NOTTINGHAM TRENT UNIVERSITY

DISCUSSION PAPERS
IN
APPLIED ECONOMICS AND POLICY

No. 2007/1 ISSN 1478-9396

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May 2007

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APPLIED ECONOMICS AND POLICY

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Testing for price convergence among Mercosur countries

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15th May 2007

Abstract

The aim of this paper is to analyse the existence of price convergence in Mercosur. Two variables are considered, Consumer Price Indices to assess convergence in the goods and services markets and real interest rates, to analyse convergence in the money markets. The univariate analysis points only to convergence in real interest rates, whilst the multivariate analysis provides evidence of common trends in both markets.

J.E.L. Classification : C32, F15.

Key words: Mercosur, economic integration, unit roots, nonlinearities, co-trending.

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1 Introduction

Mercosur (*Mercado Común del Sur* in Spanish) was created in 1991 with the signing of the Asunción Treaty, aiming to boost freedom of movement of goods, labour and currency. The countries that signed this agreement were Argentine, Brazil, Uruguay and Paraguay. Since then, most of the Latin American countries have become associate members (e.g. Chile and Bolivia) or even full members, e.g. Venezuela in 2006.

After the creation of Mercosur, the question of whether the creation of a monetary union would be appropriate has aroused a debate among both economists and politicians alike, although there seems to be general agreement to the contrary, based especially on the Optimal Currency Areas theory (see Levy-Yeyati and Sturznegger, 2000, among others).

Notwithstanding it is worth analysing the degree of economic integration within the area. There are several ways to measure the degree of economic integration between countries. For instance, