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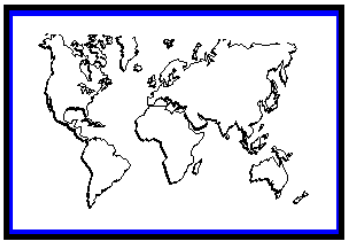

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Monetary Union and productivity di¤erences in Mercosur countries[1]

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Abstract

This paper investigates cross-country productivity convergence for the period 1960-1999. The testing strategy is based on a combination of tests and estimation methods. We use the definitions of time-series convergence by Bernard and Durlauf (1995), applying multivariate unit root tests, such as those proposed by Sarno and Taylor (1998). Moreover, in this same multivariate context, the Flôres et al. (1996) and Breuer et al. (1999) tests identify the countries that converge. Based on a sample of the 4 Mercosur countries plus associates (Chile and Bolivia) and Peru our results show evidence of convergence among the four Mercosur countries, both using Argentina and Brazil as benchmark countries. Moreover, some weaker evidence of convergence is also found with Bolivia. In contrast, convergence is rejected with Chile and Peru.

Keywords: Stochastic convergence, deterministic convergence, SUR estimation, productivity, Mercosur.

JEL classification: C32, O40.

1 Introduction.

The view that the only viable exchange rate options in the present world, characterized by a high capital mobility, are the corner solutions is increasingly extended nowadays. The logical outcome is a regionalization into currency blocs whose common currencies will ‡oat against each other. The likely future direction of the subregional and continental economic integration processes in America is far from being clear, with the creation of a Free Trade Area for the Americas (FTAA) sometimes being seen as an alternative to at least some of the subregional integration processes, as Mercosur. The recent election in 2002 of President Da Silva in Brazil has revived the debate about a future monetary union in Mercosur as a regional alternative to dollarization or currency board strategies[1]. As already di¤erent authors have assessed, Mercosur is far from achieving the necessary pre-requisites suggested by the traditional optimum currency areas (OCA) literature for a monetary union[2]. However, as a monetary union is always a goal to achieve in the long run, a more appropriate question is if the present process of integration is generating a real convergence process. In this paper we argue that the diverging path in productivity experienced by Argentina vis-à-vis the US together with its commercial dependence on Brazil at a regional level became the most important obstacle to keep its exchange rate commitment, and consequently the analysis of the di¤erences in productivity across Mercosur countries is a previous key aspect to address before any attempt to monetary integration is taken. This question was implicitly stressed in the seminal paper of De Grauwe (1975) and recently discussed for the case of Latin America in IDB, (2001, 2002). Inside a currency union, the exchange rate can only be used to gain competitiveness against third countries but not against other countries in the union. Therefore, the relationship between wages and productivity is determinant to keep a sustainable territorial equilibrium in terms of economic activity and employment inside the bloc. Divergent paths in productivity can only be o¤set increasing di¤erences in wages which can be done only in a limited extent and for a short period of time. This fact leaves the success of a monetary union very dependent on macroeconomic policy coordination in the short run and productivity convergence in the long run.

The analysis of the convergence hypothesis has regained interest as a result of new developments in the theory of economic growth. Research has concentrated on the question of convergence of GDP per capita but much less so on the question of convergence of labor productivity and/or

[1] For a short review of previous initiatives on monetary integration, see Temprano (2002).

[2] See, for instance, Levy-Yeyati and Sturzenegger (2000).

Total Factor Productivity (TFP). The new theoretical developments stress the importance of R&D activities to foster long-run growth (Romer, 1990). Moreover, economic integration, either at a global or regional level, facilitates the di¤usion of new technologies and constitutes a source of growth for less technologically advanced countries (Grossman and Helpman, 1991 and Barro and Sala-i-Martin, 1997). However, the question of whether technological spillovers provide a way towards international productivity convergence remains open from an empirical point of view. In two seminal papers, Bernard and Jones (1996a, 1996b) found evidence of TFP convergence for a group of OECD countries. More recent studies (i. e. García Pascual, 2000), have documented mixed evidence against TFP convergence, when analyzing more heterogeneous groups of countries. From a theoretical point of view, despite of the use of common technologies in di¤erent countries, productivity di¤erences may persist in the long-run due to di¤erences in social infrastructure, such as institutions and government policies or as a result of a di¤erent supply of skilled workers across countries (García Pascual, 2000). The empirical evidence for Latin America and more explicitly, for the Southern Cone is very scarce and non-conclusive[3]. The little evidence surveyed in IDB (2002) points to learning-by-exporting gains on Mercosur trade and to some importance of the import-discipline e¤ect.

