

Monetary Integration in the Southern Cone: Mercosur Is Not Like the EU?*

A study by
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ABSTRACT

Evaluating the costs and benefits of exchange rate stability requires a different approach for Mercosur than for the EU. EU member countries are highly integrated in terms of trade in goods and services. This implies that exchange rates are more important. But a high degree of trade integration also implies that competitiveness cannot get too much out of line without causing large external disequilibria. Currency fluctuations are thus more limited. By contrast, trade integration within Mercosur is much more limited and currencies are thus driven by other factors, such as confidence in the ability to serve external debt and the solidity of domestic political institutions. Concerns about the latter do not exist in the EU. This also implies that the correlation between exchange rates and interest rates might be different.

This contribution thus provides first a comparative picture of the degree of trade integration within the EU and within the Southern cone. It then investigates the correlation between two aspects of financial market volatility, namely exchange rate and interest rate volatility, comparing the situation in the Southern cone to that in the EU during the 1980s and the 1990s and the candidate countries for membership. Finally, it analyses the impact of both aspects of financial volatility on investment and labor markets in the Southern cone, finding that exchange rate variability has a significant dampening impact on employment and investment.

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1. Introduction

After the forced exit from its currency board arrangements Argentina has joined its neighbors in the Southern Cone in terms of its exchange rate arrangement. Is this a reason to stop discussing the issue of monetary integration in this area of Latin America?¹ We would argue no. The costs and benefits of fluctuating exchange rates in southern Latin America deserve another look. Europe seemed to have landed in a similar situation when in 1992/3/5 speculative attacks forced all the major currencies participating in the European Monetary System to loosen their exchange rate commitment (FRF, PTE) or abandon the system completely (ITL, GBP). However, monetary union did still start on schedule because despite intense market pressure policy makers consistently stuck to the policy choices required by the project of European monetary integration. It is thus entirely possible that monetary integration will one day again become a real option for the Mercosur area as well.

Our approach was inspired by the European experience. Previous research by the authors has shown that exchange rate variability can have a significant impact on the economy, and in particular on labor markets. The results are especially strong for intra-European exchange rate variability. This is not surprising in view of the importance of intra-European trade (both in absolute terms, e.g., as a percent of GDP, and relative to trade with the rest of the world). Should one expect to find similar results for Mercosur countries? It is difficult to give an immediate answer because there is one key difference between Europe and the Southern Cone: trade among the Mercosur countries used to be much less important than the trade of these countries with the rest of the world (mostly the EU and the US).

We document the difference in the degree of trade integration within the EU and within the Southern cone in section 2 as this might be an important background for the subsequent empirical analysis. Section 3 defines our measures of exchange rate and interest rate variability. We investigate the correlation between two aspects of financial market volatility, namely exchange rate and interest rate volatility, comparing the situation in the Southern cone to that in the EU. In section 4, the impact of both aspects of financial volatility on investment and labor markets in the Southern cone is analyzed. We present first a theoretical model which shows why exchange rate volatility should affect investment decisions negatively, then comment on some first empirical results and then provide some robustness tests. Section 5 concludes and

¹ Before the outbreak of the Argentina crisis, some authors like, e.g., Eichengreen (1998) and Giambiagi (1999) even discussed the sense or nonsense of a common currency for the Mercosur member countries. Corresponding declarations of intention were made at that time by policy circles, i.e. the president of Argentina, Fernando de la

discusses the implications of the results for the debate on the design of intra-Mercosur monetary relations.

2. Comparative picture of the degree of trade integration within the EU and within the Southern cone

We provide first a comparative picture of the degree of trade integration within the EU and within the Southern cone. We leave out Paraguay from our analysis, because no data were available from GTAP. Hence, in the following we define Argentina, Brazil and sometimes, if data are available, Uruguay as ‘the Mercosur’.² This paper focuses on Argentina and Brazil, because both countries together represent 95 % of the 215 million total population of the Mercosur and produce 97 percent of this region’s GDP. Moreover, the ‘peripheral’ countries Paraguay and Uruguay are closely tied to Argentina and Brazil via the trade channel, have very small internal markets and limited access to international capital markets. Hence, they cannot be analyzed according to the same criteria like Argentina and Brazil. Chile, not in Mercosur, serves as a comparator. EU means EU-15 throughout the paper.

Table 1: Trade integration within the Southern cone

	Exports as % of GDP		Intra-regional/ Extra-regional
	Total	Intra-regional	
Argentina	8.9	2.7	0.44
Brazil	7.6	0.9	0.13
Chile	26.5	2.8	0.11
Spain	26.6	16.4	1.61

Sources: Center for Global Trade Analysis (2001), own calculations

Table 1 shows the importance of trade for Southern cone countries and compares it with one EU member country, Spain (whose figures are not far from the EU average). This table shows clearly that the two Mercosur countries are outliers because of the low importance of trade (less than 10 % of GDP for both). The data also show that Mercosur does not really qualify as a trade bloc given that for Brazil trade with Argentina amounts only to one sixth of its total exports. However, for Argentina intra-regional trade is more important. It is interesting to

Rúa, and by the president of Brazil, Fernando Henrique Cardoso. An instructive source in this respect is Levy Yeyati and Sturzenegger (2000).

note that a neighboring country, like Chile, which is not in Mercosur, is as integrated with this block as Argentina.

Table 2 shows the importance of importers of Mercosur goods and services. We disaggregate with respect to the destination of exported goods and services by differentiating between individual Mercosur countries and the two trade blocs EU-15 and NAFTA. For example, exports from Argentina to Brazil had a share of 2.4 percent of Argentina's GDP. Two main features emerge. First, a closer inspection of the shares of the extra-Mercosur trade blocs in Table 2 corroborates the general picture developed by Levy Yeyati and Sturzenegger (2000), pp. 72 ff., that Mercosur is in principle not designed as a trading bloc relatively close to the rest of the world. Instead, the strategy consisted of a general unilateral opening to third countries and a policy of preferential access to neighbors. There is again a clear difference to the working of the EU project which tends to make intra-regional trade cheaper and to increase extra-regional barriers. Second, both for Argentina and Brazil the EU is the more important trade partner than the NAFTA. This relation is even more pronounced for Argentina (see also IMF, Directions of trade, various issues and Alesina and Barro 2001, p. 384).

Mercosur countries are rather closed economies. Was that different in the past? Figure 1 suggests that this has always been the case. It is interesting to note that during the 1960s Spain had about the same degree of openness than Argentina and Brazil. However, this changed over time, and in particular since Spain joined the EU. Nevertheless, EU membership is not the only reason for the difference. Even within the Southern Cone there are large differences. Chile, as a somewhat smaller economy than Argentina should be somewhat more open. This was already the case during the 1960s, but the difference between Chile and its neighbors has actually increased considerably over the last decade.

² For consistency reasons, we use the package GTAP Version 5 Data Base, Center for Global Trade Analysis (2001) from Purdue University, USA, for any calculations concerning, e.g., trade weights throughout the whole paper.

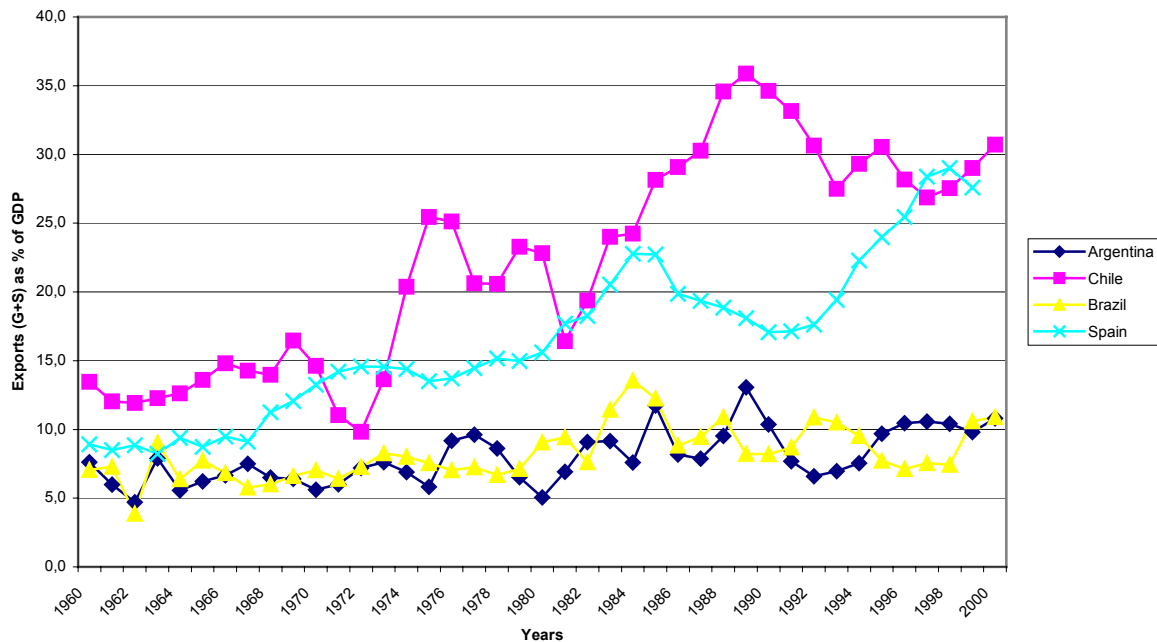
Table 2: Exports of the Mercosur Trade Bloc, 1997

Percent of gross domestic product

	Intra-Mercosur trade bloc				Total	Extra-Mercosur trade bloc			Total	Total exports
	Argentina	Brazil	Paraguay	Uruguay		EU	NAFTA	Rest of the world		
	Argentina	0.0	2.4	0.0	0.2	2.7	1.6	0.9	3.7	6.2
Brazil	0.8	0.0	0.0	0.1	0.9	2.0	1.6	3.1	6.6	7.6
Paraguay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Uruguay	1.9	5.2	0.0	0.0	7.1	5.9	3.1	6.5	15.5	22.5
Mercosur trade bloc	0.6	0.8	0.0	0.1	1.5	1.9	1.4	3.3	6.7	8.2

Sources: Center for Global Trade Analysis (2001); own calculations

Figure 1: Missing globalization of Mercosur economies



Overall the data on trade flows indicate that (despite the increase which has taken place over the last years) the volume of trade among the Southern Cone countries is still of a different order of importance than that of intra-EU trade. This basic pattern is totally consistent with the findings by Levy Yeyati and Sturzenegger (2000), pp. 68 ff., who state that the degree of interdependence between Mercosur countries, as measured by trade flows, is much lower than it was for EMU members even at the time of the “Werner Report” when monetary union was proposed for the first time in Europe. The dramatic increase in regional trade between the largest partners, Argentina and Brazil (around 400 % between 1991 and 1997) albeit starting from a low level is mainly due to the fact that the member countries increased their total trade volumes significantly. In this sense, Mercosur did not foster trade reorientation but did only accompany the general opening process experienced in Latin America in the last decade.

Mercosur has come under a lot of criticism because it might lead to trade diversion (its members still have rather high external tariffs). Trade diversion is particularly strong in cases where the effective rate of protection is high because domestic value added is low. This suggests that the Mercosur free trade agreement - combined with the maintenance of relatively high external tariffs in Argentina and Brazil might have fostered more intra-trade particularly in activities (industries) in which trade adds little value. However, this does not seem to be the case because of the industrial structure of the Mercosur economies. There is very little trade in intermediate products. Table 3 shows the strategic relevance of the three main economic sec-

tors with respect to the value added which was induced by exports. For instance, exports from Argentina to the rest of the world incorporate value added in Argentina's agricultural sector of 3.1 percent of GDP. At the same time, the share of agriculture in the value added incorporated in the exports of all sectors was 37.5 percent. To stay with Argentina as an example: with exports amounting to 8.9 % of GDP and the value added induced by exports amounting to 8.3 % of GDP there cannot have been a lot of trade in intermediate products.

Given the relatively low importance of trade for Mercosur countries, we would argue that for this group the analysis of the costs and benefits of regional exchange rate arrangements must be seen not only in terms of the impact stable exchange rates might have on trade, but more in terms of the *overall macroeconomic stability* that might result. If Latin America is different in the sense that there is little intra-regional trade, the link to the dollar should be more important than the intra-regional fixes. In the following, we investigate therefore the correlation between two aspects of financial market volatility, namely exchange rate and interest rate volatility, comparing the situation in the Southern cone to that in the EU.

Table 3: Induced Domestic Value Added Structured by Industries, 1997

Percent of gross domestic product

	Industries					Industries' share of value added			
	Agriculture	Other primary production	Manufacturing	Services	Total value added	Agriculture	Other primary production	Manufacturing	Services
Argentina	3.1	0.9	2.7	1.6	8.3	37.5	10.7	32.5	19.3
Brazil	1.4	0.3	2.8	2.3	6.9	20.8	5.0	40.6	33.6
Paraguay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Uruguay	4.7	0.7	4.6	8.9	18.8	24.9	3.6	24.4	47.0
Mercosur trade bloc	1.7	0.4	2.2	2.0	6.2	27.3	6.3	34.7	31.7
Spain	2.1	0.2	9.3	9.1	20.6	10.0	0.9	45.2	43.9
EU trade bloc	0.5	0.1	5.6	6.1	12.4	4.4	1.1	45.2	49.3
NAFTA trade bloc	0.4	0.3	3.0	4.1	7.8	5.2	3.4	39.1	52.3

Sources: Center for Global Trade Analysis (2001); own calculations

3. The link between exchange rate and interest rate volatility

For the EU the introduction of the euro eliminated at one stroke intra-area exchange rate and interest rate volatility (for 12 of the 15 EU member countries). However, for less extreme forms of monetary integration it might be the case that lowering exchange rate variability increases interest rate variability. This is a particularly important issue for the Mercosur countries, which at times have shown extreme forms of both exchange rate and interest rate variability.

Some authors like, e.g., Reinhart and Reinhart (2001) argue that there is a tradeoff between lower G-3 exchange rate volatility on the one hand and higher G-3 interest rate volatility (and consumption) on the other hand. As the main reason it is presumed that major countries can only accomplish a lower degree of exchange rate volatility if their central banks change short-term interest rates as a reaction to cross exchange rate changes. This, in turn, tends to increase G-3 income and spending volatility. The latter effects spill over to emerging market economies which are net debtors to the G-3 in different ways. First, coordination of G-3 monetary policies delivers more stable terms of trade of the emerging markets (EMs) at the cost of a more variable interest service on foreign debt. This might hamper investment within the emerging market economies. Second, the higher degree of G-3 interest volatility makes the demand for the emerging markets' exports more variable if import demand in the G-3 has a positive income elasticity. However, the larger the foreign trade ties with the larger country the more important this kind of spillover effect should be in reality. Those emerging market economies which predominantly export relatively income-inelastic primary commodities will not suffer to the same extent from an increase in G-3 interest rate volatility like developing countries do which export income-elastic manufacturing goods. In other words, the export performance of countries like, e.g., Argentina should be less exposed to G-3 interest rate variability like that of East Asian countries (Reinhart and Reinhart 2001, pp. 7 ff.).

Calvo and Reinhart (2000) apply a similar argument directly to emerging market economies. If the authorities lack credibility and if there is an inherent 'fear of floating', the outcome is biased towards lower conditional exchange rate volatility and higher interest rate volatility within the emerging market economies themselves ('pro interest variability bias', Calvo and Reinhart 2000, p. 8). Their empirical analysis for thirty-nine countries (including Argentina, Brazil, and Uruguay) and monthly data ranging from January 1970 to April 1999 corroborates exactly this conclusion, independent on whether the country under investigation is classified as a peg or a float. Hence, the authors conclude that the so-called "demise of fixed exchange

rates” which is often maintained referring to the examples of, e.g., Brazil, Chile, and Colombia is not more than a myth. However, according to Calvo and Reinhart (2000) the low degree exchange rate variability observed is not due to the absence of asymmetric shocks in the emerging countries but to monetary policies aimed at stabilizing the exchange rate.³ Interest rate policies seem to have replaced ineffective foreign reserve interventions in this respect. Hence, interest rate volatility should be observed to increase when exchange rate volatility is dampened.

In this section we would like to find out whether this popular view is correct for the EU and whether and how this insight has to be modified for the Mercosur. However, it might anyway be argued that Calvo and Reinhart (2000) and Reinhart and Reinhart (2001) more or less make use of the old and common argument against reducing exchange rate variability that volatility must have a valve somewhere else. In other words, could the gains from suppressing exchange rate variability that are suggested by our results be lost if the volatility reappear elsewhere, for example in higher interest rate variability? We would argue that recent research *on OECD economies* is suggestive in this respect. Seen on the whole, the existing literature is skeptical about the “squeeze the balloon” theory, i.e. a trade off between exchange rate volatility and the volatility of other variables. Rose (1996), for example, shows that official action can reduce exchange rate variability even holding constant the variability of fundamentals such as interest rates and money. Co-ordination between the Fed and the ECB could thus keep the dollar-euro volatility under control. This view is supported by results of Flood and Rose (1995) who show that there is no clear tradeoff between exchange rate volatility and macroeconomic stability. Furthermore, Jeanne and Rose (1999) develop a model of a foreign exchange market with an endogenous number of noise traders and multiple equilibria of high and low exchange rate volatility. In their model monetary policy can be used to lower exchange rate volatility without affecting macroeconomic fundamentals. Similarly, Canzoneri et al. (1996) show, e.g., for some G-3 countries that exchange rates do not generally move in the direction one would expect if they were to offset shocks.

Our analysis in the preceding section revealed that trade integration within Mercosur is much more limited than in the EU. Hence, it is not clear a priori whether the empirical results by Reinhart and Reinhart (2000) also hold for LDCs. We would argue that there are important differences, mostly in terms of exchange rate determination. For Argentina and Brazil, ex-

³ On the contrary, the terms of trade in most of the emerging market economies are subject to larger and more frequent shocks than their counterparts in the G-3. This appears intuitive given the large share of primary commodities in their exports.

change rates are driven by other factors, such as confidence in the ability to serve external debt and the solidity of domestic political institutions. Concerns about the latter do not exist in the EU (and of course also not in the U.S.). This also implies that the correlation between exchange rates and interest rates might be different. If fluctuations in the availability of international capital are the main driver of exchange rates and interest rates in Mercosur, one would expect exchange rate and interest rate variability to move together. During the Mexican, Asian, Russian, and other crises exchange rates usually depreciate and interest rates increase together.

