek to assess the willingness of each country to join the monetary union. Consistent with our theoretical framework, this can be done by comparing the first two statistical moments of the probability density functions of the reduced normalized values of each Mercosur currency series relative to the implied Mercosur SAC series. Table 4 shows that the standard deviation of the normalized Mercosur SAC is about 20 (10) times lower than the normalized currency values for Argentina and Brazil (Chile and Uruguay). The maximum expected annual depreciation of Mercosur SAC is well below the 10 percent level, with a 0 percent probability of observing an annual depreciation higher than 10 percent. Figure 5 illustrates in terms of the probability density functions for each Mercosur currency and SAC. In general, our results support the view that within the Mercosur region sufficient ex ante incentives exist for constituent countries to join a monetary union.

Figure 5. Probability density functions of the implied Mercosur SAC and the normalized RNVal series for each Mercosur country



VI. Conclusion

This paper developed and demonstrated empirical methods to construct an ideal common currency for mid-sized open economies with incomplete markets and Mercosur countries in particular. As a theoretical foundation, we adopted an ISOLG version of Neumeyer's (1998) general equilibrium with incomplete markets model. Regarding the analytical approach, we employed the currency invariant index and stable aggregate currency (SAC) methods of Hovanov et al. (2004). The proposed common currency is constructed as a derivative of an underlying dynamic portfolio of securities that proxies the nominal exchange rates' risk factors and floats against the rest of the world currencies. We estimated implied currency series for Mercosur countries for purposes of computing an implied Mercosur SAC. The resulting optimal currency weights of the implied SAC were relatively balanced across Mercosur countries, which suggests that such an optimal currency basket would be subject to symmetric-collective control within the agency in charge of regional monetary policy. The implied Mercosur SAC is considerably more stable than its component currencies. Importantly, the Mercosur SAC could be used as the basis for a single, common currency in the sense that its value could be tied to this optimal currency basket. This empirical evidence can be interpreted to mean that sufficient incentives exist to justify Mercosur countries' adoption of a monetary union, in line with arguments by Eichengreen (1998) and Levy-Yeyati and Sturzenegger (2000).

We are aware that other regions of the world are contemplating the adoption of a common basket currency. Asian and African countries have been discussing their possible construction over the past decade. It is therefore likely that common basket currencies will emerge at some point in the near future. The present paper shows how to construct a single common currency with value tied to a minimum variance currency basket for mid-sized open monetary economies and, therefore, has important implications to emerging market countries.

Appendix. Data sources and definitions

The sample covers four Mercosur countries: Argentina, Brazil, Chile, and Uruguay. We do not include Bolivia and Paraguay due to data limitations. Our sample represents 100% of the region's market capitalization, and more than 90% of its economic activity measured in real GDP terms. The set of instrumental market variables used in our analysis is as follows: 1) end- of-month official nominal foreign exchange daily rates provided by the central banks of each country (www.bcra.gov.ar and www.bcu.gub.uy); 2) annualized monthly short-term interest rate differentials calculated in dollar terms as the log difference between the home country short-term interbank bond equivalent yield (when the time series are available, and 7-day call deposit rates otherwise) provided by the central banks of each country and the equivalent U.S.dollar denominated LIBOR provided by the Bank of England (www.bankofengland.w.uk); and 3) annualized monthly sovereign credit spreads measured in basis points calculated from the J.P.Morgan Emerging Market Bond Indices (EMBI+) provided by J.P.Morgan & Co.Inc.(www2.jpmorgan.com/MarketDataInd/EMBI/). In the case of Uruguay, we use sovereign spreads calculated from the Uruguay Bond Index (UBI) provided by República AFAP (www.rafap.com). The hard currency SAC time series uses the same currencies as in Hovanov et al.(2004). The sample covers the period from January 1994 to June 2002. We excluded other relevant macroeconomic variables due to the fact that they are not available on a monthly basis. While there is a vast literature of exchange rate models that stresses the econometric significance of macroeconomic variables, modeling the dynamics of exchange rates is beyond the scope of the present paper.

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