In this paper we empirically investigate the extent of convergence in labor productivity at an aggregate level using annual data for the period 1960-1999. It is commonly known that di¤erences in aggregate productivity may be due to di¤erences in the sectoral mix, in the level of technology and/or in capital intensity. Even if we are aware of that relative price of labor is an important driving force behind the relevant processes, the purpose of this paper is not to discover the sources of labor productivity. Here we merely try to assess whether productivity di¤erences between Mercosur countries are persistent or we can detect a tendency for them to disappear. Moreover, according to Tyrväinen (1998), for many purposes, labor productivity is the most useful productivity measure, being more robust than most of the alternatives as eliminates biases in cross-country productivity comparisons due to di¤erences in participation rates. Even if hourly labor productivity is the most relevant measure to assess international di¤erences in competitiveness as working hours may di¤er across countries, unfortunately, hours worked are not available for any of the countries studied and we examine labor productivity on a per employee basis.

The di¤erent econometric approaches to measure real convergence can be divided into two classes: with cross-section data, tests of the average growth

[3] See Muendler (2002) for the case of Brazil and Pavcnik (2000) for Chile.

rates of the considered variable across a sample of countries (¯ convergence) as well as measures of dispersion of this variable across countries over time (¾ convergence); in the context of time series information, tests of stationarity of di¤erences in the variable levels over time (mainly, unit root and cointegration tests).

The assumptions behind these approaches are di¤erent. As pointed by Bernard and Durlauf (1996), with cross-section tests economies are assumed to be in transition towards a unique steady state (absolute convergence), and initial di¤erences should tend to shrink over time. Di¤erent steady states can also be considered (conditional convergence) introducing other explanatory variables (Barro and Sala-i-Martin, 1995) or using panel data with …xed e¤ects. However, with time series tests, economies are assumed to be near the steady-state equilibrium.

The econometric speci…cation adopted in this paper concentrates on the time series de…nition of convergence proposed by Bernard and Durlauf (1996). Their de…nition implies that the presence of a unit root or a deterministic component in the series of productivity di¤erences (with respect to the most productive country) constitutes evidence against convergence. Bernard and Jones (1996b) extended Bernard and Durlauf's de…nition to a multivariate framework by using panel data unit root tests to investigate productivity convergence. Overall, the advantage of the multivariate approach is that it enhances the power and e¢ciency of the test over the univariate counterparts. The multivariate unit root tests used here provide three signi…cant improvements over previous test employed in the study of productivity convergence. First, they allow all the parameters in the panel speci…cation to vary across countries. Second, they account for the presence of signi…cant cross-country correlations in the data. Third, when the null hypothesis of non-convergence is rejected, a second test determines the number and identi…es the converging countries.

This paper is organized as follows: in the second section, we brie‡y summarize the process of monetary integration in the American Southern Cone; in section three, we present the main de…nitions of convergence used in the paper, whereas in the following section we describe the testing hypotheses and techniques; the …fth section discusses the empirical results, and the last one concludes.

2 The monetary integration debate in Mercosur.

The process of economic integration between Argentina and Brazil started in the mid 80's on a bilateral basis. However, this process was fostered and widened in 1991, after the Asunción Treaty was signed. This Treaty started the process for the creation of a free trade zone between Argentina, Brazil, Paraguay and Uruguay, the so-called Mercosur or Southern Cone Common Market. The Treaty also established the objective of a Common Market, which would be e¤ective on January 1st 1995.

In December 1994, the Ouro Preto Summit modi…ed the pre-agreed schedule, with member countries agreeing to form a customs union previous to the implementation of a common market. The customs union began to operate on January 1st 1995 and is expected that for 2006 all exceptions had to disappear and the customs union would be in full operation.

Since its creation, Mercosur has su¤ered from recurrent trade tensions among its member countries caused by divergent macroeconomic developments and sharp ‡uctuations in their real exchange rates. In order to manage this problem, Mercosur launched in 2000 an initiative to foster coordination of their macroeconomic policies, the creation of a Macroeconomic Monitoring Group (MMG). From September 2000, the Mercosur countries started publishing harmonized indicator for …scal de…cit, debt and in‡ation.