Having established that the Mercosur is not like the EU in several respects which are relevant for the issue of monetary integration, we now proceed to the second practical issue: How should one measure exchange rate and interest rate variability? Let us first define our measures of exchange rate and interest rate variability relevant for Mercosur countries. We used a very simple measure: for each year of our total sample from 1970 to 2001 we calculated a standard deviation of the basis of twelve monthly observations of the first difference of the respective exchange rate and interest rate measure. To take the closer ties to the EU than to the U.S. as a special pattern of Mercosur foreign trade relationships into account (see chapter 2), we also include the volatilities of the euro exchange rates of the Argentine peso, of the Brazilian real, and of the Uruguayan peso. However, extra calculations show that the correlation between dollar and euro volatilities of the respective home currencies amount to close to 99 percent for Argentina and Brazil, as could have been expected. Finally, we include nominal and real euro-dollar exchange rate volatility in order to test whether there are real impacts of G-3 exchange rate volatilities in Mercosur countries (as projected by Reinhart and Reinhart 2001).

At this stage, it is useful to illustrate the exact definitions of the exchange rate and interest rate volatility variables based on the example of Argentina. Here, we consider the volatility of the nominal and real exchange rate vis-à-vis the US-dollar `VOLNER_ARPUSD` and `VOLRER_ARPUSD`, of the nominal and real exchange rate vis-à-vis the euro `VOLNER_ARPEUR` and `VOLRER_ARPEUR`, of the nominal and real dollar-exchange rate of the euro `VOLNER_USDEUR` and `VOLRER_USDEUR`, of the real effective rate `VOLREER_ARG`, and of the nominal and real effective intra-Mercosur exchange rate `VOLNEERINTRAMERC_ARG` and `VOLREERINTRAMERC_ARG`. The volatility of the nominal short-term interest rate is called `INTEREST_ARG`, the one of real interest rate volatility

REALINTEREST_ARG.⁴ For more details concerning the construction of our volatility measures see the annexes A1 to A3.

Due to the specific sequencing of exchange rate regimes in each of the Mercosur countries, it seems to be useful to split the total sample up into different sub-samples to check for robustness of the results. This becomes clear after an inspection of Table 4 below which displays the main country-specific characteristics of the history of regimes and in some cases indicates a high probability of structural breaks in the coefficients of correlation between exchange rate and interest rate volatility on the one hand and those between volatility and the real sector variables on the other hand.

⁴ We used money market rates as a proxy for the short-term interest rate in the cases of Brazil and the euro zone. For the U.S., we focus on the treasury bill rate. However, for Argentina, Uruguay and Paraguay, we preferred the deposit rate because this enables us to use a by far larger data set (starting in march 1977 instead of March 1979 in the case of Argentina, in November 1992 instead of July 1999 in the case of Paraguay, and in July 1976 instead of December 1991 in the case of Uruguay).

Tab. 4: Sequencing of exchange rate regimes in Mercosur countries (1970-2001)

<i>Argentina</i>	<i>Brazil</i>
<p><i>First half 1970: fixed exchange rate</i></p> <p><i>Since second half of 1970: multiple exchange rates with a changing mix of commercial and financial rates for different transactions</i></p> <p><i>Second quarter 1973 to last quarter 1974: fixed exchange rate</i></p> <p><i>Last quarter 1974: strong devaluation</i></p> <p><i>Second quarter 1975: strong devaluation “el Rodri-gazo”, end of import-substitution industrialization</i></p> <p><i>March 1976 to December 1978: passive crawling peg</i></p> <p><i>December 1978 to first quarter 1981: pre-announced sliding peg (“tablita”)</i></p> <p><i>First quarter 1981 to June 1985: floating exchange rate / adjusted passively to inflation until Austral plan June 1985</i></p> <p><i>June 1985 to first quarter 1991: four different attempts to fix or control the exchange rate (Austral and primavera plans by Alfonsín and plans under Menem) each leading to sharp devaluations and high inflation</i></p> <p><i>March 1991 to December 2001: “convertibility plan“, pegging the peso one-to-one to the US-dollar, transformation of central bank to a quasi currency board</i></p>	<p><i>May 1970: Cruzeiro introduced</i></p> <p><i>1970-1986: continuous devaluation in small steps, interrupted by maxi-devaluations in '79 and '83</i></p> <p><i>February 1986: “cruzado plan”: cruzado replaces cruzeiro (1:10,000), fixed exchange rate during six months</i></p> <p><i>June 1987 to 1992: different unsuccessful attempts to stabilize the exchange rate (Bresser Plan, Summer Plan, Collor Plan)</i></p> <p><i>January 1989: new cruzado instead of old cruzado (1:1,000)</i></p> <p><i>March 1990: cruzeiro replaces new cruzado one-to-one</i></p> <p><i>March 1990 to September 1994: independent floating with respect to the US-dollar</i></p> <p><i>August 1993: introduction of the cruzeiro real equal to 1.000 cruzeiros</i></p> <p><i>March 1994: creation of the unidade real de valor (URV) as an inflation-indexed unit of account, preservation of some flexibility in the exchange rate policy</i></p> <p><i>July 1994 to February 1995: floating exchange rate and real appreciation: July 1994: introduction of the real, equal to 2.750 cruzeiros reais, as a new currency</i></p> <p><i>March 1995 to 1998: return of the mini-devaluation, March 1995: exchange rate band of 5 % for the real</i></p> <p><i>October 1994 to January 1999: managed floating</i></p> <p><i>January 1999: moderate exchange rate devaluation, announcement of new exchange rate target zone, floating in response to a speculative attack two days after the announcement.</i></p> <p><i>From January 1999 on: independent floating with respect to the US-dollar</i></p>
<i>Paraguay</i>	<i>Uruguay</i>
<p><i>1960 to 1982: fixed exchange rate to the US-dollar at 126 PYG/USD</i></p> <p><i>During the 1980s: numerous devaluations and various changes of the exchange rate system</i></p> <p><i>1988: use of five different exchange rates (among others: introduction of a system of official minimum export prices called Aforo)</i></p> <p><i>From March 1989 on and during the 1990s: flexible exchange rates, continuous devaluations</i></p>	<p><i>Since the 1970s: the monetary authorities carried out a free float with frequent intervention (dirty float)</i></p> <p><i>July 1975: introduction of the new peso, replacing the old peso at a rate of 1:1,000</i></p> <p><i>March 1993: the Uruguayan peso becomes the new currency, equivalent to 1,000 new pesos</i></p>

Source: Bonomo and Terra (2001), pp. 124 ff., Diaz-Bonilla and Schamis (2001), p. 73, IFS (IMF), and own compilation.

The average variability (standard deviations) of the nominal dollar exchange rate of the ARP was 7.32 % for the whole period, that of the BRR, the PYG, and the URP was much lower at 3.69, 2.11, and 2.52 %.⁵ Also in nominal terms, interest rate variability usually moves around an aberrant 31.87 % for Argentina, 28 % for Brazil, 11 % for Paraguay, and 4.57 % for Uruguay. Calculating real exchange rate variability makes more sense in principle and is much lower than the nominal one for each Mercosur country (6.38 % for Argentina, 2.54 % for Brazil). The correlations between our measures of exchange rate and interest rate variability are shown in Tables 5a to 5c below. Note that these tables display the correlation coefficients (Bravais, Pearson) in percent. Are the correlation coefficients significant? Under the assumption that both variables are (commonly) normally distributed, the (one-sided) test-statistics $(cor.coef. / \sqrt{(1 - cor.coef.)^2}) \cdot \sqrt{N - 2}$ may be used for an answer. The latter is student-t-distributed with N-2 degrees of freedom (N = numbers of observation). As corresponding calculations immediately reveal, the lowest empirical realization of this test statistics (Table 5a) amounts to 1.53 for Argentina which is still significant on the ten percent level, whereas the relevant test statistics especially for Uruguay, but also in some cases for Brazil and Paraguay are not significant on the usual significance levels.

Starting from our total sample from 1970 to 2001, we compute each of the second moments for the Bravais, Pearson correlation coefficient, using all non-missing observations for the relevant series. Hence, we use the maximum number of observations for our unbalanced sample. In the case of Argentina, we additionally limited the sample to the period from 1981 on, taking the transition from pre-announced sliding peg (“tablita”) to floating exchange rate into account. Finally, we limited the sample to annual data from 1991 on. By this, we operationalize Argentina’s transition from different attempts to fix or to control the exchange rate (Alfonsín and Menem) to the convertibility plan. In the case of Brazil, we introduced a sample split for the year 1994 (real plan). For Paraguay, reliable data were only available from 1990 on, i.e., after the transition to flexible exchange rates. For Uruguay, no sample split seems to be indicated according to our above considerations (see Table 4).⁶

⁵ However, one has to be cautious because this measure calculated over the whole available sample includes, e.g., for Argentina such different periods like the period of extreme exchange rate instability like 1989/90 and the currency board phase in the nineties. Hence, sample splits are highly indicated here.

⁶ As a robustness check, we calculated the correlation coefficients based on breaks in 1981, 1989, 1991, and 1994 for all countries of the sample under investigation here. The outcome did not change the general pattern of results displayed above.

Table 5a: Correlation matrices of indicators of exchange rate and interest rate variability
(full sample, Paraguay from 1990 on)

	Argentina		Brazil		Uruguay		Paraguay	
	VOL INTEREST _ARG	VOLREAL INTEREST _ARG	VOL INTEREST _BRA	VOLREAL INTEREST _BRA	VOL INTEREST _UY	VOLREAL INTEREST _UY	VOL INTEREST _PY	VOLREAL INTEREST _PY
VOLNER_CONUSD	0.90***	/	0.82***	/	0.27*	/	0.43**	/
VOLRER_CONUSD	/	0.83***	/	0.31**	/	0.24*	/	0.36*
VOLNER_CONEUR	0.91***	/	0.80***	/	0.23*	/	0.26	/
VOLRER_CONEUR	/	0.85***	/	0.22*	/	0.23*	/	0.30*
VOLNER_USDEUR	0.29**	/	-0.16	/	0.05	/	0.33*	/
VOLRER_USDEUR	/	0.29*	/	-0.16	/	-0.01	/	0.40**
VOLREER_CON	/	0.82***	/	0.34**	/	0.15	/	-0.12
VOLNEERINTRAM ERC_CON	0.85***	/	0.41***	/	0.01	/		
VOLREERINTRAM ERC_CON	/	0.80***	/	0.17	/	0.15		

Sample: VOLNER_ARPUSD and VOLRER_ARPUSD from 1971 on; VOLNER_ARPEUR and VOLRER_ARPEUR from 1979 on; VOLNER_USDEUR and VOLRER_USDEUR from 1978 on; VOLREER_ARG from 1979 on; VOLNEERINTRAMERC_ARG from 1971 on; VOLREERINTRAMERC_ARG from 1971 on; VOLINTEREST_ARG and VOLREALINTEREST_ARG from 1977 on; VOLNER_BRRUSD and VOLRER_BRRUSD from 1970 on; VOLNER_BRREUR and VOLRER_BRREUR from 1979 on; VOLNER_USDEUR and VOLRER_USDEUR from 1978 on; VOLREER_BRA from 1979 on; VOLNEERINTRAMERC_BRA and VOLREERINTRAMERC_BRA from 1971 on; VOLINTEREST_BRA and VOLREALINTEREST_BRA from 1970 on; VOLNER_UYPUSD and VOLRER_UYPUSD from 1970 on; VOLNER_UYPEUR and VOLRER_UYPEUR from 1979 on; VOLNER_USDEUR and VOLRER_USDEUR from 1978 on; VOLREER_UY from 1980 on; VOLNEERINTRAMERC_UY and VOLREERINTRAMERC_UY from 1971 on; VOLINTEREST_UY and VOLREALINTEREST_UY from 1976 on; VOLNER_PYGUSD and VOLRER_PYGUSD from 1970 on; VOLNER_USDEUR and VOLRER_USDEUR from 1978 on; VOLREER_PY from 1980 on; VOLINTEREST_PY and VOLREALINTEREST_PY from 1990 on. Significance levels are ***: 1 %; **: 5 %; *: 10 % respectively.

Note: _CON = _ARG, _BRA, -UY, _PY.

Table 5b: Correlation matrices of indicators of exchange rate and interest rate variability (limited samples)

	Argentina (from 1981 on)		Argentina (from 1991 on)		Brazil (from 1994 on)	
	VOL INTEREST _ARG	VOLREAL INTEREST _ARG	VOL INTEREST _ARG	VOLREAL INTEREST _ARG	VOL INTEREST _BRA	VOLREAL INTEREST _BRA
VOLNER_CONUSD	0.90***	/	0.90***	/	0.83***	/
VOLRER_CONUSD	/	0.83***	/	0.93***	/	-0.07
VOLNER_CONEUR	0.90***	/	0.90***	/	0.87***	/
VOLRER_CONEUR	/	0.84***	/	0.94***	/	-0.07
VOLNER_USDEUR	0.26*	/	0.57***	/	-0.31	/
VOLRER_USDEUR	/	0.26*	/	0.61***	/	-0.31
VOLREER_CON	/	0.82***	/	0.81***	/	-0.31
VOLNEERINTRAMER C_CON	0.84***	/	0.44**	/	0.83***	/
VOLREERINTRAMER C_CON	/	0.79***	/	0.52***	/	-0.03

According to Table 5c, the correlation coefficient of the *nominal* dollar-euro exchange rate variability (VOLNER_USDEUR) and the variability of Euroland-U.S. *nominal* interest differential (VOLDIFINTEREST_EURUS) (from 1978 on due to availability of VOLNER_USDEUR) is 0.13. The correlation coefficient of *real* dollar-euro exchange rate variability and variability of Euroland-U.S. *real* interest differential (from 1978 on due to availability of VOLNER_USDEUR) amounts to 0.19. Finally, the coefficients of correlation between the volatilities of the Euroland and the U.S. real effective exchange rate and the variability of Euroland-U.S. *real* interest differential are -0.03 and -0.18 respectively. However, none of them is significant.

Table 5c: Correlation matrix of dollar-euro exchange rate volatility and variability of Euro-land-U.S. interest differential

	VOLNER_USDEUR	VOLRER_USDEUR	VOLREER_EUR	VOLREER_US
VOLDIFINTEREST_EURUS	0.13	/	/	/
VOLDIFREALINTEREST_EURUS	/	0.19	-0.03	-0.18

Sample: for all variables from 1987 on.

The general picture emerging from these first correlation exercise is the following. For countries subject to speculative attacks and/or bouts of hyperinflation exchange rate and interest rate volatility move together. The case of Argentina is remarkable in this respect where both volatilities nearly move one-to-one. However, during calmer periods (either of currency board that is perceived to be credible, or a floating exchange rate regime with inflation under control) the relationship is less tight. The same applies for the major floating exchange rates. Dollar volatility is not systematically related to interest rate volatility (this holds irrespectively of whether one uses the volatility of dollar interest rates, or that of interest rate differentials). The fact that the real exchange rate indices are somewhat less variable than the nominal ones just confirms that exchange rates during high inflation periods, even in the short run, do move to somewhat offset price developments. Our approach is related to, but not identical to the work of Reinhart and Reinhart (2001) as well as Calvo and Reinhart (2000a). These authors speak of volatility, but discuss in reality the impact of changes in the first moments (levels) of the G-3 exchange rates on ‘innocent bystanders’, like Mercosur countries. We look only at the second moment. Table 5a suggests that a higher variability of the dollar/euro exchange rate is not strongly correlated with interest rate volatility in Mercosur (correlation coefficients of 0.29 and -0.16 respectively for Argentina and Brazil). As for Mercosur, i.e. for Argentina and Brazil, interest rate volatility is almost the same as exchange rate volatility this implies that dollar/euro volatility is also not strongly correlated with volatility of the Mercosur currencies. Just to repeat: we are comparing and correlating second moments. Even if they are not correlated it can still remain true that a weak euro creates difficulties for Argentina when it is pegged to the dollar.

We now move to analyze the impact of both aspects of financial volatility on investment and labor markets in the Southern cone. In other words, we investigate another potential reason for the recently discussed emerging market economies’ ‘fear of floating’.

4. Real impacts of exchange rate and interest rate volatility in the Mercosur?

In the following, we first introduce a consistent model and develop testable hypotheses in order to investigate possible consequences of exchange rate and interest rate volatility in Mercosur countries. The resulting hypotheses are then tested empirically. At first, however, we would like to elaborate on our motivation behind these efforts.

4.1 Motivation

The exchange rates between the G-3 and those between Mercosur and G-3 currencies (and less so via cross-rates also the intra-Mercosur exchange rates) are closely watched exchange rates in Latin America. Their gyrations, which are at times difficult to understand on purely economic grounds, are often perceived to be politically costly. The relevance of exchange rate variability as a proxy for risk for the Brazilian economic activity has already been emphasized, e.g., by Paredes (1989) and Coes (1981). Intuitively, for instance a dollar-peg would not do justice to Argentina's and Brazil's structure of foreign trade and might hamper their international competitiveness. The main reason is that this peg does not shelter these Mercosur economies from exchange rate variability vis-à-vis the euro or the yen (Krugman and Obstfeld 2000, pp. 525 ff.). Reinhart and Reinhart (2001) claim that G-3 exchange rate and interest rate volatility would seem *a priori* to have a negative effect on economic growth in the developing world. Higher interest rate volatility may delay investment whereas higher G-3 exchange rate volatility may hamper emerging market trade.⁷

However, their basic empirical results based on simple sample splits and on fundamental regressions testing for the relevance of specific G-3 factors let them conclude that enforcing target zones in the G-3 currencies merely means choosing a point along the tradeoff between lower exchange rate volatility and higher interest volatility. Their results are ambiguous with respect to the welfare effects of suppressing volatility. Only when they refer their sample split tests to the joint behavior of the relevant volatilities, they are able to deliver empirical evidence in favor of at least net positive growth impacts of reducing G-3 exchange rate volatility in emerging market economies, even if interest (and, by this, also consumption) volatility has increased at the same time. Seen on the whole, the case for limiting G-3 exchange rate volatility is not given from the point of view of emerging countries according to the results by Reinhart and Reinhart (2001). However, it has to be noted that their results are driven by their

⁷ See Calvo and Reinhart (2000a), pp. 15 ff., and Reinhart and Reinhart (2001), p. 10.

specific assumptions underlying the transmission mechanism of financial market volatility on the real sector. Moreover, the results also suggest that direct benefits to emerging market economies should have their origin only in suppressed volatility of their *own* trade-weighted currencies. According to Rose (1999), a country should prefer adopting a common currency to target zones in this case.

It has even been argued in the wake of the large devaluation of the Brazilian real while Argentina was still caught in its currency board arrangements that movements of the dollar-euro rate comparable to those of the mark-dollar rate since 1971 would break the Mercosur apart (Financial Times 2001, Levy Yeyati and Sturzenegger 2000). This was an argument about the appropriate level (of the effective rate for the Argentinean peso), rather than volatility, which is our main issue.

The starting assumption of most economists is likely to be that exchange rate variability cannot have a significant impact on labor markets (whether in OECD economies or in emerging markets) given that the link between exchange rate variability and the volume of trade is known to be weak. However, there are two reasons why exchange rate volatility should have a strong negative impact on emerging markets' economies and, hence, may constitute the basis for the fear of large exchange rate swings (Calvo and Reinhart 2000a). First, the pattern of trade invoicing is different in emerging markets as compared to that in industrial countries. Following McKinnon (1999), primary commodities are primarily dollar invoiced. Since the Mercosur countries' exports have a high primary commodity content (see Table 3), exchange rate volatility should have a significant impact on foreign trade of these countries. This is especially valid for Argentina with its primary product share of 48.2 percent of total domestic value added induced by exports. However, even the lower respective values for Brazil (25.8%), and Uruguay (28.5%) are extremely large as compared with the EU trade bloc (5.5%). Second, the capital markets in emerging markets are of an incomplete nature. If futures markets are either illiquid or even nonexistent, tools for hedging the exchange rate risk are simply not available in these countries. As a complement, emerging markets are on average more intolerant to large exchange rate fluctuations because the pass-through from exchange rate swings to inflation is much higher in emerging markets (Calvo and Reinhart 2000a, pp. 18 f.).

Why would an increase in exchange rate volatility lead quickly to a lower volume (flow) of trade? The theoretical models that are used in this context start typically from the idea that in order to export one needs to sustain a sunk cost. This implies for all types of production, and

perhaps even more for primary goods, which require large sunk capital investments. In view of the relatively low trade linkages between Mercosur countries and the importance of primary commodities, which are typically priced in dollars (see chapter 2) it might as well be argued that intra-Mercosur exchange rate variability should be of less concern than G-3 exchange rate volatility for the Mercosur countries.⁸

Another approach is that excessive volatility of G-3 exchange rates is perceived to be costly for those emerging markets which link their currencies to the dollar because large swings in dollar's exchange rate on the foreign exchange market change their competitiveness (Reinhart and Reinhart 2001, p. 21, Calvo and Reinhart 2000). This is called the spending channel. According to this view, many developing countries are in 'fear of floating' directly or indirectly (with respect to G-3 volatility) and, hence, link their currencies to the dollar or the euro via a hard peg or a managed float. Examples were Argentina for a "fixed exchange rate regime" (March 1991 – December 2001) and both Brazil ('plano real' July 1994 – December 1998) and Uruguay (throughout) for regimes of "managed floating" (see Table 4 in this paper and Calvo and Reinhart (2000), Tables 5 and 7).

4.2 Modeling the impacts of exchange rate volatility on labor markets: Are we legitimized to transfer the European transmission channel to the Mercosur?

During the past decade, Latin American governments implemented economic reforms that affected almost every sector. Nonetheless, in most countries labor markets remain highly regulated. As of the late 90's, only a handful of Latin American nations had reformed their labor markets in any significant way, while most continued to rely on labor legislation enacted several decades earlier.⁹ This legislation has favored employment protection while taxing employers heavily. Most analysts argue that the social protection provided through labor market regulation limits the market's ability to adjust wages and unemployment. Moreover, social protection is seen as the principal cause of large pockets of "precarious" employment,

⁸ An additional argument would be that intra-regional capital flows within the Mercosur are much lower than flows with countries outside Mercosur. Hence, only exchange rate variability with external currencies should generate quantitatively important speculative capital flows. From this perspective, the main benefits of EMU in the European context (disappearing speculative inflows in the wake of capital market liberalization) do not apply for Mercosur, although capital flow volatility is much higher in the Mercosur than in the EU. See Levy Yeyati and Sturzenegger (2000), pp. 77 f.

⁹ In Argentina, discussions about labor market reforms have been the central focus of the public economic policy debate in the last few years. Labor legislation has been modified as a condition of support by the IMF. However, even the two major changes in labor market legislation 1991 and 1995 introduced flexibility only at the margin. See extensively Hopenhayn (2001), pp. 3 ff. For first modest steps taken by Brazil in August 1998 to relax obstacles to part-time employment, to reduce costs of hiring and firing, e.g. costs of temporary layoffs, and fostering flexible modes of overtime compensation see Eichengreen (1998), pp. 31 ff. On economic reforms and labor markets in Latin American countries in general see Edwards, Cox Edwards (2000).

that is, employment that does not receive any of the benefits and protection awarded by current legislation.¹⁰ Many of the rules governing labor markets in Latin America raise labor costs, create barriers to entry and exit, and, hence, introduce rigidities in the employment structure. As in continental Europe, these rigidities include the exceedingly restrictive regulations on hiring and firing practices, as well as burdensome social insurance schemes. Most importantly, they prevent countries from reacting rapidly to new challenges from increased foreign competition. In contrast, e.g., to the Caribbean, Labor Codes are much more encompassing in the scope of matters regulated and favor indefinite, full-time labor contracts through detailed regulation of probationary periods, benefits, and severance payments in case of separation. Employment stability protection like mandated severance payments and other regulations penalizing employment termination in Latin America is *even stricter* than in the majority of the OECD countries (Heckman and Pagés 2000, Márquez and Pagés 1998).

After controlling for differences in education and firm size, job security increases job duration in Latin America. Finally, union density is falling in Latin America (although still double as high as in the U.S., i.e. above 25 % of the non-agricultural labor force in Argentina and Brazil). The collective bargaining coverage rate (e.g., Argentina 72 % of formal sector workers) is lower than in Europe (between 80 and 90 percent in most countries) but higher than in East Asian countries. The reason is that, with the exception of Uruguay with its highly centralized bargaining system, pervasive state interventions traditionally lower incentives of workers to organize themselves in unions. State intervention tended to centralize collective bargaining in Argentina and Brazil as opposed to Peru and Chile where it decentralized collective bargaining. Hence, Argentina and Brazil systems can be considered as corporatist and highly interventionist systems whereas Uruguay can be regarded as rather unregulated (Márquez and Pagés 1998).

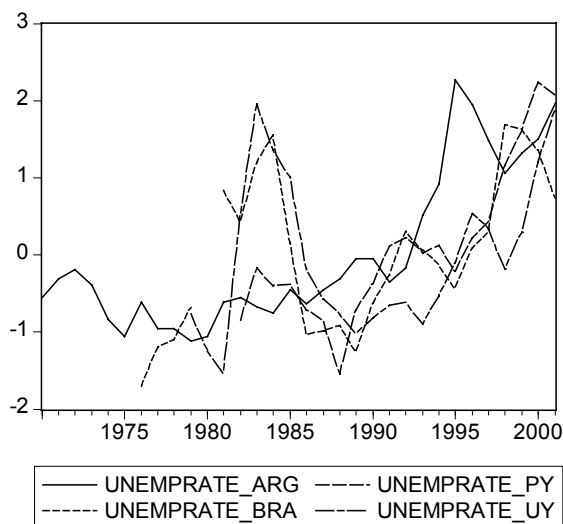
Given the importance of this debate, remarkable little empirical research is available on the relationship between labor market regulations and labor market performance in Latin America. The main purpose of recent empirical studies like Edwards and Cox Edwards (2000), Edwards and Lustig (1997), Heckman and Pagés (2000), and Márquez and Pagés (1998) is to help fill this gap. However, the main message from all these studies is that the bulk of impact of job security legislation in Latin America is *on employment* and not on unemployment (Heckman and Pagés 2000). This basic insight is important for our empirical investigation which should thus primarily focus on employment rather than on unemployment rates. As

¹⁰ However, others believe that dismantling existing labor regulations will worsen social conditions and increase

shown by Lazear (1990), this result is not unusual because a reduction in employment is mirrored by a decline of participation rates if workers' participation decisions are determined by job security policies.

Although we spent much efforts in order to use the best available labor market data (for the exact sources see annex A5) we are well aware of the fact that our analysis might be hampered by the existence of a large amount of inofficial employment in the Mercosur countries. This so-called informal sector is even more important in Brazil than in Argentina. Due to these facts, registered unemployment figures might be only a poor proxy for actual figures. Most significant in Latin America in the past was the rise of open urban unemployment which reached double-digits in most countries in the nineties (and for Uruguay already in the eighties), a time in which reasonably reliable statistics have become available. The relevant unemployment figures are presented in Figure 2.

Figure 2: Unemployment rates in Mercosur countries (1970-2001)



Note: Data are normalized for comparability reasons. For data sources see annex A5.

As already noted previously, unemployment and underemployment are measured differently and thus comparisons across countries are strictly speaking not warranted. Still, the fact that unemployment rates, however measured, climbed significantly in country after country is indicative of a consistent regional trend. What this trend suggests is that increases in informal employment did not function as an effective counter-cyclical mechanism against the contraction of the so-called modern sector. Instead, both informality and open unemployment grew together in most countries. As a result, masses of people found themselves without access

poverty and income inequality.

even to the meager earnings drawn in the past from odd-jobbing, street vending, and other informal activities.

However, the existence of an in-official sector should not matter too much for regressions if one uses changes of employment. Moreover, data on employment refers of course only on official employment, i.e. those officially declared and thus subject to social security contributions, income tax, and all official labor market regulations. This implies that we not take into account the potentially very large grey or underground economy for data availability reasons. The focus on the official labor market is, however, entirely appropriate. In the grey economy the cost of firing are presumably much lower because official employment regulations do not apply. This implies that our model of firing costs applies mainly to official employment and we would expect volatility to be mainly a deterrent to official employment. Data on (official) employment is usually much more accurate than data on unemployment, because the definition of who is looking for work, but unable to find it, changes often. Moreover, the geographical coverage of the unemployment statistics changes over time as well, at times the national unemployment data reflect mainly data from one or two major provinces. Employment data, by contrast is usually nation-wide because it encompasses all people on the social security registers.

Hence, seen on the whole, we feel legitimized to transfer the transmission channel which was originally established for the EU to the Mercosur when modeling the impacts of exchange rate volatility on labor markets. By this, we follow the general perception that labor markets are very rigid in the Mercosur countries and, above all, labor markets in Argentina are even more sclerotized than its European counterparts (Galvani and Nickell 1998, Levy Yeyati and Sturzenegger 2000, pp. 74 ff.)

4.3 The model

The goal of the next sections 4.3 and 4.4 is twofold. First, we develop a simple model apart from the Reinhart and Reinhart (2001) spending channel to illustrate a mechanism that explains a negative relationship between exchange rate uncertainty and job creation.¹¹ This model has originally been based on the idea that uncertainty of future earnings raises the ‘option value of waiting’ with decisions which concern *investment projects* in general (see Dixit 1989, Belke and Gros 2001). In this framework, we now model the labor market more explicitly.

¹¹ For a similar model that analyzes the effect of exchange rate uncertainty on investment, see Belke and Gros (2001).

When firms open a job, they have to incur sunk costs (hiring and capital costs). Moreover, wage payments are typically also sunk since firing restrictions and employment contracts prevent the firms from firing the workers too rapidly. If the exchange rate is uncertain, firms fear an unfavorable appreciation of the (domestic) currency in which case they incur heavy losses. With high uncertainty, firms may prefer to delay job creation, and this is even so if they are risk-neutral. Moreover, the better the bargaining position of workers is, the higher is the option value of waiting and the stronger is the impact of uncertainty on employment. Since generous unemployment compensation systems, union power and firing restrictions generally improve the bargaining position of workers (section 4.2), we would expect that the link between exchange rate uncertainty and employment should be rather strong in sclerotized Mercosur member countries.

The second goal is (section 4.4) to provide some casual empirical evidence on the negative relation between exchange rate and interest rate uncertainty and labor markets in the Mercosur. We consider the influence of two measures of return variability, namely exchange rate and interest rate variability potentially of the Mercosur member countries¹² on two key labor market indicators, changes in unemployment rates and employment growth, and changes in investment.¹³ Our results confirm the theoretical presumption that there is a negative impact of exchange rate and interest rate variability on (un-) employment and investment in countries like Argentina and Brazil whose labor markets are generally perceived to be rather rigid.

The literature provides other mechanisms through which uncertainty may have an adverse impact on employment. First, in unionized labor markets in which contract wages are set in advance, uncertainty in labor demand (coming from uncertainty in productivity or in the exchange rate) may cause rational unions to set a higher wage than would otherwise be the case. Uncertainty results in a 'risk premium' in the wage, and thus in higher unemployment (Andersen and Sorensen 1988 and Sorensen 1992). Another channel by which uncertainty might affect employment is via its impact on investment. Our theoretical arguments are equally valid for firms who decide about an investment project, and, by the same reasoning, high uncertainty might induce firms to postpone investment projects (see Belke and Gros 2001).¹⁴

¹² For an analysis of the costs of intra-European variability for European labor markets which was suppressed by EMU see Belke and Gros (2001).

¹³ These are the two politically most important variables of the indicators linked to popular explanations of the impact of financial volatility on the real sector (Dixit (1989), Aizenman and Marion (1996), Ramey and Ramey (1995)).

¹⁴ Aizenman and Marion (1999) provide further empirical evidence on a negative relation between various volatility measures and private investment. They argue that increasing volatility has a negative impact on investment if investors are disappointment-averse. Moreover, in the presence of credit constraints, realized investment is on

Unemployment can be expected to rise if investment falls because investment is an important component of demand. Moreover, technological complementarities between labor and capital imply that a capital slowdown entails a fall in employment (see e.g. Rowthorn 1999).

In the following, we present a simple model of job creation and exchange rate uncertainty to illustrate the basic idea underlying the 'option value of waiting' à la Dixit (1989). The model which heavily relies on Belke and Kaas (2002) does not pretend to be close to reality. It is designed to convey the basic idea in a simple way. Moreover, our intention is to present a model that allows us to ask whether even a *temporary, short-run* increase in uncertainty can have a strong impact on employment, and how this impact depends on labor market parameters.

Consider a set-up in which there are three periods and a single firm active in an export-oriented industry decides about job creation. During the first two periods (called zero and one) the firm can open a job, hire a worker and produce output that is sold in a foreign market during the following periods. If the job is created during period zero, the worker is hired for two periods (zero and one) to produce output to be sold in periods one and two. If the job is created in period one, the worker is hired only for period one and output is sold in period two.

To create a job, the firm pays a start-up cost c which reflects the cost of hiring, training and the provision of job-specific capital. After a job is created, a worker is hired and is paid a wage w above the worker's fallback (or reservation) wage \underline{w} during every period the worker is employed. The fallback wage measures (besides disutility of work) all opportunity income that the worker has to give up by accepting the job. In particular, it includes unemployment benefits, but it might also be positively related to a collective wage set by a trade union or to a minimum wage, both of which should raise the worker's fallback position. In general, we would argue that the fallback wage should be higher in countries that are characterized by generous unemployment benefit systems, by strong trade unions or by minimum wage legislation.

In every period in which the worker is employed, he produces output to be sold in the following period in a foreign market at domestic price p which has a certain component p^* (the foreign price) plus a stochastic component e (the exchange rate). We assume that the foreign price is fixed ('pricing to market' or dollar invoiced exports), and that the exchange rate follows a random walk. In period one, the exchange rate e_1 is uniformly distributed between $-\sigma_1$

average lower when investment demand is more volatile, since credit constraints bind more often. Real impacts of volatility are also confirmed by Ramey and Ramey (1995).

and $+\sigma_1$. The exchange rate in period two, e_2 , is uniformly distributed between $e_1-\sigma_2$ and $e_1+\sigma_2$. An increase in σ_1 means an increase in uncertainty, or an increase in the mean preserving spread in period $i=1,2$ (σ_i is proportional to the standard deviation of e_i). Uncertainty can be temporary (e.g. if $\sigma_1>0$ and $\sigma_2=0$) or persistent (if also $\sigma_2>0$). As will become apparent soon, however, the variability of the exchange rate during the second period has no influence on the result.¹⁵

The wage rate w for the job is determined by the (generalized) Nash bargaining solution that maximizes a weighted product of the worker's and the firm's expected net return from the job. We assume that both the firm and the worker are risk-neutral. This assumption implies that risk-sharing issues are of no importance for our analysis. Thus we may assume realistically (but without loss of generality) that the worker and the firm bargain about a fixed wage rate w (which is independent of realizations of the exchange rate) when the worker is hired, so that the firm bears all the exchange rate risk. A wage contract which shifts some exchange rate risk to the worker would leave the (unconditional) expected net returns unaffected, and has therefore no effect on the job creation decision. Of course, if the firm was risk-averse, the assumption that the firm bears all exchange rate risk would make a postponement of job creation in the presence of uncertainty even more likely.

Consider first the wage bargaining problem for a job created in *period zero* in which case the worker is hired for two periods. After the job is created (and the job creation cost is sunk), the (unconditional) expected net return of this job is equal to $E_0(S_0) = 2p^* - 2\underline{w} = 2\pi$ where $\pi = p^* - \underline{w}$ denotes the expected return of a filled job per period (we abstract from discounting). Denoting the bargaining power of the worker by $0 < \beta < 1$, the firm's net return from the job created in period zero is¹⁶

$$(1) \quad E_0(\Pi_0) = (1-\beta)E_0(S_0) - c = 2(1-\beta)\pi - c.$$

In order to make the problem non-trivial, the expected return from job creation in period zero must be positive, i.e. we assume that $2(1-\beta)\pi - c > 0$.

¹⁵An interesting aspect of this crude model is that it does not contain an often used assumption, namely that the uncertainty is resolved at the end of the first period. In reality uncertainty is usually not resolved, but persists. In a model with an infinite horizon this could imply that the same decision represents itself every period in the same way. A monetary union constitutes an exception to the rule that uncertainty just continues in the sense that the start of it should definitely eliminate uncertainties about the economic environment. In this sense, the start of a monetary union might boost employment.

¹⁶ Formally, the wage bargain leads to a wage rate maximizing the Nash product $(2w-2\underline{w})^\beta(2p^*-2w)^{1-\beta}$ whose solution is $w=(1-\beta)\underline{w}+\beta p^*$, and hence the expected net return for the firm is $2p^*-2w-c=(1-\beta)(2p^*-2\underline{w})-c$.

Implicit in our model is the assumption that the firm and the worker sign a binding employment contract for two periods (zero and one). Hence they cannot sign a contract that allows for the possibility of job termination in the first period whenever the exchange rate turns out to be unfavorable. In period one (after realization of the exchange rate) the conditional expected surplus from job continuation is $E_1(S_1) = \pi + e_1$ which may be negative if the exchange rate falls in period one below $-\pi < 0$. In such circumstances, both the worker and the firm would benefit from termination. If a contract allowing for termination in period one could be signed, the unconditional expected surplus in period zero would be larger (consequently both the worker and the firm would prefer to sign such a contract).¹⁷ However, having in mind the interpretation of a rather short period length (a month, to be compatible with our empirical analysis), the assumption of a binding contract for two periods seems to be more appropriate. Of course, once a binding contract for two periods is signed, the worker always prefers continuation (since the contract wage exceeds the fallback wage), and the firm would incur losses if the exchange rate turns out to be unfavorable. Later on in this chapter we consider an alternative set-up which allows for the possibility of job destruction. It turns out that in this case uncertainty does not delay job creation, but job destruction becomes more likely if uncertainty increases. Hence, the negative relationship between exchange rate variability and employment is robust to this variation.

If the firm waits until *period one* it keeps the option of whether or not to open a job. It will create a job only if the exchange rate realised during period one (and so expected for period two) is above a certain threshold level, or barrier, denoted by b . Given that an employment relationship in period one yields a return only during period two, this barrier to make the creation of the job just worthwhile is given by the condition that the (conditional) expected net return to the firm is zero:

$$(2) \quad (1-\beta)(p^* + b - \underline{w}) - c = 0 \text{ or } b = c/(1-\beta) + \underline{w} - p^* = c/(1-\beta) - \pi .$$

Whenever $e_1 \geq b$, the firm creates a job in period one, and the conditional expected net return to the firm is $E_1(\Pi_1) = (1-\beta)(\pi + e_1) - c \geq 0$. Whenever $e_1 < b$, the firm does not create a job in period one, and its return is zero. Hence, whenever both events occur with positive probabili-

¹⁷ Of course, such a flexible contract implies that some exchange rate risk is shared between the worker and the firm. However, the reason why they both benefit is not the risk-sharing aspect, but the fact that the flexible contract excludes continuation of unprofitable work relationships.

ties (i.e. whenever $\sigma_1 > b > -\sigma_1$)¹⁸, the unconditional expected return of waiting in period zero is given by:

$$(3) \quad E_0(\Pi_1) = [(\sigma_1 + b)/(2\sigma_1)]0 + [(\sigma_1 - b)/(2\sigma_1)][(1-\beta)(\pi + (\sigma_1 + b)/2) - c],$$

where the first element is the probability that it will not be worthwhile to open a job (in this case the return is zero). The second term represents the product of the probability that it will be worthwhile to open the job (because the exchange rate is above the barrier) and the average expected value of the net return to the firm under this outcome. Given condition (2) this can be rewritten as:

$$(4) \quad E_0(\Pi_1) = (1-\beta) (\sigma_1 - b)^2 / (4\sigma_1).$$

This is the key result since it implies that an increase in uncertainty *increases* the value of the waiting strategy, since equation (4) is an increasing function of σ_1 .¹⁹ As σ_1 increases it becomes more likely that it is worthwhile to wait until more information is available about the expected return during period two. At that point the firm can avoid the losses that arise if the exchange rate is unfavorable by not opening a job. This option not to open the job becomes *more valuable with more uncertainty*. The intuitive explanation is that waiting implies that the firm foregoes the expected return during period one, but it keeps the option not to open the job which is valuable if the exchange rate turns out to be unfavorable. The higher the variance the higher the potential losses the firm can avoid and the higher the potential for a very favorable realization of the exchange rate, with consequently very high profits.

It is now clear from (1) and (4) that a firm prefers to wait if and only if

$$(5) \quad (1-\beta)(\sigma_1 - b)^2 / (4\sigma_1) > 2(1-\beta)\pi - c.$$

As the left hand side is increasing in σ_1 , the firm delays job creation if exchange rate uncertainty is large enough. The critical value at which (5) is satisfied with equality can be solved as²⁰

$$(6) \quad \sigma_1^* = 3\pi - c/(1-\beta) + 2\sqrt{\pi(2\pi - c/(1-\beta))}.$$

¹⁸ We do not a priori restrict the sign of the barrier b . Hence one of these conditions is automatically satisfied, whereas the other is satisfied only if uncertainty is large enough.

¹⁹ Formally this results from the fact that equation (4) is only valid whenever σ_1 exceeds b (otherwise the exchange rate could never exceed the barrier and the firm never creates a job in period 1) and whenever $-\sigma_1$ is lower than b (otherwise the exchange rate could never fall below the barrier and the firm always creates a job in period one).

Whenever $\sigma_1 > \sigma_1^*$, firms decide to postpone job creation in period zero. Since σ_1^* is increasing in π (and thereby decreasing in the fallback wage \underline{w}), decreasing in the cost of job creation c and decreasing in the worker's bargaining power β , we conclude that a strong position of workers in the wage bargain (reflected in a high fallback wage or in the bargaining power parameter) and higher costs of hiring raise the option value of waiting and make a postponement of job creation more likely. Thus, the adverse impact of exchange rate uncertainty on job creation and employment should be stronger if the labor market is characterized by generous unemployment benefit systems, powerful trade unions, minimum wage restrictions or large hiring costs. That such features of the labor market are detrimental to employment is of course not surprising. The adverse impact of these features on employment has been confirmed empirically in various studies, and there are many other theoretical mechanisms explaining it (see e.g. Nickell 1997 and Layard, Nickell and Jackman 1991). What our simple model shows is that these features also reinforce the negative employment effects of exchange rate uncertainty.

Another important implication of the model is that *only the current*, short term uncertainty σ_1 has an impact on the decision to wait. Future uncertainty, represented here by σ_2 , does not enter in the decision under risk neutrality. If one takes a fixed period, e.g. one month, the likelihood that job creation will be postponed to the end of that period depends only on the uncertainty during that period and not on future uncertainty. This implies that *even short spikes* in uncertainty as, e.g., grasped by a contemporaneous uncertainty proxy in empirical investigations of the real option effect detected above, can have a *strong impact* on employment.

In the following, we consider the scenario of a labor market in which the firm and the worker can sign *a contract only for one period* and keep the option to terminate the work relationship whenever it becomes unprofitable. In period 1, the conditionally expected surplus of job continuation is $\pi + e_1$ which is positive whenever $e_1 > -\pi$. Hence, whenever uncertainty is large enough ($\sigma_1 > \pi$), there is job destruction in period 1 with probability $(\sigma_1 - \pi)/(2\sigma_1)$. The (unconditional) expected net return to the firm from a job created in period zero (and with the option of destruction in period one) is therefore

$$(7) \quad E_0(\Pi_0) = [(1-\beta)\pi - c] + [(\sigma_1 - \pi)/2\sigma_1]0 + [(\sigma_1 + \pi)/2\sigma_1](1-\beta)[\pi + (\sigma_1 - \pi)/2],$$

where the first term is the expected return from the job in period one, whereas the second and third term represent the expected surplus from the job in period two (after destruction or after

²⁰ The other (smaller) solution to this equation is less than $|\beta|$ and is therefore not feasible.

continuation in period one) under the assumption $\sigma_1 > \pi$. If $\sigma_1 < \pi$, the job would never be destroyed, and the expected net return is, as before, $2(1-\beta)\pi - c$. Hence, after rearranging (7), the expected net return from a job created in period zero can be written

$$E_0(\Pi_0) = \begin{cases} 2(1-\beta)\pi - c, & \text{if } \sigma_1 < \pi, \\ (1-\beta)\left(\pi + (\sigma_1 + \pi)^2/(4\sigma_1)\right) - c, & \text{if } \sigma_1 \geq \pi. \end{cases}$$

On the other hand, if the firm waits until period one, the (unconditional) expected net return is, as before,

$$E_0(\Pi_1) = \begin{cases} \max(0, (1-\beta)\pi - c), & \text{if } \sigma_1 < |\pi - c/(1-\beta)|, \\ (1-\beta)(\sigma_1 + \pi - c/(1-\beta))^2/(4\sigma_1), & \text{if } \sigma_1 \geq |\pi - c/(1-\beta)|. \end{cases}$$

It is now easy to see that the firm never delays job creation. First, if $\sigma_1 \leq |\pi - c/(1-\beta)| < \pi$, the firm never destroys a job in period one, and so we have $E_0(\Pi_0) > E_0(\Pi_1)$. Second, if $\sigma_1 \geq \pi$, the condition $E_0(\Pi_0) > E_0(\Pi_1)$ means that

$$4\sigma_1(\pi - c/(1-\beta)) + (\sigma_1 + \pi)^2 > (\sigma_1 + \pi - c/(1-\beta))^2$$

which turns out to be equivalent to $(2(1-\beta)\pi - c)(c/(1-\beta) + 2\sigma_1) > 0$ and which is satisfied because of our assumption $2(1-\beta)\pi - c > 0$. Hence, the firm does not delay job creation also in this case. Finally, if $|\pi - c/(1-\beta)| < \sigma_1 < \pi$, the condition $E_0(\Pi_0) > E_0(\Pi_1)$ means that

$$4\sigma_1(2(1-\beta)\pi - c) - (1-\beta)(\sigma_1 + \pi - c/(1-\beta))^2 > 0.$$

But since this inequality is satisfied at the boundaries $\sigma_1 = \pi$ and $\sigma_1 = |\pi - c/(1-\beta)|$ and since the left hand side is a concave function of σ_1 , the inequality is also satisfied in the interval $|\pi - c/(1-\beta)| < \sigma_1 < \pi$. Hence, firms always prefer to create a job in period zero, and so exchange rate uncertainty has no impact on job creation.

However, since there is job destruction with probability $(\sigma_1 - \pi)/(2\sigma_1)$ (whenever $\sigma_1 > \pi$), *the probability of job destruction is increasing in uncertainty*. Hence, there is also a negative impact of exchange rate uncertainty on employment in this case. Moreover, this effect is more pronounced if the worker's fallback wage is higher (if π is smaller). Therefore, the basic conclusions of our basic model remain valid.

Our crude model has abstracted from risk aversion. However, we would argue that the basic conclusion, that even a temporary increase in uncertainty can make a postponement of job creation optimal does not change, is robust because a prolonged period of high uncertainty means that expected returns beyond the next period would be discounted more heavily. More-

over, the additional impact of risk aversion on job creation should be stronger under the realistic assumption that firms bear all the exchange rate risk.

In sum, we retain two conclusions from the model. First, even a *temporary* 'spike' in exchange rate variability can induce firms to wait with their creation of jobs (of course and for exactly this reason, the level of the exchange rate at the same time loses explanatory power). Second, the relationship between exchange rate variability and (un-) employment should be particularly strong if the labor market is characterized by rigidities that improve the bargaining position of workers. A stronger fallback position of workers raises the contract wage, lowers the net returns to firms and induces firms to delay job creation in the face of uncertainty.

Our argument rests on the assumption that workers cannot be fired immediately if the exchange rate turns out to be unfavorable. Hence, sunk wage payments are associated with the decision to hire a worker. These sunk costs and, consequently, the impact of uncertainty on job creation become more important if there are high firing costs. However, as we argued above, even if there are no firing costs and if workers can be laid off at any point in time, exchange rate uncertainty should have a direct impact on job destruction. A more elaborate labor market model of job creation and job destruction (e.g., following the model of Pissarides 2000, Chapter 3) might further clarify these issues, but we would expect that uncertainty has a negative effect on both job creation and destruction flows. In the empirical analysis, we therefore prefer to employ aggregate labor market indicators rather than more disaggregate job flow data.²¹

Interest rate volatility should have a similar effect as exchange rate volatility in the context of our model. A weaker domestic exchange rate increases the profits of an exporter (or the profits on domestic sales for producers competing with imports). Lower interest rates have the same effect, for all types of producers (as all production involves some investment). Uncertainty about future interest rates will be particularly important for longer term investments in the Mercosur countries in which long-term financing was simply not available during decades, thus forcing producers to rely on rolling over short term credits over long time periods.

After having modeled the impact of return uncertainty on employment and investment decisions, we now ask whether exchange rate and interest rate volatility (including a G-3 indicator variable like the volatility of the nominal and real euro-dollar exchange rate) have any ability

²¹ Klein, Schuh and Triest (2000) investigate the impact of exchange rate movements on job flows in the US. They find a response of job destruction to dollar appreciation, whereas job creation does not respond significantly to depreciations. This result reflects the asymmetric responses of job creation and destruction to aggregate

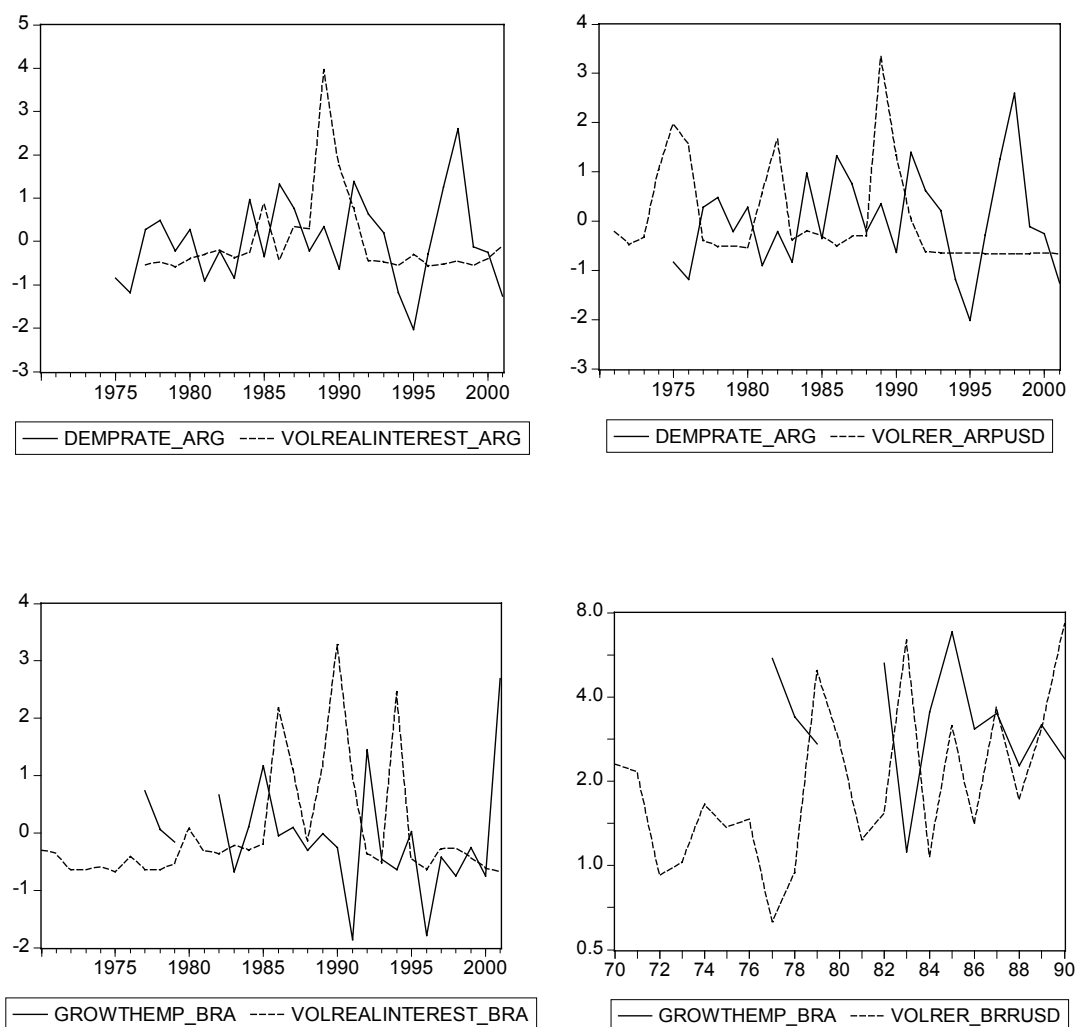
to explain the residuals of fundamental investment and (un-) employment regressions for Mercosur economies. Up to now, the amount of literature which examines the link between exchange rate variability and the real sector in emerging markets is rather thin. Hence, we feel legitimized to present and comment some first results.