However, since then Argentina has experienced a currency devaluation, sovereign debt default and a freeze on bank accounts that followed a ten year period of one-to-one parity with US dollar. During this time, Argentina took steps to privatize state-owned enterprises and open itself to international trade, especially with Brazil, which became Argentina's largest trading partner through the Mercosur customs union.

One big obstacle to Argentina exports was the appreciation of the dollar, and thus the peso, against other major currencies, starting in 1995 which made Argentinian goods relatively expensive to the rest of the world. Argentina and Brazil were at least in the same boat during the mid-1990s when Brazil was also pegging to the US dollar but Brazil unilaterally devalued the real in January 1999. Without a nominal devaluation of the peso, the only way market forces could reduce the real exchange value of the peso was for prices in Argentina to fall relative to prices in the US. This task was not possible, given the US productivity boom which held down US in‡ation and raised the real rates of return what implied higher real borrowing costs in Argentina's domestic credit market. Therefore, Argentina did not attend any of the two meetings the MMG held in 2001 but the new Argentine government

is more supportive of Mercosur integration and the prospects have improved.

Once Argentina has decided to abandon its currency board agreement in January 2002, the interest in monetary integration with Mercosur may be reinforced again as a way of establishing a credible monetary regime[4]. At the same time Brazil seems to be interested in re-launching the process of regional integration as an alternative to the continental one led by the US. Under this framework, the assessment of real convergence becomes a key factor for the future.

3 De…ning convergence in the context of integrated time series.

Bernard and Durlauf (1995) de…ne long-run convergence between countries i and j if the long-term forecasts of the considered variable (productivity in our case) for both countries at …xed time t are equal :

$$\lim_{k \to \infty} E(y_{i;t+k} - y_{j;t+k} \mid I_t) = 0 \qquad (1)$$

where I_t stands for the information available at time t. This de…nition will be satis…ed if $y_{i;t+k} - y_{j;t+k}$ is a mean zero stationary process. It implies that for countries i and j to converge the two series must be cointegrated with cointegrating vector $[1; -1]$. In addition, if the variables are trend-stationary, then the de…nitions imply that the time trends for each country must be the same.

The de…nition in equation (1) can be extended to more than two countries. Bernard and Durlauf (1995) call it multivariate convergence. Thus, countries $i = 1; :::; n$ converge if the long-term forecasts of output for all countries are equal at a …xed time t :

$$\lim_{k \to \infty} E(y_{1;t+k} - y_{i;t+k} \mid I_t) = 0 \qquad \forall i \qquad (2)$$

Similarly, countries $i = 1; :::; n$ contain a single common trend if the long-term forecasts of output are proportional at a …xed time t:

All these conditions have been widely applied to study the existence of convergence with the main problem being that convergence is a gradual and

[4] However, such a regime may create serious problems for Argentina and Uruguay due to their high degree of dollarization, unless Argentina's current "repeso…cation" strategy succeeds.

on-going process. Testing for cointegration is a powerful way of assessing whether convergence has already occurred.

The time series evidence has not been, in general, supportive of the convergence hypothesis. Ben-David (1994) and Quah (1994) do not …nd conclusive evidence of convergence among a large number of countries using the Summers-Heston data. Campbell and Mankiw (1989) and Bernard and Durlauf (1995) fail to …nd convergence among OECD countries. Reichlin (1999) argues that the notion of convergence derived from Quah's approach is closely related to that implied by cointegration. The di¤erence is that while Quah cares about groups, in the cointegration framework one cares about individuals. Although Quah's methodology is more adequate to handle a large number of time series, an important problem may arise when it is not possible to …nd a normalization for which the model for the quantiles is stationary: in this case, the results are di¢cult to interpret.

Following this discussion, the time series literature and, more speci…cally, the cointegration techniques, o¤er a well developed framework for testing for convergence. Cointegration is a necessary, though not su¢cient, condition for convergence to exist between two non-stationary series. Only in this case the di¤erences between the series will neither diverge or have in…nite variances. If the series under consideration are I(1), it may be reasonable to de…ne convergence in terms of the di¤erence between them being of a lower integration order (Hall, Robertson and Wickens, 1992).