4.4 Empirical analysis

In this section we present and comment the results of first tests of the importance of our array of measures of exchange rate variability and our two measures of interest rate volatility (nominal and real interest rate variability VOLINTEREST and VOLREALINTEREST) on two measures of labor market performance (changes in the unemployment rate DUNEMPRATE, employment growth EMPGROWTH) and one measure for investment (change in real gross fixed capital formation GROWTHREALINVEST) in the Mercosur countries. To start with a summary: exchange rate variability and interest rate variability enter most of the equations with the expected sign and are in most of the cases statistically significant. The empirical problem tackled in this chapter is visualized in Figure 3 below, based on the example of the respective real dollar exchange rate and real interest rate variability as determinants employment in Argentina and in Brazil. The hypothesis tested is that there is a significant impact of the variable represented by the dotted line on the variable plotted by the uninterrupted line.

shocks that have been detected in other studies. It does not contradict our conclusions, however, since job creation might just respond to *exchange rate volatility* rather than to actual appreciations or depreciations.

Figure 3: Exchange rate and interest volatility as determinants of employment in Mercosur?



Note: Data are normalized for illustration purposes. For data sources see annex A5.

Methodology

Before commenting the individual results we need to explain our methodology. In cases of doubt we always preferred *taking differences* since the disadvantages of differencing when it is not needed appear to us much less severe than those of failing to difference when it is appropriate. In the first case the worst outcome would be that the disturbances are moving average, but the estimators would still be consistent, whereas in the second case the usual properties of the OLS test statistics would be invalidated. All macroeconomic time series and the exchange rate data we use are listed in detail in the annex A5.

As a first step we present the results of some simple tests. We explain the first difference of the unemployment rate and employment growth by their own past and lags of our measures of exchange rate variability and interest rate variability. The results which are summarized below

in the Tables 6a and 6b are thus based on standard causality tests on the annual data used throughout this paper. The Tables 6a and 6b just summarize the regression results from bivariate VARs on annual data (1970-2001, sometimes shorter periods had to be used subject to data availability).²² The hypothesis tested is, as usual, that exchange rate variability and interest variability do not have an influence on the real economy variables investigated here.²³ All the results presented here are implicitly based on a comparison of two regression equations, exemplified here with respect to the impact of exchange rate variability on unemployment. The notations are chosen for consistency reasons (for a similar procedure see Belke and Gros 2001 and 2002):

$$(8) \quad DUE_t = \alpha_0 + \sum_{i=1}^N \alpha_i \cdot DUE_{t-i} + u_t, \text{ and}$$

$$(9) \quad DUE_t = \alpha_0 + \sum_{i=1}^N \alpha_i \cdot DUE_{t-i} + \sum_{i=0}^N \beta_i \cdot EXV_{t-i} + u_t,$$

where DUE_t stands for change in the unemployment rate (between period t and $t-1$), EXV_{t-i} specifies the level of exchange rate variability (between period $t-i$ and period $t-i-1$), u_t represents the usual i.i.d. error term and N is the maximum number of considered lags (here: 2 lags). Exchange rate variability (measured by one of the indicators as explained above) can then be said to "cause" unemployment if at least one β , i.e. one of the coefficients on the past and contemporaneous level of exchange rate variability, is significantly different from zero. In other words, these tests measure the impact of exchange rate variability on changes in national unemployment rates once the autonomous movements in unemployment have been taken into account by including lagged unemployment rates among the explanatory variables. Thus, a significant effect (of whatever sign) implies that one can reject the hypothesis that (the change in) exchange rate variability does not influence unemployment at the usual confidence levels. In order to be allowed to use the standard t -distribution for the purpose of model selection one has to use changes at least in the unemployment rate as the level of this variable is clearly non-stationary. Substituting the unemployment rate by the change in employment or

²² The individual regression results are available on request.

²³ We thus use VARs in first differences of the respective real variables. Since we classify all real variables as integrated of order one we feel justified to deviate from the usual specification of an Augmented Dickey-Fuller test (including a drift term) only by neglecting the (insignificant) lagged endogenous level variable. The significance of the coefficient estimates of the lags of the changes in the real variables and of the indicator of exchange

in investment in the above setting describes our proceedings in the case of employment and investment instead of unemployment. The same is valid if we insert measures of interest rate volatility instead of exchange rate volatility.

The Tables 6a and 6b show the results for Argentina and Brazil, using the eleven different volatility measures and the three real economy variables. In view of the analysis in our chapter 3, we prefer to emphasize the results gained for the *limited samples* case. The results based on full samples estimates for Argentina, Brazil and Uruguay can be found in the Annex A4. For each of the real sector variables mentioned we first used as explanatory variables only their own past and lags of the exchange rate and interest rate variability measures. Hence, each table contains 33 (= 11 times 3) entries by construction. The results reported in the first row of Table 6a, for example, imply that exchange rate variability, as measured by the standard deviation of the nominal exchange rate of the peso against the US-dollar, has a significant impact on labor markets and investment in Argentina.

As exchange rate variability could be either caused by, or stand for some other macroeconomic variables we also performed a series of robustness tests by adding

- the (first difference of the) level of the respective definition of the exchange rate, and
- the (first difference of the) real short term interest rate.

Only the coefficient estimate, its significance level and the lag order of exchange rate variability are displayed in the summary tables. The numbers in parentheses correspond to the lag order of exchange rate variability. If the impact effect is for example estimated to be lagged two years, this might indicate inflexibilities in the respective national labor market. According to our model, the expected sign of exchange rate and interest rate variability is positive for (the changes in) the unemployment rate and negative for (the changes in) employment and investment.

The specification of the underlying equations is based on the usual diagnostics combined with the Schwarz Bayesian Information Criterion (SCH). The latter is chosen as our primary model selection criterion since it asymptotically leads to the correct model choice (if the true model is among the models under investigation, Lütkepohl 1991). The regression which reveals the lowest SCH value and at the same time fulfills the usual diagnostic residual criteria is chosen.²⁴ As already stated above, the sample has been chosen to be 1970 to 2001. However, in

rate variability can then be judged on the basis of the usual standard normal respectively the asymptotic values of the student-t-distribution. See Belke and Gros (2001, 2002) and Haldrup (1990), pp. 31 f.

²⁴ However, one important precondition for their application is the same number of observations for the alternative specifications. See Banerjee et al. (1993), p. 286, Mills (1990), p. 139, and Schwarz (1978).

the case of Argentina it is limited in order to exclude its currency board period. The inclusion of the latter would have introduced structural breaks in the relationships because the correlation between exchange rate volatility as a variable that does not move and a real sector variable is nil per se. This procedure is exactly the same for each country. We never intervene to exercise a discretionary judgment. As usual, we add country specific dummies from time to time in order to account for possible breaks in the VAR relations. These dummies are added only if they improve the SCH statistics (higher informational contents even if a penalty for the extra dummy is taken into account) and do not lead to a rejection of the normality assumption of the residuals (Jarque and Bera 1987). At the same time they should contribute to fulfill the criteria on the residuals, especially those on normality. However, none of our results is due to the implementation of these dummies. Most of the dummies were also economically meaningful (relating to episodes emphasized by Díaz-Bonilla and Schamis 2001) and mostly disappeared when policy variables were introduced in the robustness tests below.

Summary of results

The results have to be read off the Tables 6a and 6b below as follows. In these tables, point estimates for the impact of exchange rate volatility and interest rate volatility are displayed together with their significance levels. For Argentina (Table 6a), the point estimate obtained from the first specification implies that a decrease of one percentage point in the variability (standard deviation) of the nominal bilateral exchange rate of the peso vis-a-vis the US-dollar is associated during the same year with a decrease in the unemployment rate of 0.06 percentage points. This is economically not significant, but it is not surprising that the effect during the same year is small. A jump in exchange rate variability from the average (9%) to zero, e.g. through the currency board, would yield in the same year already a more perceptible 0.5%. We will comment only briefly on the impact coefficients because the longer run effects depend of course on the dynamic behavior of the variables (Belke and Gros 2001 and 2002). Only the results of the best, basic specification are displayed.

Table 6a: Regression results for Argentina (until 1990)

	DUNEMPRATE_ARG	DEMPRATE_ARG	GROWTH REALINVEST_ARG
VOLNER_ARPUSD	0.06*** (0)	-0.02** (-1)	-0.44* (0)
VOLRER_ARPUSD	0.07*** (0)	-0.03*** (-1)	-0.51* (0)
VOLNER_ARPEUR	0.04** (0)	-0.02** (-1)	-0.65** (0)
VOLRER_ARPEUR	0.05* (0)	-0.03** (-1)	-0.78** (0)
VOLNER_USDEUR	1.38*** (0)	-0.52*** (-1)	-11.33** (0)
VOLRER_USDEUR	1.41*** (0)	-0.53*** (-1)	-10.57* (0)
VOLREER_ARG	0.05* (0)	-0.03** (-1)	-0.80** (0)
VOLNEERINTRAMERC_ARG	0.06*** (0)	-0.02** (-1)	-0.44* (0)
VOLREERINTRAMERC_ARG	0.07*** (0)	-0.03*** (-1)	-0.48* (0)
VOLINTEREST_ARG	0.01*** (0)	-0.003* (-1)	-0.11*** (0)
VOLREALINTEREST_ARG	0.01*** (0)	-0.003* (-1)	-0.10*** (0)

Note: Point estimates for the impact of exchange rate volatility are displayed together with their significance levels (***: 1 %; **: 5 %; *: 10 %). Numbers in brackets refer to the lags of the implemented volatility variable.

The first upper right hand entry in Table 6a comes from a standard causality type regression whose results are reproduced in detail below in Table 7 in order to give a concrete example. This entry refers to the impact of the variability of the nominal bilateral exchange rate vis-à-vis the US-dollar on Argentina's labor markets. The dependent variable in this case is represented by the change in the unemployment rate (DUNEMPRATE_ARG). The depicted specification of the regression equation leads to the 'best' result in terms of the (lowest realization of the) Schwarz criterion, samples being the same throughout. The dummies for the years 1974 and 1975 approximate the stimulative fiscal and monetary policies with which the government under Isabel Peron tried to rekindle economic growth (Díaz-Bonilla and Schamis (2001), pp. 76 f.).

Table 6b: Regression results for Brazil (until 1993)

	DUNEMPRATE_BRA	GROWTHEMP_BRA	GROWTH REALINVEST_BRA
VOLNER_BRRUSD	0.11* (-1)	-0.50*** (-1)	-2.03*** (-1)
VOLRER_BRRUSD	0.28*** (0)	-0.92*** (-1)	-4.46*** (0)
VOLNER_BRREUR	0.12** (-1)	-0.65*** (-2)	-2.19** (-1)
VOLRER_BRREUR	0.26* (0)	-0.82* (-1)	-5.59*** (-0)
VOLNER_USDEUR	/	-1.78** (-2)	/
VOLRER_USDEUR	/	-1.93** (-2)	/
VOLREER_BRA	0.28* (0) 0.39* (-2)	-1.37*** (-1)	-7.13*** (0) -4.50* (-2)
VOLNEERINTRAMERC_BRA	0.04* (-1)	-0.13*** (-2)	-0.72*** (-1)
VOLREERINTRAMERC_BRA	0.05** (-1)	-0.12* (-2)	-0.87*** (-1)
VOLINTEREST_BRA	/	-0.03** (-1)	-0.16** (-1)
VOLREALINTEREST_BRA	/	-0.03** (-1)	-0.13** (-1)

Note: Point estimates for the impact of exchange rate volatility are displayed together with their significance levels (***: 1 %; **: 5 %; *: 10 %). Numbers in brackets refer to the lags of the implemented volatility variable.

Let us now interpret the results summarized in the Tables 6a and 6b above, starting with Argentina, then commenting the results for Brazil and finally concluding with some general remarks. For Argentina we focus on the results up to 1990, i.e. the inauguration of the currency board regime. It is apparent that one could no longer expect exchange rate variability to have any influence on macroeconomic variables after the installation of the currency board.²⁵ Tables 6a and 6b above show that all the different volatility variables, whether they are based on exchange rates or on interest rates, have a significant influence on labor markets and investment and that in all the cases the sign is the expected one (negative for employment and investment and positive for unemployment). Table A4 in the annex shows the results for the full sample, including the currency board period, 1991 to 2001. It is also interesting to note that

²⁵ For Argentina significant estimates only result if the nineties are excluded from the sample (see annex). Even experimenting with a dummy for the currency board period did not help in this respect. In addition, it turned out that the implementation of a dummy for 1990 would have had a strong inadequate impact on the results.

the effect of both exchange rate and interest rate volatility are contemporaneous for unemployment and investment, but lagged one period in all cases for employment. This might be due to the fact that in times of increased uncertainty firms stop first investing in machinery (investment) and the workforce (no new hiring). This they can do immediately. However, they might take some time to see how things work out before they actually start hiring.

Table 7: Example regression for Argentina: unemployment rate on the variability of the nominal bilateral exchange rate vis-à-vis the US-dollar

Dependent Variable: DUNEMPRATE_ARG				
Method: Least Squares				
Sample(adjusted): 1973 1990				
Included observations: 18 after adjusting endpoints				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.214707	0.254948	-0.842163	0.4162
DUNEMPRATE_ARG(-1)	-0.565809	0.174110	-3.249719	0.0070
DUNEMPRATE_ARG(-2)	-0.251537	0.151962	-1.655258	0.1238
D74	-3.328228	0.821639	-4.050718	0.0016
D75	-3.953302	0.974150	-4.058207	0.0016
VOLNER_ARPUSD	0.060749	0.016028	3.790162	0.0026
R-squared	0.743486	Mean dependent var	0.038889	
Adjusted R-squared	0.636606	S.D. dependent var	1.259850	
S.E. of regression	0.759465	Akaike info criterion	2.548798	
Sum squared resid	6.921453	Schwarz criterion	2.845588	
Log likelihood	-16.93918	F-statistic	6.956224	
Durbin-Watson stat	1.708864	Prob(F-statistic)	0.002880	

Note: D74 and D75 are 'Peron'-Dummies defined in the text.

Concerning individual volatility measures it is apparent that real and nominal measures have usually the same point estimates and significance levels. This is not surprising in view of the fact that in the very short run (monthly data for the volatility measures) changes in nominal and real exchange rates are highly correlated (but not exactly the same, as documented elsewhere). It is also not surprising that the dollar/euro exchange rate variability has a larger point estimate than that of the volatility of the national exchange rate against the dollar because the former is much less variable than the latter.

For Brazil we obtain a similar pattern as for Argentina: the results are much stronger when we limit the sample to the period before the real plan, i.e. up to 1993.²⁶ For this sample period we find again that all the significant coefficients have the expected sign, and seem to act with a lag of one or two years. The latter can serve as a first hint in favor of exogeneity of the volatility variables with respect to the real sector variables (Belke and Gros 2001). As a striking fact, the lag structure is exactly the same for the unemployment rate and growth of real investment. We would give the same interpretation as above: the unemployment rate and investment can react more quickly because in times of increased uncertainty it is easier to stop immediately new hiring and investment projects. The main difference with respect to Argentina is that the dollar/euro exchange rate does not seem to be as important and interest rate volatility is not always significant. The former might be due to the difference in the geographical distribution of exports (see chapter 2). Moreover, this exactly mirrors the empirical evidence delivered by Reinhart and Reinhart (2001) that only the volatility of the own currency should matter (see section 4.1). The latter might be caused by the widespread use of indexation clauses in Brazil prior to the real plan period. The point estimates are generally higher for Brazil. This might be caused by the fact that the volatilities for Argentina are higher than those for Brazil (see section 3). The latter implies firms have adapted to this environment, implying that impact of observed changes in exchange rate variability might be lower.

Let us now turn to some more general issues. There is practically no difference between the results using the volatility of the national currency against the US dollar or against the euro. This was to be expected as the average volatility of the dollar/euro rate VOLRER_USDEUR is at 2.37 % (sample 1978 to 1990) so much lower than, for example, the average volatility of the Argentine currency (or rather currencies) in real terms against either of these two major currencies, e.g., against the euro VOLRER_ARPEUR which amounts to 9.63% (sample 1979 to 1990). For the reasons already alluded to, interest and exchange rate volatility are highly correlated (in the case of Argentina in particular). Hence, it is not surprising that the two yield not too different results, at least with respect to the sign and the significance levels.

The results are generally weaker for unemployment than for employment. This suggests that movements in and out of the labor force dominate over flows into and out of unemployment in the adjustment of the labor market. This is a quite typical finding for Latin America (see section 4.2). The significance of entry into and exit from the labor force is clearly supported

²⁶ The results for Brazil (full sample) and for Uruguay (full sample) are displayed in the annex (Tab. A2 and A3).

by our model developed in section 4.3. Let us now finally turn to some robustness tests of the empirical results gained so far.

Robustness: missing variables?

The purpose of the following is to report the results of some tests for the robustness of the relationships found so far. We try to take into account the two most plausible ways in which our measures of exchange rate and interest rate variability could stand for some other variable. For each hypothesis we then implement the same procedure based on the SCH criterion explained above.

The two hypotheses we consider are:

- i) Exchange rate variability is just a sign of a misalignment (i.e. a wrong level of the exchange rate).
- ii) Interest rate variability just reflects the financial stress defined as high real (short-term) interest rates.

ad i) A first possible reason for the significant correlation of exchange rate variability with (un-) employment and investment might be that this volatility just stands for misalignments of the real exchange rate. The sign of the correlation, negative for employment (positive for unemployment) makes it a priori unlikely that exchange rate variability just stands for a misaligned exchange rate because Mercosur currencies were usually variable when they were very weak. But this argument needs to be addressed because it represents a possible explanation for the results we obtain if devaluations are contractionary as claimed for some.

ad ii) Interest rate variability could also just be the result of a tight monetary policy. The hypothesis is that this policy leads to employment losses in the short-term, and that this is exclusively assigned to interest rate variability in Tables 6a and 6b. However, this problem of identification can be reduced by explicitly adding a variable that indicates the degree of tightness to the equation. We use the *interest rate* as a first indicator. This control variable actually improves the performance of the equation overall.²⁷

In order to take these hypotheses into account, we added the first difference (the level is not stationary) of the exchange rate in the regressions displayed in the Tables 8a and 8b, if the implemented volatility measure is one for exchange rate variability. In contrast, if an interest

²⁷ Space and time constraints did not allow us to pursue other combinations, e.g., 1) both intra- and extra-Mercosur exchange rate variability on the one hand and interest rate changes on the other hand, 2) or interest rate variability on the one hand and exchange rate changes on the other hand.

rate volatility measure enters the regression equation, the change in the respective interest rate (again, the level is non-stationary) is inserted as a control variable. Hence, in order to check for robustness, we augment the regression equations which are underlying the results depicted in Tables 6a and 6b (we use the same sample period to conceive comparability) with an additional regressor which in each case is the variable for which the respective volatility measure is calculated. For example, in row one of Table 6a we add the change in the nominal dollar exchange rate of the Argentine peso and get the first row of Table 8a. By this, we secure overall consistency of our procedure. In contrast to the Tables 6a and 6b, point estimates are now displayed for the impact of exchange rate volatility *and for the additional robustness variable* together with their significance levels. Interpreting Tables 8a and 8b, one has to keep in mind that an increasing nominal (real) exchange rate index means a nominal (real) devaluation (appreciation) of the home currency (see annex).

Table 8a: Robustness regression results for Argentina (until 1990)

	DUNEMPRATE_ARG	DEMPRATE_ARG	GROWTH REALINVEST_ARG
VOLNER_ARPUSD	0.11*** (0) -0.006** (-1)	-0.02*** (-1) 0.006*** (-2)	-0.46* (0) /
VOLRER_ARPUSD	0.06*** (0) 0.01** (-2)	-0.02** (-1) -0.007* (-2)	-0.50* (0) /
VOLNER_ARPEUR	0.04** (0) /	-0.02* (-1) 0.004* (-2)	-0.61* (-1) /
VOLRER_ARPEUR	0.05* (0) 0.02* (-2)	-0.02* (-1) -0.007* (-2)	-0.70** (0) -0.21** (-1)
VOLNER_USDEUR	1.38*** (0) -0.01* (0)	-0.70** (-1) /	-13.80* (0) /
VOLRER_USDEUR	1.45*** (0) 0.01* (0)	-0.66** (-1) /	-13.15* (-1) /
VOLREER_ARG	0.04* (0) 0.03** (-2)	-0.03* (-1) /	-0.75** (0) -0.20** (-1)
VOLNEERINTRAMERC_ARG	/	/	/
	-0.01*** (-2)	0.04** (-2)	/
VOLREERINTRAMERC_ARG	0.06*** (0) 0.02*** (-2)	-0.03** (-1) -0.007* (-2)	/
	0.01** (0) /	/	-0.10*** (0) -0.06** (-1)
VOLINTEREST_ARG	0.01** (0) /	/	-0.10*** (0) -0.06*** (-1)
VOLREALINTEREST_ARG	0.01** (0) /	/	-0.10*** (0) -0.06*** (-1)

Note: The first numbers displayed are the point estimates for the impact of exchange rate volatility. The second numbers refer to the respective robustness variable. The respective significance levels are attached to the point estimates (***: 1 %; **: 5 %; *: 10 %; -: not significant). Numbers in brackets in each case refer to the lags of the implemented volatility variable. Regression equations include the respective robustness variable. / means ‘not significant’.

The results suggest that the above mentioned hypotheses that variability just stands for a wrong level do not hold a lot of explanatory power as the addition of the change in the exchange rate does in no case change the magnitude or significance level of the coefficient of exchange rate variability (except some cases for intra-Mercosur exchange rate volatility). The argument that a high degree of variability stands for the ‘wrong’ level does not really make sense if one looks at the dollar/euro rate. We have tabulated the results, but they are more difficult to interpret since it is not clear a priori whether a strong dollar is good or bad for Mercosur exports (since the shares of the US and the EU are not that different).

Table 8b: Robustness regression results for Brazil (until 1993)

	DUNEMPRATE_BRA	GROWTHEMP_BRA	GROWTH REALINVEST_BRA
VOLNER_BRRUSD	0.16*** (-1) -0.006** (-1)	-0.66*** (-1) 0.01* (-2)	-1.89** (-1) /
VOLRER_BRRUSD	0.24** (0) -0.02* (-1)	-0.67*** (-1) -0.10** (-2)	-4.73*** (0) -0.53*** (0)
VOLNER_BRREUR	0.17** (-1) -0.009** (-1)	-0.64*** (-2) /	-2.71** (-1) /
VOLRER_BRREUR	0.65** (0) -0.06* (-1)	-0.88* (-1) /	-5.86*** (0) -0.43** (0)
VOLNER_USDEUR	/	-1.78* (-2) -	/
VOLRER_USDEUR	/	-1.93** (-2) -	/
VOLREER_BRA	/	-1.44*** (-1) /	-4.60** (-2) -0.70*** (-1)
VOLNEERINTRAMERC_BRA	0.04* (-1) /	-0.14*** (-2) -	-0.63*** (-1) +0.07** (-2)
VOLREERINTRAMERC_BRA	0.05** (-1) /	-0.12* (-2) /	-0.87*** (-1) /
VOLINTEREST_BRA	/	-0.03** (-1) -0.009** (-1)	-0.14** (-1) -0.05** (-1)
VOLREALINTEREST_BRA	/	-0.03** (-1) -0.01** (-1)	-0.13** (-1) -0.06** (-1)

Note: The first numbers displayed are the point estimates for the impact of exchange rate volatility. The second numbers refer to the respective robustness variable. The respective significance levels are attached to the point estimates (***: 1 %; **: 5 %; *: 10 %; -: not significant). Numbers in brackets in each case refer to the lags of the implemented volatility variable. Regression equations include the respective robustness variable. / means ‘not significant’.

As expected, adding the real short term interest rate to the equation does in some cases change the results in the sense that the coefficient on interest rate variability does not remain significant. Nevertheless, for Argentina, we still find that in the four equations regarding unemployment and investment interest rate variability remains significant and enters with the expected sign. For

Brazil there are, however, more entries in the employment and investment columns. The number of significant relations even increases.

Our main focus is on the importance of volatility; we are thus not particularly interested in the size of the additional variables introduced to test for robustness. However, it is interesting to observe that for Mercosur countries a devaluation has a in most cases positive impact on the economy. The only exceptions are the two results gained for the impact of the real exchange rate of the Brazilian real against the dollar and against the euro on the change in the Brazilian unemployment rate. The point estimates of the parameters are usually somewhat smaller for the robustness variable (the first moment) than for the second moment.

In chapter 2, we have shown that both for Argentina and Brazil the EU is the more important trade partner than the NAFTA. This relation is even more pronounced for Argentina. However, we do not find that exchange rate variability vis-à-vis the euro is more important than that vis-à-vis the dollar, as the point estimates are in most cases virtually undistinguishable.

Exogeneity of volatility variables?

Reverse causation and missing third variables are possible objections against the simple test results presented so far. Whenever exchange rate variability influences real variables with a lag, reverse causation appears less plausible. But even in cases of a contemporaneous relationship reverse causation appears not to be a problem as suggested by additional pairwise Granger causality tests which are applied to exchange rate and interest rate variability and the real sector variables used in this contribution. Hence, the Tables A4 and A5 in the annex each display the results from (11 volatility variables times 3 real sector variables =) 33 pairwise Granger causality tests.

For the data for Argentina and Brazil we are not forced to reject the hypothesis that the real sector variables do not Granger cause our volatility measures in 63 out of 66 cases. However, based on our estimates displayed in Tables 6a, 6b, 8a and 8b we do in the overwhelming majority of cases reject the hypothesis that our volatility measures do not “cause” the three real sector variables. Therefore it appears that “causality” runs from volatility to the real sector.

However, there are even some additional arguments which speak in favor of our exogeneity hypothesis for the volatility variables. We are skeptical in general about the possibility that exchange rate and interest rate variability at our high frequency was caused by slow moving variables such as labor market rigidities or unemployment and investment. A further argument validating our methodology and our results comes from the work of Canzoneri, Vallés

and Viñals (1996) and others who show for a different sample of countries that exchange rates reacted mainly to financial shocks rather than real fundamentals. Rose (1995) and Flood and Rose (1995) also emphasize that exchange rate volatility is largely noise. It does not make much sense to treat a noise series as endogenous.

Multicollinearity of volatility and robustness variables?

Are there problems of multicollinearity, e.g., for interest rate volatility? The Tables 8a and 8b suggest some collinearity between the volatility variable and the change in the exchange rate or interest rate variable, since the coefficient of the latter is sometimes not significant. Therefore, one might argue that the issue of reverse causation from real variables to exchange rate variability appears to be less of a problem than the possibility that exchange rate volatility might itself be affected by the additional regressors considered in the larger VARs introduced in this section. To check for robustness we applied (2 times 22 =) 44 pairwise Granger-causality tests to exchange rate volatility and the additional explanatory variables. On the whole, these tests (Tables A6 and A7 in the annex) confirm that our regression results are not spurious.

Finally, we would like to stress again that one should be very cautious with any far-reaching conclusions in view of the weak quality of the labor market data for the Mercosur countries.

5. Summary and outlook

The data from the past investigated by us suggest that exchange rate variability (whether extra- or intra-Mercosur) and interest rate variability have had a statistically significant negative impact on employment, and investment for a number of countries like Argentina, Brazil and Uruguay. We have argued that this result is due to the fact that all employment and investment decisions have some degree of irreversibility. Our model of the 'option value of waiting' also suggests that temporary short-run increases in variability could have a stronger impact than permanent ones on decisions that involve sunk costs, such as hiring, firing or investing. Our results here confirm earlier results for European countries, which went in the same direction. The fact that similar results were obtained for other countries as well, renders the limited number of observations, which would otherwise constitute a reason to be cautious, less important.

We have investigated on both intra- and extra-Mercosur exchange rate variability because the geographical distribution of trade of the countries in question is less concentrated than for European countries. We are aware of the general finding in the empirical literature that the impact of exchange rate variability on trade is small. However, we do not want, nor need, to take a stance

on whether the economic impact of exchange rate variability on trade is strong or not. We simply argue that exchange rate variability has a stronger impact on investment and employment than on current production and exports, because the latter can be adjusted with the existing labor through variations in utilization rates. Irreversibility of set-up costs is thus not an important consideration for production that can be sold within weeks or days, whereas it is crucial for long-run decisions, such as decisions to invest or to hire additional workers.

In general, our results are rather strong in that we find in almost all cases, and despite extensive robustness tests, that exchange rate and interest rate variability have a significant impact on investment and employment. However, the impact is smaller than estimated by ourselves (Belke and Gros 2001) for the pre-EMU period in Europe. In this respect, we argued that the 'nature' of exchange rate variability is different from pre-EMU Europe and at times much larger. This implies that firms have adapted to the environment, implying that the impact of observed changes in exchange rate variability might be lower. But we also acknowledge that some aspects of the results remain unsatisfactory. The prior that intra-Mercosur exchange rate volatility has a higher impact on Argentina's real sector (exports to the Mercosur trade bloc amount to 2.7 percent of its GDP) than for the Brazilian one (only 0.9 % of GDP go to Mercosur countries) is only partially corroborated by the estimations. This is a general feature also of our earlier work in the sense that for Europe we also did not find a systematic correlation between openness and the strength of the impact of exchange rate volatility on trade. This is the main reason why we do not invoke more the general finding of the literature on the impact of exchange rate variability on international trade, which is that for LDCs this channel is much more important.

What are the implications of the results for the debate on exchange rate policy in Mercosur and on the design of intra-Mercosur monetary relations? By accepting our main result one could jump to the policy conclusion that fixing exchange rates either within the Mercosur or against G-3 currencies should bring about significant benefits. Our estimates are not precise enough to decide which option would yield larger benefits. Whether there are benefits depends essentially on whether the gains from suppressing exchange rate variability are lost if the volatility reappears elsewhere, for example in a higher dollar variability or higher interest rate variability. Recent research (Rose 1995) shows that official action can reduce exchange rate variability even holding constant the variability of fundamentals such as interest rates and money.

We would argue that fixing the exchange rate might be beneficial if the underlying policies are compatible with this choice. This is a big if as the experience of Argentina shows if fiscal policy is out of control then fixing the exchange rate might just suppress the appearance of the true

problem temporarily. In the case of Argentina one might even argue that the currency board worked too well for too long, thus allowing a considerable dis-equilibrium to accumulate under the surface. The explosion that followed in the end then might have such high costs that it can easily offset the benefits of a stable exchange rate that were accumulated in the preceding 10 years. Our analysis is more appropriate for countries and time periods during which there are no violent regime shifts. Our results should become relevant again when Mercosur countries will have shifted to a 'normal' regime, which has two aspects: first, that movements of the exchange rate do not take extreme values because of doubts that the country will go bankrupt or sink into anarchy, and, secondly, that any fixing of exchange rates is supported by other policy choices. To enforce this, any renewed attempt to fix exchange rates (either within the region or by using an external anchor) would have to be accompanied by tight fiscal policy rules.

In sum, we maintain that the high degree of exchange rate variability observed from time to time in Mercosur has tangible economic costs, but that fixing exchange rates was too often considered a free lunch by irresponsible politicians.

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Annex

1. Construction of exchange rate and interest rate variability series

What kind of exchange rate did we take as the basis for our calculations? To measure volatility of the Mercosur currencies themselves, we used both the nominal and real bilateral US-dollar rates and the real effective exchange rates of the Mercosur currencies. Following the hypothesis by Reinhart and Reinhart (2001) that it is G-3 volatility which matters for the real sector of emerging markets (especially those with a peg to a G-3 currency), we use the nominal and real bilateral exchange rate of the US-dollar vis-à-vis the euro area (reconstituted for the past) and the effective rates of the dollar and the euro. In order to have percentage changes we either used directly the first difference of the raw numbers for the exchange rates when they are indices, with a base around 100. In the case of the remaining rates we used the first difference of the natural logarithm. The historical series of the external effective exchange rate of Euroland was taken directly from the official sources, which calculate the average of bilateral exchange rates of the 11 present euro countries, with weights given by the non-euro trading partners. In order to convey an exact picture of our proceedings, the algorithm for the construction of the variability variables (VOL ...) is described in the annex as well.

We use *monthly* exchange rates to calculate volatility instead of daily (or other higher frequency) volatility because the required data were easier to obtain on a consistent basis for the entire sample period. Another reason to prefer this measure over more short-term alternatives (e.g., daily variability) was that we are convinced that while the latter might be important for financial actors it is less relevant for decisions whether *to employ or to invest*, which have a longer time horizon. The drawback of this decision was that we had to use annual data in order to have a meaningful measure of variability. We thus had only about 31 observations for each country, but this turned out to be sufficient.

In principle one could have used option prices to extract implicit forward looking volatilities, but option prices are generally available only for the US dollar and sometimes against the DM (the euro), and even then only for limited periods. Hence, it would not have been possible to construct a measure of euro volatility on a consistent basis using option prices. We used *actual* exchange rate changes instead of only unanticipated ones. But at the monthly horizon the anticipated change is usually close to zero. That's why actual and unanticipated changes should give the same results. An advantage of using monthly data is that price indices are available on a monthly basis so that one could use real exchange rates. We have preferred to

start with nominal rates in this first test since over a short-term horizon nominal and real exchange rates are usually highly correlated.

Concerning our measure of interest rate volatility we apply an analogous procedure. In most cases (Argentina, Paraguay and Uruguay) we refer to the deposit rate. In the case of Brazil, we use the money market rate; for the euro zone we choose the German money market rate until December 1994 and from January on the 3-month rate. Finally, the U.S. interest rate is approximated by the treasury bill rate. Real interest rates are deflated with the respective consumer price index (see annex). When calculating the relevant volatilities for the euro-dollar relationship, we used the interest rate *differential* instead of the interest rate levels in this case, because it is not ex ante obvious whether, e.g. the U.S. interest rate is exogenous to the euro interest rate (as it might be presumed for the U.S. interest rate with respect to, e.g., Argentina).

It seems important to note that the model for a negative relationship between G-3 exchange rate and interest (or monetary aggregate) volatility developed by Reinhart and Reinhart (2001), pp. 5 ff. is not exactly based on our measure of volatility. However, their measure is closely linked to our than to the first moment of exchange rate and interest rate changes which are also often used in this context. The same is valid with respect to Calvo und Reinhart (2000), pp. 5 ff. who use annual averages of the absolute value of the monthly change in the logarithm of the real exchange rate and of the percentage point change in the real treasury bill rate.

2. Plot of selected volatility variables

In the following, some examples of our volatility measures are displayed graphically.