The time series literature has recently bene…ted from new developments in the area of multivariate time series tests. Although Bernard and Durlauf (1995) also de…ned convergence in a multivariate setting, they were aware of the additional di¢culties of this type of analysis, mainly related to identi…cation. Two strands of the multivariate analysis have recently experienced an intense development: …rst, the panel unit root techniques and, second, the multivariate unit roots. Levin et al. (2002) and Im, Pesaran and Shin (1999) proposed di¤erent versions of unit root tests in a panel setting, whereas Hadri (2000) built stationarity tests in panels. Although all these tests are being extensively used in applied research on the …eld, their main drawback is the assumption (common to all the tests) of absence of correlation across the cross-sections of the panel. That is, the individual members of the panel (countries) are independent. This assumption cannot be maintained in the majority of the cases, specially when the countries analyzed are neighbors or are involved in integration processes. The multivariate unit root tests, in contrast, do not impose this assumption but incorporate the error covariance matrix in the estimation, by resorting to the more e¢cient SURE technique.

4 Testing hypotheses and techniques.

In this section we will brie‡y present the multivariate tests that we have applied to testing for productivity convergence in Mercosur. The tests are used sequentially. In a …rst stage, two versions of a test for non-convergence among a group of countries is applied (either the …rst stage of the Flôres et al. (1996) test or the MADF test proposed by Sarno and Taylor (1998)). However, these tests do not identify the countries that e¤ectively converge so that once (and if) non-convergence has been rejected, in a second stage, we use two more tests (multivariate SURE versions of the DF and the ADF tests) to identify which are the converging countries.

4.1 Multivariate unit root tests I: no identi…cation of countries outside the club.

The application of our approach uses unit root or stationarity tests to determine the existence and the extent of convergence. The multivariate tests in this subsection, if the null of non-convergence is rejected, are unable to identify which countries are converging.

4.1.1 Sarno and Taylor (1998) multivariate augmented Dickey-Fuller test (MADF)[5].

In the Multivariate ADF test proposed by Sarno and Taylor (1998), the sum of the autoregressive coe¢cients may vary across countries under the alternative hypothesis[6].

Sarno and Taylor (1998)'s proposal, MADF hereafter, considers an N-dimensional stochastic process de…ned by:

$$dy_{it} = {}^{1}_{i} + \sum_{j=1}^{k} \frac{1}{2}_{ij} dy_{it\ j} + u_{it} \qquad (3)$$

for $i = 1; :::; N$, where N denotes the number of series in the panel. The disturbances $u_t = (u_{1t}:::u_{N\,t})^{0}$ are assumed to be independently, normally distributed, with zero means. In contrast to the standard ADF test, that involves separately testing each of the N nulls of non-stationarity, Sarno and

[5] A …rst application of the test appeared in 1997 as a CEPR Discussion Paper that was …nally published as Taylor and Sarno (1999).

[6] Abuaf and Jorion (1990) also proposed a pooled multivariate unit root test of the DF type.

Taylor (1998) estimate the system (3) by the SURE method, taking into account the contemporaneous correlations among the disturbances. Their joint null is:

$$H_0 : \sum_{j=1} \rho_{ij} - 1 = 0; \qquad \forall i = 1, \ldots, N \tag{4}$$

and is tested by way of a Wald statistic.

The ρ coefficients are allowed to differ across the panel members and the test also permits heterogeneous lags.

Process (3) can be also be specified in differences:

$$\Delta y_{it} = \alpha_i + \rho_i y_{it-1} + \sum_{j=1} \theta_{ij} \Delta y_{it-j} + u_{it} \qquad t = 1, \ldots, T; \quad i = 1, \ldots, N \tag{5}$$

where the MADF test becomes a joint test of the null $\rho_1 = \rho_2 = \ldots = \rho_N = 0$.

4.2 Multivariate unit root tests II: identifying countries outside the club.

In the previous test, rejection of the null means that not all the members of the panel contain a unit root. Breuer et al. (1999) point out that there may be a mixture of I(0) and I(1) processes in the panel. However, as the tests are joint tests, rejection does not provide information about how many panel members follow the null and how many don't, being impossible to identify which are the stationary and non-stationary cross-sections. The two multivariate tests proposed here can, on the contrary, identify which variables contain a unit root and which do not. Thus, they complement the MADF test, and should be applied in a second stage of the analysis.

4.2.1 Flôres et al. (1996) multivariate unit root test.

Flôres, Preumont and Szafarz (1996) developed multivariate testing procedures, FPS hereafter, that generalize the multivariate pooled test by Abuaf and Jorion (1990). They consider that those tests that impose the same autoregressive parameter ρ for all countries, do not allow to differentiate the order of integration across them. Moreover, even from an econometric point of view, it might not be necessary to impose a common ρ to benefit from panel data: Thus, they propose multivariate tests with different speeds of

mean reversion in the autoregressive process:

$$dy_{it} = {}^{1}{}_{i} + \text{½}_{i} dy_{it\,i\,1} + u_{it}; \qquad i = 1; :::; N \tag{6}$$

They designed a testing strategy based on sequentially using a test that imposes the same autoregressive parameters. A rejection of the null indicates that at least some of the series may be stationary. Then, they suggest to continue with their test. Unit root tests for a particular series are more powerful if performed jointly with stationary series, because they help in weakening the in‡uence of the non-stationary ones.

The sequential testing strategy is described below, where the Monte Carlo technique has to be applied in order to obtain the critical values by simulation:

1. Under the …rst null hypothesis (called H_0), the data generating process is based on the autoregressive model with $\text{½}_i = 1$; for the N countries. If the null is not rejected the sequence stops.

2. If the null is rejected, they estimate the parameters ½_i and de…ne a set of countries I_1 for which the null is rejected. They consider that these countries' series are stationary.

3. In a third step, a new data generating process for the null is assumed, in which the series $j \in I_1$ have as slope parameters $\text{½}_j = 1$; while the slope coe¢cients are taken at their previous point estimates, $\text{½}_j = \hat{\text{½}}_j$; for the series considered stationary, that is, $j \in I_1$: Then, they use the second FPS test to check whether any of the $j \in I_1$ are non-stationary.

4.2.2 Breuer et al. (1999) multivariate test.

Breuer et al. (1999), also allow for heterogeneous serial correlation across the panel, contemporaneous correlation among the errors, and di¤erent autoregressive parameters for each panel member under the alternative. In contrast to the MADF test, separate null and alternative hypotheses are tested for each panel member within a SURE framework.

Similarly to the other tests, the SURADF test has nonstandard distributions and the critical values must be obtained by simulation. The simulation produces critical values for testing the null hypothesis that $\text{½}_i = 0$, in an equation such as (5) for each individual member of the panel. The critical values, as in the FPS case, are speci…c to the estimated covariance matrix for the system considered and the sample size and number of panel members. The procedure allows identi…cation of how many and which members of the panel contain a unit root and which do not.

5 Empirical Results

In the motivation of the paper, it has been argued that the failure of Argentina to keep its exchange rate agreement with the US can be, at least partially, explained by the diverging path followed by productivity in the two countries. Thus, before concentrating in Mercosur, we study the case of Argentina and the US.

In …gure 1, the lack of convergence becomes apparent: the productivity di¤erential between the two countries had been decreasing during the end of the sixties and the majority of the seventies; however, the gap widened during the eighties and, although it stabilized in the nineties, stayed at higher levels than those of the beginning of the sample.

Moreover, we formally test the convergence behavior of the two labor productivities using unit roots. The results appear in tables 1 and 2. First, following the de…nitions given in section 3, we test for unit roots in the productivity di¤erential. Although the presence of two roots is easily rejected both with the ADF and the Phillips-Perron test, in none of the versions of the tests it is possible to reject the non-stationarity (or divergence) of the di¤erential.

Then, as the unit root tests may have low power in the presence of structural changes (Perron, 1989), we apply several unit root tests that allow for endogenously determined breaks. The …rst two tests assume that the stochastic process has no trend and was proposed by Perron and Vogelsang (1992). Two possibilities are considered: a progressive (Innovation Outlier Model, IOM) or an instantaneous change (Additive Outlier Model or AOM). In contrast, the case of trending processes is studied in Perron (1997), who proposes tests for changes occurring in the mean of the process (model 1), in the trend (model 3) or in both (model 2)[7]. The results appear in table 2, where the rejection of the unit root hypothesis is not possible in any of the cases considered. However, it should be noted that the dummies capturing the structural changes are signi…cant in most of the cases. More precisely, in the models allowing for a change in the mean …nd it in 1983, whereas those for a changing trend …nd it in the seventies.

Thus, once the diverging path of Argentinian and US productivity has been assessed, we concentrate in the panel analysis and test for productivity convergence in the Mercosur area and associate countries (that is, Bolivia and Chile) plus Peru. Two benchmark countries are considered in the analysis: Argentina, that is the one with higher productivity along the sample, and

[7] When testing for a structural change in trending processes, we have chosen the case of the change occurring progressively, with the exception of model 3, where the corresponding test is not de…ned.

Brazil, the largest economy. In addition, two "convergence clubs" are also considered: the …rst one consists of Mercosur plus Bolivia, and the second one includes all the countries in our sample, so that Chile and Peru are added.