Figure A1: Volatilities of real effective exchange rates

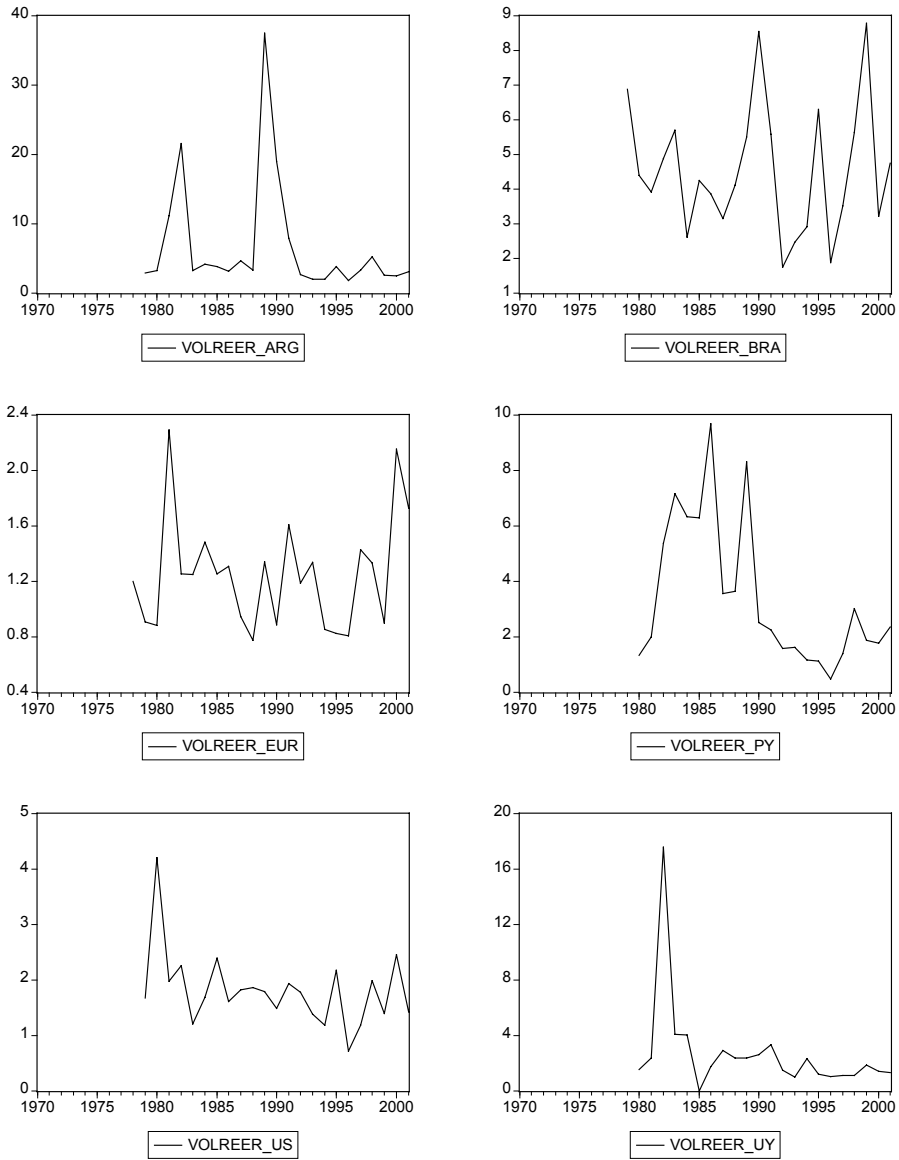


Figure A2: Volatilities of intra-Mercosur real effective exchange rates

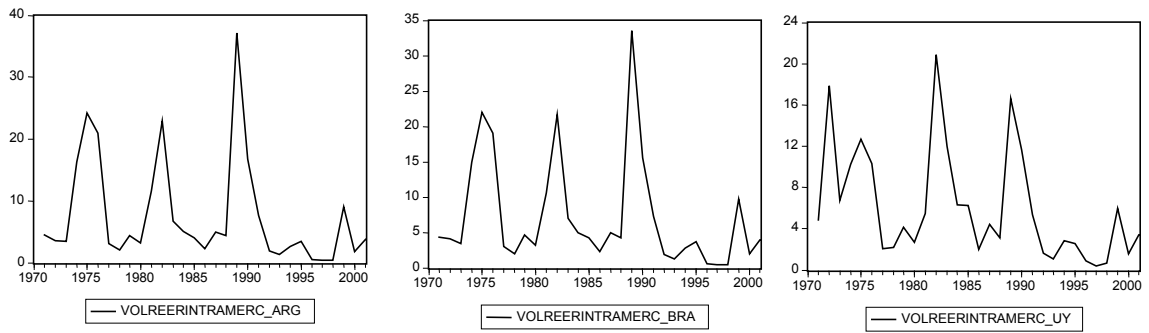
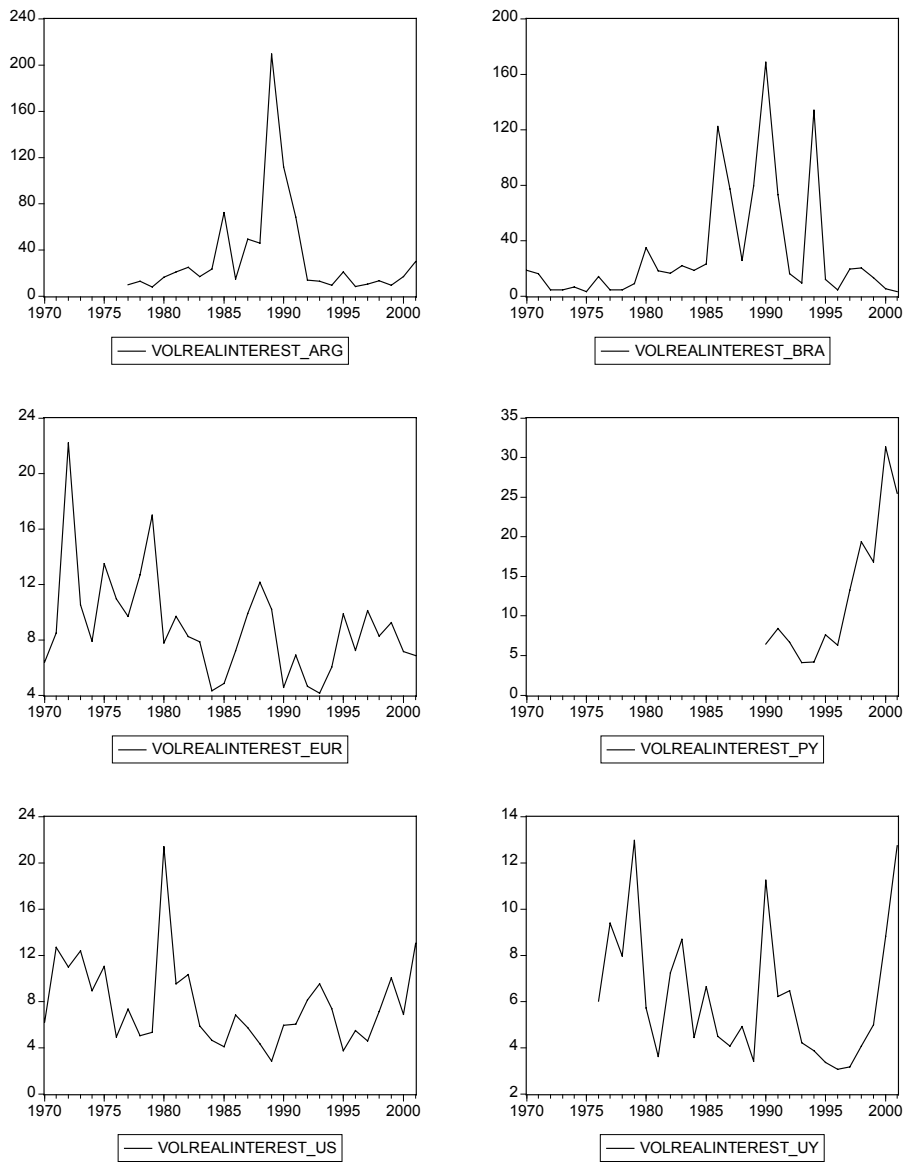


Figure A3: Volatilities of real short-term interest rates



3. Program to calculate Mercosur exchange rate and interest variability series

```
SMPL 1970.1 2001.12

FOR %EX NER_ARPBRR NER_ARPEUR NER_ARPPYG NER_ARPUSD NER_ARPUYP
NER_BRREUR NER_BRRPYG NER_BRRUSD NER_BRRUYP NER_PYGEUR
NER_PYGUSD NER_PYGUYP NER_USDEUR NER_UYPEUR NER_UYPUSD
RER_ARPBRR RER_ARPEUR RER_ARPPYG RER_ARPUSD RER_ARPUYP RER_BRREUR
RER_BRRPYG RER_BRRUSD RER_BRRUYP RER_PYGEUR RER_PYGUSD
RER_PYGUYP RER_USDEUR RER_UYPEUR RER_UYPUSD REER_ARG REER_BRA
REER_EUR REER_PY REER_US REER_UY INTEREST_ARG INTEREST_BRA INTEREST_EUR
INTEREST_PY INTEREST_US INTEREST_UY REALINTEREST_ARG
REALINTEREST_BRA REALINTEREST_EUR REALINTEREST_PY REALINTEREST_US
REALINTEREST_UY

GENR VOL%EX = NA

FOR !1=0 to 372 STEP 12

SMPL 1970.1+!1 1970.12+!1

GENR VOL%EX=SQR(@VAR(D(log(%EX))*100))

NEXT

NEXT

FOR %INTEREST DIFINTEREST_EURUS DIFREALINTEREST_EURUS

GENR VOL%INTEREST = NA

FOR !1=0 to 372 STEP 12

SMPL 1970.1+!1 1970.12+!1

GENR VOL%INTEREST=SQR(@VAR(D(%INTEREST)/%INTEREST(-1)))

NEXT

NEXT
```

4. Regression and Granger causality tests results

Table A1: Regression results for Argentina (full sample)

	DUNEMPRATE_ARG	DEMPRATE_ARG	GROWTHREALINVEST_ARG
VOLNER_ARPUSD	/	/	-0.64*** (0) +1.14*** (-1)
VOLRER_ARPUSD	/	-0.03* (-1) +0.03** (-2)	-0.72*** (0) +1.35*** (-1)
VOLNER_ARPEUR	/	/	-0.72*** (0) 1.22*** (-1)
VOLRER_ARPEUR	/	/	-0.86** (0) 1.49*** (-1)
VOLNER_USDEUR	1.12*** (0) 1.02*** (-2)	-0.26* (-1)	-8.97*** (0)
VOLRER_USDEUR	1.10*** (0) 1.00** (-2)	-0.27* (-1)	-8.46** (0)
VOLREER_ARG	/	+0.04* (-2)	-0.80*** (0)
VOLNEERINTRAMERC_ARG	/	-0.02* (-1) +0.03*** (-2)	-0.45** (0)
VOLREERINTRAMERC_ARG	/	+0.04*** (-2)	-0.53** (0)
VOLINTEREST_ARG	/	/	-0.18*** (0) +0.30*** (-1)
VOLREALINTEREST_ARG	/	/	-0.18*** (0) +0.29*** (-1)

Note: Point estimates for the impact of exchange rate volatility are displayed together with their significance levels (***: 1 %; **: 5 %; *: 10 %). Numbers in brackets refer to the lags of the implemented volatility variable.

Table A2: Regression results for Brazil (full sample)

	DUNEMPRATE_BRA	GROWTHEMP_BRA	GROWTHREALINVEST_BRA
VOLNER_BRRUSD	/	-0.16* (-1)	-0.65* (-2)
VOLRER_BRRUSD	/	-0.46* (-1)	-2.46*** (0)
VOLNER_BRREUR	0.10** (-1)	-0.30*** (-2)	-0.78* (-2)
VOLRER_BRREUR	/	/	/
VOLNER_USDEUR	/	-2.30** (-2)	/
VOLRER_USDEUR	/	-2.36** (-2)	/
VOLREER_BRA	0.20** (-1)	-0.54** (-1)	-3.09** (0)
VOLNEERINTRAMERC_BRA	0.04* (-1)	-0.08* (-2)	-0.61*** (-1)
VOLREERINTRAMERC_BRA	0.05** (-1)	/	-0.76*** (-1)
VOLINTEREST_BRA	/	-0.03** (-2)	-0.11** (-1)
VOLREALINTEREST_BRA	/	-0.03** (-2)	-0.10* (-1)

Note: Point estimates for the impact of exchange rate volatility are displayed together with their significance levels (***: 1 %; **: 5 %; *: 10 %). Numbers in brackets refer to the lags of the implemented volatility variable.

Table A3: Regression results for Uruguay (full sample)

	DUNEMPRATE_UY	GROWTHEMP_UY	GROWTH REALINVEST_UY
VOLNER_UYPUSD	0.28*** (0)	-2.26** (-2)	-1.53** (0) -1.16** (-1)
VOLRER_UYPUSD	0.27*** (0)	/	-1.46*** (0)
VOLNER_UYPEUR	0.30*** (0)		-2.58*** (-1)
VOLRER_UYPEUR	0.30*** (0)		-2.69*** (-1)
VOLNER_USDEUR	/	/	-7.17* (0)
VOLRER_USDEUR	/	/	-6.47* (0)
VOLREER_UY	0.33*** (0)	/	-2.52*** (-1)
VOLNEERINTRAMERC_UY	0.11* (0)	-0.10** (-1)	-0.68** (0)
VOLREERINTRAMERC_UY	0.18*** (0)	-0.15** (-1)	-0.96** (0)
VOLINTEREST_UY	0.15** (0)	/	-2.81** (0)
VOLREALINTEREST_UY	0.18* (0)	-0.19* (0)	/

Note: Point estimates for the impact of exchange rate volatility are displayed together with their significance levels (***: 1 %; **: 5 %; *: 10 %). Numbers in brackets refer to the lags of the implemented volatility variable.

Table A4: Pairwise Granger causality tests for exogeneity, Argentina (until 1990)

Sample: 1970 1990			
Lags: 2			
Null Hypothesis:	Obs	F-Statistic	Probability
DUNEMPRATE_ARG does not Granger Cause VOLNER_ARPUSD	18	0.12724	0.88160
DEMPRATE_ARG does not Granger Cause VOLNER_ARPUSD	14	0.11310	0.89431
GROWTHREALINVEST_ARG does not Granger Cause VOLNER_ARPUSD	18	1.41721	0.27747
DUNEMPRATE_ARG does not Granger Cause VOLRER_ARPUSD	18	0.12798	0.88096
DEMPRATE_ARG does not Granger Cause VOLRER_ARPUSD	14	0.77229	0.49030
GROWTHREALINVEST_ARG does not Granger Cause VOLRER_ARPUSD	18	1.87850	0.19202
DUNEMPRATE_ARG does not Granger Cause VOLNER_ARPEUR	10	0.41030	0.68392
DEMPRATE_ARG does not Granger Cause VOLNER_ARPEUR	10	0.15039	0.86412
GROWTHREALINVEST_ARG does not Granger Cause VOLNER_ARPEUR	10	2.97760	0.14073
DUNEMPRATE_ARG does not Granger Cause VOLRER_ARPEUR	10	0.56661	0.60007
DEMPRATE_ARG does not Granger Cause VOLRER_ARPEUR	10	0.87667	0.47166
GROWTHREALINVEST_ARG does not Granger Cause VOLRER_ARPEUR	10	1.66061	0.27987
DUNEMPRATE_ARG does not Granger Cause VOLNER_USDEUR	11	0.13773	0.87401
DEMPRATE_ARG does not Granger Cause VOLNER_USDEUR	11	0.23971	0.79405
GROWTHREALINVEST_ARG does not Granger Cause VOLNER_USDEUR	11	3.46332	0.10000
DUNEMPRATE_ARG does not Granger Cause VOLRER_USDEUR	11	0.01988	0.98038
DEMPRATE_ARG does not Granger Cause VOLRER_USDEUR	11	0.07952	0.92452
GROWTHREALINVEST_ARG does not Granger Cause VOLRER_USDEUR	11	2.43737	0.16796
DUNEMPRATE_ARG does not Granger Cause VOLREER_ARG	10	0.69747	0.54055
DEMPRATE_ARG does not Granger Cause VOLREER_ARG	10	0.93030	0.45344
GROWTHREALINVEST_ARG does not Granger Cause VOLREER_ARG	10	1.87016	0.24752
DUNEMPRATE_ARG does not Granger Cause VOLNEERINTRAMERC_ARG	18	0.03811	0.96272
DEMPRATE_ARG does not Granger Cause VOLNEERINTRAMERC_ARG	14	0.35379	0.71137
GROWTHREALINVEST_ARG does not Granger Cause VOLNEERINTRAMERC_ARG	18	1.19252	0.33457
DUNEMPRATE_ARG does not Granger Cause VOLREERINTRAMERC_ARG	18	0.10576	0.90041
DEMPRATE_ARG does not Granger Cause VOLREERINTRAMERC_ARG	14	0.77773	0.48803
GROWTHREALINVEST_ARG does not Granger Cause VOLREERINTRAMERC_ARG	18	1.64289	0.23114
DUNEMPRATE_ARG does not Granger Cause VOLINTEREST_EUR	18	2.60862	0.11156
DEMPRATE_ARG does not Granger Cause VOLINTEREST_EUR	14	4.35821	0.04747
GROWTHREALINVEST_ARG does not Granger Cause VOLINTEREST_EUR	18	0.46633	0.63740
DUNEMPRATE_ARG does not Granger Cause VOLREALINTEREST_ARG	12	0.10970	0.89762
DEMPRATE_ARG does not Granger Cause VOLREALINTEREST_ARG	12	0.17749	0.84102
GROWTHREALINVEST_ARG does not Granger Cause VOLREALINTEREST_ARG	12	4.20507	0.06317

Table A5: Pairwise Granger causality tests for exogeneity, Brazil (until 1993)