The …rst stage of the Flôres et al. (1996) test is presented in table 3, where the null hypothesis of non-convergence (unit root) is rejected in two of the cases: when the benchmark country is Brazil, for the group including all the countries considered, whereas when Argentina is the benchmark, the null is rejected at 10% for the Mercosur plus Bolivia club.

We also apply the Wald test proposed by Sarno and Taylor (1998), the so-called MADF test whose null hypothesis would be absence of convergence. From the results in table 4, the non-convergence is rejected in the four cases considered. This implies that some degree of convergence is present among the group of countries considered, although it is not possible to identify which are the ones converging.

Then, the second step of the analysis we sort out the converging countries using two multivariate unit root test that account for cross-sectional dependence among the elements of the panel. The …rst one, proposed by Flôres et al. (1996), is a Dickey-Fuller type test, whereas the second one, by Breuer et al. (1999) is a version of the Augmented Dickey-Fuller test. In addition, as it has been described in the previous section, the testing procedure is also di¤erent. Notwithstanding this fact, the results obtained do not show important discrepancies (see table 7 for a summary). First, according to the FPS test (see table 5), only two of the country groups are considered (non-convergence could not be rejected for two of the groups). In the case of Brazil, it would converge with the other three Mercosur countries, and some very weak convergence would be also exhibited with Bolivia. For Argentina, only the smaller group can be considered, and convergence is found with Bolivia and Brazil. Second, table 6 shows the SURADF test results. As before, Brazil converges to the Mercosur countries (with the exception of Bolivia, that does not converge at all). For Argentina, the group of countries converging is somewhat larger, although the evidence is weaker, specially in the case of Paraguay.

6 Concluding remarks.

The debate about a future monetary union in Mercosur has revived recently as a regional alternative to dollarization or currency board strategies. In this paper we argue that the diverging path in productivity experienced by Argentina against the US together with its commercial dependence on Brazil at a regional level became the most important obstacle to keep its exchange

rate commitment, and consequently the analysis of differences in productivity across Mercosur countries is a previous key aspect to address before any attempt to monetary integration is taken. In this paper we empirically investigate the extent of convergence in labor productivity at an aggregate level using annual data for the period 1960-1999. The multivariate unit roots tests used here provide three significant improvements over pervious test employed in the study of productivity convergence. First, they allow all the parameters in the panel specification to vary across countries. Second, they account for the presence of significant cross-country correlations in the data. Third, when the null hypothesis of non-convergence is rejected, a second test determines the number and identifies the converging countries.

The results obtained in the empirical analysis are as follows. First, using time series unit root tests allowing for structural changes it is not possible to find any evidence of convergence between Argentina and the US, as expected. Second, in a multivariate context and among an extended Mercosur area non-convergence is rejected when taken into account cross-sectional dependence. Finally, we are able to identify the converging countries that are basically the full Mercosur members. It should be emphasized that using any of the tests and whatever the club considered, the two largest countries (Argentina and Brazil) show convergence.

These results support the view that regional monetary integration in Mercosur cannot be discarded. However, previous to any serious attempt in this direction formal mechanisms of macroeconomic policy coordination in the short run should be established.

A Tables

Table 1
ADF and PP unit root tests
Productivity differential US vs. Argentina (1960-1999)

Test		Trend and intercept	Intercept	No det. term
ADF	¢difusar	-5.3963***	—	—
	difusar	-2.1534	-1.4772	0.5136
PP	¢difusar	-5.4275***	—	—
	difusar	-1.9921	-1.2018	0.5975

Note: See MacKinnon (1992) for the critical values of the tests. The three asterisks denote rejection of the unit root null hypothesis at 1% critical value.

Table 2
Unit root tests allowing for structural changes
by Perron and Vogelsang (1992) and Perron (1997)
Productivity difference: US vs. Argentina (1960-1999)

Model	T_b	k	$\hat{A}$	$\hat{\mu}$	$\hat{}$	$\hat{}$	$\hat{t}_{\hat{}}$
Selection criterion: t-sig (Kmax = 4)							
No trend-IOM	1983	0	—	0.0480	—	0.5387	-3.292
				(3.1492)			
No trend-AOM	1983	2	—	0.0891	—	0.4194	-3.334
				(8.182)			
Trend: Model 1-IOM	1983	0	-0.0007	0.0628	-0.0272	0.5026	-3.386
			(-0.784)	(2.576)	(-0.977)		
Trend: Model 2-IOM	1977	4	-0.0068	-0.3934	0.0197	-0.2719	-3.2524
			(-1.662)	(-2.603)	(2.575)		
Trend: Model 3-IOM	1974	1	-0.0079	—	0.0152	0.4778	-3.222
			(-3.698)		(5.526)		

Note: The critical values for the tests can be found in Perron and Vogelsang (1992) for the two first tests, tables 5 and 4, respectively; Perron (1997)

tables 1(a), 1(d) and 1(g) for Models 1, 2 and 3, respectively. Asterisks would denote rejection of the null hypothesis of a unit root.

Table 3
First stage of the Flôres et al. (1996) test

Benchmark	Club	Wald DF	99% crit.	95%	90%
Brazil	Arg, Bol, Par, Ur	11.48	19.19	14.92	12.46
Brazil	Arg,Bo,Ch,Par,Pe,Ur	24.25¤¤¤	22.66	18.03	15.53
Argentina	Bo, Br, Par, Ur	17.62¤	22.80	19.11	16.34
Argentina	Bo,Br,Chi,Par,Pe,Ur	12.62	23.45	18.29	15.25

Table 4
Sarno and Taylor MADF test (1998)

Benchmark	Club	MADF	99% crit.	95%	90%
Brazil	Arg, Bol, Par, Ur	16.44¤¤¤	13.69	10.17	8.52
Brazil	Arg,Bo,Ch,Par,Pe,Ur	23.35¤¤¤	23.04	16.21	13.84
Argentina	Bo, Br, Par, Ur	13.12¤¤	14.89	10.14	8.36
Argentina	Bo,Br,Chi,Par,Pe,Ur	21.64¤¤¤	18.39	13.73	11.21

Note: The asterisks (¤); (¤¤) and (¤¤¤) denote rejection of the hypothesis of no convergence (non-stationarity) at 10, 5 and 1% respectively.

Table 5
Flôres et al. (1996) unit root test

Benchmark	Club	$\bar{}$	10%	5%	1%
Brazil	Arg.	0.9344***	0.9742	0.9658	0.9485
	Bol.	0.9713*	0.9751	0.9692	0.9568
	Chile	1.0039	0.8304	0.7857	0.6849
	Par.	0.8156***	—	—	—
	Peru	0.9951	0.8679	0.8200	0.6960
	Ur.	0.8888***	—	—	—
Argentina	Bol.	0.9191***	0.9922	0.9906	0.9874
	Br.	0.8634***	—	—	—
	Par.	0.9717	0.9666	0.9567	0.9293
	Ur.	0.9591	0.9313	0.9063	0.8383

Note: The asterisks (*); (**) and (***) denote rejection of the hypothesis of no convergence (non-stationarity) at 10, 5 and 1% respectively.

Table 6
Breuer et al. (1999) SURADF test

Benchmark	Club	SURADF	10%	5%	1%
Brazil	Arg.	-1.622¤	-1.504	-1.812	-2.319
	Bol.	-0.850	-1.505	-1.828	-2.475
	Par.	-3.123¤¤¤	-1.418	-1.756	-2.560
	Ur.	-2.629¤¤¤	-1.427	-1.752	-2.521
Brazil	Arg.	-1.780¤¤	-1.235	-1.641	-2.335
	Bol.	-1.103	-1.641	-1.975	-2.613
	Chile	-2.268	-2.343	-2.601	-3.208
	Par.	-3.398¤¤¤	-1.689	-2.093	-2.742
	Pe	-0.581	-1.753	-2.213	-2.747
	Ur.	-3.215¤¤¤	-1.079	-1.501	-2.346
Argentina	Bol.	-1.352	-1.459	-1.888	-2.679
	Br.	-2.811¤¤¤	-1.475	-1.793	-2.540
	Par.	-1.008	-1.543	-1.881	-2.633
	Ur.	-1.515¤	-0.942	-1.642	-1.956
Argentina	Bol.	-1.875¤¤	-1.481	-1.807	-2.420
	Br.	-2.606¤¤	-1.475	-1.793	-2.625
	Chile	0.597	-1.343	-1.703	-2.471
	Par.	-1.540¤	-1.465	-1.841	-2.321
	Peru	-1.055	-1.507	-1.851	-2.509
	Ur.	-2.485¤¤	-1.412	-1.844	-2.526