Sample: 1970 1993			
Lags: 2			
Null Hypothesis:	Obs	F-Statistic	Probability
DUNEMPRATE_BRA does not Granger Cause VOLNER_BRRUSD	11	0.57322	0.59181
GROWTHEMP_BRA does not Granger Cause VOLNER_BRRUSD	11	0.15391	0.86063
GROWTHREALINVEST_BRA does not Granger Cause VOLNER_BRRUSD	20	0.34319	0.71493
DUNEMPRATE_BRA does not Granger Cause VOLRER_BRRUSD	11	0.02013	0.98014
GROWTHEMP_BRA does not Granger Cause VOLRER_BRRUSD	11	0.42746	0.67057
GROWTHREALINVEST_BRA does not Granger Cause VOLRER_BRRUSD	20	0.31563	0.73406
DUNEMPRATE_BRA does not Granger Cause VOLNER_BRREUR	10	0.06160	0.94096
GROWTHEMP_BRA does not Granger Cause VOLNER_BRREUR	10	0.34632	0.72301
GROWTHREALINVEST_BRA does not Granger Cause VOLNER_BRREUR	13	0.76528	0.49646
DUNEMPRATE_BRA does not Granger Cause VOLRER_BRREUR	10	0.14623	0.86753
GROWTHEMP_BRA does not Granger Cause VOLRER_BRREUR	10	0.33368	0.73109
GROWTHREALINVEST_BRA does not Granger Cause VOLRER_BRREUR	13	0.05090	0.95068
DUNEMPRATE_BRA does not Granger Cause VOLNER_USDEUR	10	1.94686	0.23698
GROWTHEMP_BRA does not Granger Cause VOLNER_USDEUR	10	3.15206	0.13012
GROWTHREALINVEST_BRA does not Granger Cause VOLNER_USDEUR	14	1.50949	0.27207
DUNEMPRATE_BRA does not Granger Cause VOLRER_USDEUR	10	1.41545	0.32576
GROWTHEMP_BRA does not Granger Cause VOLRER_USDEUR	10	2.59733	0.16846
GROWTHREALINVEST_BRA does not Granger Cause VOLRER_USDEUR	14	1.42910	0.28907
DUNEMPRATE_BRA does not Granger Cause VOLREER_BRA	10	0.27249	0.77210
GROWTHEMP_BRA does not Granger Cause VOLREER_BRA	10	1.51958	0.30507
GROWTHREALINVEST_BRA does not Granger Cause VOLREER_BRA	13	0.65453	0.54543
DUNEMPRATE_BRA does not Granger Cause VOLNEERINTRAMERC_ARG	11	0.00899	0.99106
GROWTHEMP_BRA does not Granger Cause VOLNEERINTRAMERC_ARG	11	0.03552	0.96531
GROWTHREALINVEST_BRA does not Granger Cause VOLNEERINTRAMERC_ARG	20	1.38112	0.28148
DUNEMPRATE_BRA does not Granger Cause VOLREERINTRAMERC_BRA	11	0.06423	0.93842
GROWTHEMP_BRA does not Granger Cause VOLREERINTRAMERC_BRA	11	0.14094	0.87134
GROWTHREALINVEST_BRA does not Granger Cause VOLREERINTRAMERC_BRA	20	1.61251	0.23210
DUNEMPRATE_BRA does not Granger Cause VOLINTEREST_BRA	11	1.79351	0.24513
GROWTHEMP_BRA does not Granger Cause VOLINTEREST_BRA	11	0.05188	0.94986
GROWTHREALINVEST_BRA does not Granger Cause VOLINTEREST_BRA	20	0.74368	0.49210
DUNEMPRATE_BRA does not Granger Cause VOLREALINTEREST_BRA	11	1.95062	0.22253
GROWTHEMP_BRA does not Granger Cause VOLREALINTEREST_BRA	11	0.08504	0.91956
GROWTHREALINVEST_BRA does not Granger Cause VOLREALINTEREST_BRA	20	0.49117	0.62141

Table A6: Pairwise Granger causality tests for collinearity, Brazil (until 1993)

Sample: 1970 1993			
Lags: 2			
Null Hypothesis:			
	Obs	F-Statistic	Probability
DNER_USDEUR does not Granger Cause VOLNER_ARPUSD	10	1.64941	0.28176
VOLNER_ARPUSD does not Granger Cause DNER_USDEUR		1.97201	0.23366
DRER_ARPUSD does not Granger Cause VOLRER_ARPUSD	17	0.25393	0.77981
VOLRER_ARPUSD does not Granger Cause DRER_ARPUSD		0.64730	0.54080
DNER_ARPEUR does not Granger Cause VOLNER_ARPEUR	10	0.27593	0.76971
VOLNER_ARPEUR does not Granger Cause DNER_ARPEUR		0.64037	0.56546
DRER_ARPEUR does not Granger Cause VOLRER_ARPEUR	10	0.19087	0.83199
VOLRER_ARPEUR does not Granger Cause DRER_ARPEUR		1.04636	0.41725
DNER_USDEUR does not Granger Cause VOLNER_USDEUR	10	0.17078	0.84772
VOLNER_USDEUR does not Granger Cause DNER_USDEUR		2.76643	0.15526
DRER_USDEUR does not Granger Cause VOLRER_USDEUR	10	0.30133	0.75238
VOLRER_USDEUR does not Granger Cause DRER_USDEUR		2.33932	0.19182
DREER_ARG does not Granger Cause VOLREER_ARG	10	0.06961	0.93364
VOLREER_ARG does not Granger Cause DREER_ARG		5.32913	0.05762
DNEERINTRAMERC_ARG does not Granger Cause VOLNEERINTRAMERC_ARG	17	5.08888	0.02509
VOLNEERINTRAMERC_ARG does not Granger Cause DNEERINTRAMERC_ARG		3.16092	0.07894
DREERINTRAMERC_ARG does not Granger Cause VOLREERINTRAMERC_ARG	17	0.08418	0.91980
VOLREERINTRAMERC_ARG does not Granger Cause DREERINTRAMERC_ARG		0.46574	0.63855
DINTEREST_ARG does not Granger Cause VOLINTEREST_ARG	11	1.46720	0.30287
VOLINTEREST_ARG does not Granger Cause DINTEREST_ARG		2.11429	0.20184
DREALINTEREST_ARG does not Granger Cause VOLREALINTEREST_ARG	11	1.36871	0.32382
VOLREALINTEREST_ARG does not Granger Cause DREALINTEREST_ARG		1.94391	0.22343

Table A7: Pairwise Granger causality tests for collinearity, Brazil (until 1993)

Sample: 1970 1993			
Lags: 2			
Null Hypothesis:	Obs	F-Statistic	Probability
DNER_BRRUSD does not Granger Cause VOLNER_BRRUSD	21	4.00341	0.03893
VOLNER_BRRUSD does not Granger Cause DNER_BRRUSD		0.47820	0.62848
DRER_BRRUSD does not Granger Cause VOLRER_BRRUSD	21	1.43466	0.26725
VOLRER_BRRUSD does not Granger Cause DRER_BRRUSD		0.84662	0.44720
DNER_BRREUR does not Granger Cause VOLNER_BRREUR	13	3.65378	0.07460
VOLNER_BRREUR does not Granger Cause DNER_BRREUR		1.63188	0.25446
DRER_BRREUR does not Granger Cause VOLRER_BRREUR	13	3.69713	0.07293
VOLRER_BRREUR does not Granger Cause DRER_BRREUR		0.18704	0.83294
DNER_USDEUR does not Granger Cause VOLNER_USDEUR	13	0.23825	0.79340
VOLNER_USDEUR does not Granger Cause DNER_USDEUR		1.12704	0.37049
DRER_USDEUR does not Granger Cause VOLRER_USDEUR	13	0.25428	0.78151
VOLRER_USDEUR does not Granger Cause DRER_USDEUR		1.19173	0.35236
DREER_BRA does not Granger Cause VOLREER_BRA	13	8.26253	0.01132
VOLREER_BRA does not Granger Cause DREER_BRA		0.44627	0.65502
DNEERINTRAMERC_BRA does not Granger Cause VOLNEERINTRAMERC_BRA	20	0.59728	0.56288
VOLNEERINTRAMERC_BRA does not Granger Cause DNEERINTRAMERC_BRA		2.54312	0.11193
DREERINTRAMERC_BRA does not Granger Cause VOLREERINTRAMERC_BRA	20	0.05226	0.94925
VOLREERINTRAMERC_BRA does not Granger Cause DREERINTRAMERC_BRA		0.47821	0.62902
DINTEREST_BRA does not Granger Cause VOLINTEREST_BRA	21	1.75644	0.20436
VOLINTEREST_BRA does not Granger Cause DINTEREST_BRA		1.04519	0.37444
DREALINTEREST_BRA does not Granger Cause VOLREALINTEREST_BRA	21	1.76103	0.20359
VOLREALINTEREST_BRA does not Granger Cause DREALINTEREST_BRA		0.82133	0.45756

5. Data

CPI_ARG: Consumer Price Index Argentina (1995=100), Source: Instituto Nacional de Estadística y Censos, (<http://www.indec.mecon.gov.ar>).

CPI_BRA: Consumer Price Index Brazil (1995=100), Source: IFS (IMF) series CPI (22364...ZF...) + IMF – Statistical Yearbook and various Monthly Reports.

CPI_PY: Consumer Price Index Paraguay (1995=100), Source: IFS (IMF) series CPI (22364...ZF...) + IMF – Statistical Yearbook and various Monthly Reports and Banco Central del Paraguay (from September 1999 on).

CPI_UY: Consumer Price Index Uruguay (1995=100), Source: IFS (IMF) series CPI + IMF – Statistical Yearbook and various Monthly Reports.

CPI_EUR: Consumer Price Index (1995=100), Source: until December 1994 Bundesbank, from January 1995 on ECB.

CPI_US: Consumer Price Index (1995=100), Source: IFS (IMF) series CPI (11164...ZF...) + IMF – Statistical Yearbook and various Monthly Reports.

DNER_USDEUR: = $D(\text{LOG}(\text{NER_USDEUR})) * 100$; growth rate of the nominal dollar exchange rate of the euro; the remaining exchange rate growth rates are constructed analogously.

EMP_BRA: Employment general level Brazil (in thousands): Persons aged 10 years and over. Excl. rural population of Rondônia, Acre, Amazonas, Roraima, Pará and Amapá. Sep. of each year. Prior to 1979: excl. rural areas of Northern Region, Mato Grosso, Goiás and Tocantins. 1992 methodology revised; data not strictly comparable. Source: LABORSTA (<http://laborsta.ilo.org/>), IFS (IMF) and <http://www4.bcb.gov.br/series-i/default.asp>.

EMPRATE_ARG: Evolución de la las principales variables ocupacionales (en % of employed population to total population), Empleo, Tasa de Empleo en Aglomerados Urbanos, Source: Encuesta Permanente de Hogares, INDEC. <http://www2.mecon.gov.ar/infoeco/>.

EMP_URU: Employment general level (in thousands), urban areas, incl. professional army; excl. compulsory military service, persons aged 14 years and over. 1984 and 1986 first semester, ACLARACIÓN IMPORTANTE: Hasta el año 1997 la encuesta cubría a las localidades de 900 y más habitantes y a partie del año 1998 cubre de 5.000 o más habitantes. Source: IFS (IMF), LABORSTA (<http://laborsta.ilo.org/>), Instituto Nacional de Estadística (<http://www.ine.gub.uy/>), Principales Resultados Encuesta Continua de Hogares.

EMP_PY: Employment Paraguay (in thousands), Source: Banco Central del Paraguay, Real sector data, población ocupada (<http://www.bcp.gov.py/gee/statistic/indice.htm>), see http://www.ine.gub.uy/mercosur/english/cuadros/mc_3_1.htm for the data consistency is massively hampered by different definitions of the sample, e.g., Metropolitan area of Asunción.(4) Urban area. (5) National total for urban and rural areas. Encuesta Permanente de Hogares.

INTEREST_ARG: Deposit Rate (in home currency), Source: IFS (IMF) series 21360L.ZF... .

INTEREST_BRA: Money Market Rate (in home currency), Source: IFS (IMF) series 22360B..ZF... .

INTEREST_PY: Deposit Rate (in home currency), Source: IFS (IMF) series.

INTEREST_UY: Deposit Rate (in home currency), Source: IFS (IMF) series.

INTEREST_EUR: until December 1994: German money market rate, Source: Bundesbank; from January 1995 on: 3-month rate, Source: ECB, Monthly Reports.

INTEREST_US: treasury bill rate, Source: Federal Reserve Bank.

INVEST_ARG: Gross Fixed Capital Formation Argentina (millions of Arg. peso), Source: IMF Statistical Yearbook, IFS (IMF).

INVEST_BRA: Gross Fixed Capital Formation Brazil (millions of real), Source: IMF Statistical Yearbook, IFS (IMF).

INVEST_PY: Gross Fixed Capital Formation Paraguay (billions of guarani), Source: IMF Statistical Yearbook, IFS (IMF).

INVEST_UY: Gross Fixed Capital Formation Uruguay (millions of Urug. peso), Source: IMF Statistical Yearbook, IFS (IMF).

NER_ARPUSD: IMF – Statistical Yearbook and various Monthly Reports.

NER_BRRUSD: IMF – Statistical Yearbook and various Monthly Reports.

NER_PYGUSD: IMF – Statistical Yearbook and various Monthly Reports.

NER_UYPUSD: Banco Central del Uruguay (until June 1973) and IMF – Statistical Yearbook and various Monthly Reports (from July 1973 on).

NER_USDEUR: Bilateral nominal US \$/ECU exchange rate period av., Source: IMF – Statistical Yearbook and various Monthly Reports, IFS (IMF) series 111..EB.ZF... .

The remaining bilateral nominal exchange rate time series were created via cross-rates.

NEER_PY: Nominal effective exchange rate of the Paraguayan Guarani, Source: IFS (IMF) series.

NEER_UY: Source: IFS (IMF) series.

NEER_EUR: Nominal effective exchange rate euro zone, Source: IFS (IMF) series 163..NEUZF...

NEER_US: Nominal effective exchange rate of the US-dollar based on unit labor costs, Source, IFS (IMF) series 111..NEUZF... .

REALINTEREST_ARG: real short-term interest rate of Argentina; INTEREST_ARG deflated by the consumer price index.

REALINTEREST_BRA: real short-term interest rate of Argentina; INTEREST_BRA deflated by the consumer price index.

REALINTEREST_PY: real short-term interest rate of Argentina; INTEREST_PY deflated by the consumer price index.

REALINTEREST_UY: real short-term interest rate of Argentina; INTEREST_UY deflated by the consumer price index.

REALINTEREST_EUR: real short-term interest rate of Argentina; INTEREST_EUR deflated by the consumer price index.

REALINTEREST_US: real short-term interest rate of Argentina; INTEREST_US deflated by the consumer price index.

REER_PY: Real effective exchange rate based on relative CPI of the Paraguayan Guarani, Source: IMF – Statistical Yearbook and various Monthly Reports.

REER_UY: Real effective exchange rate based on relative CPI, Source: IMF – Statistical Yearbook and various Monthly Reports.

REER_US: Real effective exchange rate of the US-dollar based on unit labor costs, Source: IFS (IMF) series 111..REUZF... .

REER_EUR: Real effective exchange rate Euro area based on unit labor costs, Source: IFS (IMF), series 163..REUZF... .

REER_ARG: Annual data: Real effective exchange rate Argentina in terms of import prices, Source: Comisión Económica para América Latina y el Caribe <http://www.eclac.org/publicaciones/DesarrolloEconomico>. Monthly data:

reer_arg =

$4.739 * RER_ARPJPY + 22.058 * RER_ARPUSD + 35.402 * RER_ARPEUR + 35.004 * RER_ARPBRR + 2.797 * RER_ARPUYP$ (weights from Center for Global Trade Analysis (2001): GTAP 5: exports + imports).

REER_BRA: Annual data: Real effective exchange rate Brazil in terms of import prices, Source: Comisión Económica para América Latina y el Caribe <http://www.eclac.org/publicaciones/DesarrolloEconomico>. Monthly data: reer_bra = $8.258 * RER_BRRJPY + 31.974 * RER_BRRUSD + 41.362 * RER_BRREUR + 16.431 * (1/RER_ARPBRR) + 1.974 * RER_BRRUYP$ (weights from Center for Global Trade Analysis (2001): GTAP 5: exports + imports).

UNEMPRATE_ARG: Evolución de la las principales variables ocupacionales (en %), Desocupación (in percent), Sources: Encuesta Permanente de Hogares, INDEC. <http://www2.mecon.gov.ar/infoeco/>.

UNEMPRATE_BRA: Unemployment rate Brazil (in percent), TAXA DE DESEMPREGO ABERTO - ORIGINAL E DESSAZONALIZADA - TAXAS MEDIAS 30 dias; Source: <http://www.ibge.gov.br> on the page "Indicadores Conjunturais" [Conjuncture Indicators] under the heading "Trabalho e Rendimento" [Labor and Income]: "Ajuste sazonal - taxa de desemprego" [Seasonal adjustment - unemployment rate]. IBGE, Diretoria de pesquisas, departamento de emprego e rendimento, pesquisa mensal de emprego.

UNEMPRATE_PY: Unemployment rate Paraguay (in percent), Source: Banco Central del Paraguay, Real sector data, población ocupada (<http://www.bcp.gov.py/gee/statistic/indice.htm>).

UNEMPRATE_URU: Unemployment rate Uruguay (in percent), Source: Instituto Nacional de Estadística INE, TASA DE DESEMPLEO ANUAL - Total País urbano y Por Departamento, <http://www.ine.gub.uy/bancodedatos/ECH/ECH%20TOT%20Des%20A.xls>.

VOLNEER_EUR: Exchange rate variability from NEER_EUR.

VOLNEER_US: Exchange rate variability from NEER_US.

VOLREER_EUR: Exchange rate variability from REER_EUR.

VOLREER_US: Exchange rate variability from REER_US.

VOL_USDEUR: Exchange rate variability from NERDOLLECU.

$VOLREERINTRAMERC_ARG = 0.926 * volrer_arpbrr + 0.074 * volrer_arpuyp.$

$VOLREERINTRAMERC_BRA = 0.8927 * volrer_arpbrr + 0.1073 * volrer_brruyp.$

$VOLREERINTRAMERC_UY = 0.60 * volrer_brruyp + 0.40 * volrer_arpuyp.$

$VOLNEERINTRAMERC_BRA = 0.8927 * volner_arpbrr + 0.1073 * volner_brruyp.$

$VOLNEERINTRAMERC_ARG = 0.926 * volner_arpbrr + 0.074 * volner_arpuyp.$

$VOLNEERINTRAMERC_UY = 0.60 * volner_brruyp + 0.40 * volner_arpuyp.$

(weights = exports plus imports weights from Center for Global Trade Analysis 2001 for consistency reasons)

The remaining volatility variables are constructed analogously.