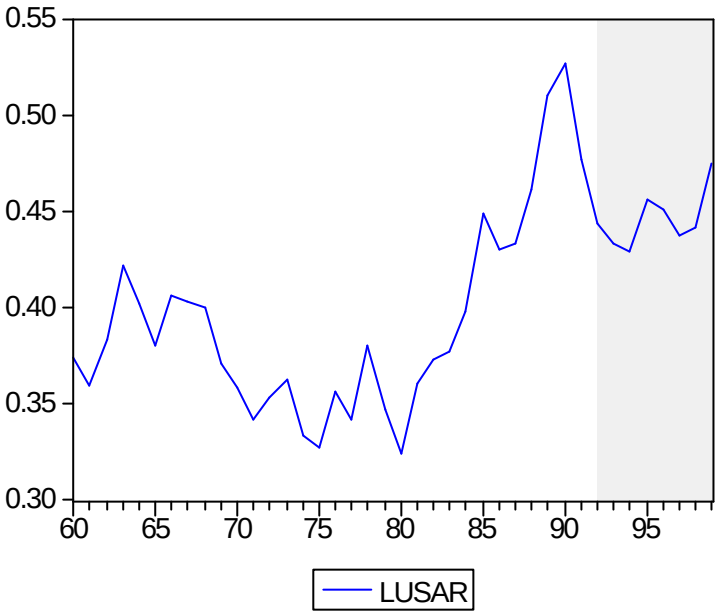
Note: The asterisks (¤); (¤¤) and (¤¤¤) denote rejection of the hypothesis of no convergence (non-stationarity) at 10, 5 and 1% respectively.

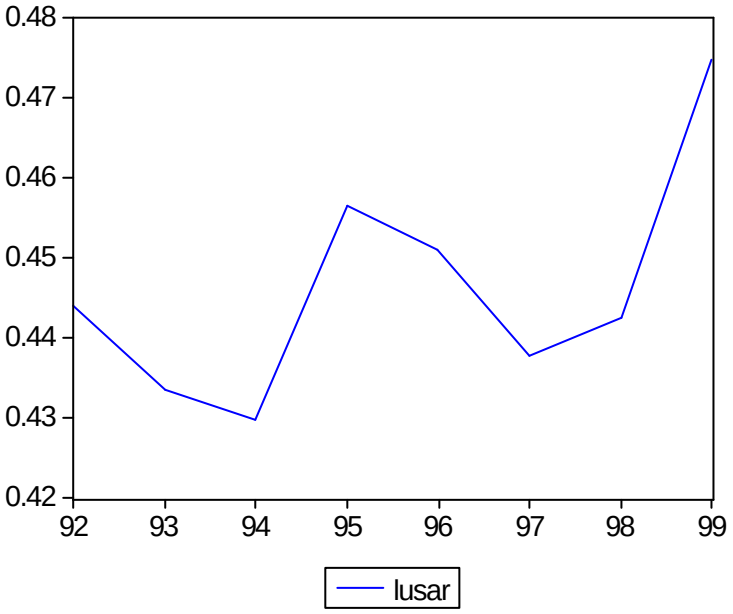
Table 7
Summary convergence results from the multivariate tests
that identify the converging countries

Countries	FPS test	SURADF test
Bra-Arg	Yes	Yes
Bra-Bol	Yes(10%)	—
Bra-Chi	—	—
Bra-Par	Yes	Yes
Bra-Pe	—	—
Bra-Ur	Yes	Yes
Arg-Bol	Yes	Yes
Arg-Bra	Yes	Yes
Arg-Chi	—	—
Arg-Par	—	Yes(10%)
Arg-Pe	—	—
Arg-Ur	—	Yes

B Graphs

Graph 1: Productivity differential: US vs. Argentina





C Data appendix

The data used in the analysis are taken from the World Bank data base. The data include output and employment for the Mercosur member countries as well as Peru, Chile and Bolivia for the period 1960 to 1999. The series are in neperian logarithms.

All the estimations have been performed using Eviews, RATS versions 3.11 and 4.10, and Matlab 6.1. J. Breuer, R. McNown and M. Wallace provided the RATS codes to compute the MADF and SURADF tests, P. Perron the RATS codes for the unit root analysis with structural breaks and Leonardo Souza wrote the Matlab code to compute the FPS test. All the data and results mentioned in the text but not displayed are available upon request to the authors.

y_t: GDP, real terms.

$empl_t$: employment.

productivity : $\ln(y_t) - \ln(empl_t)$:

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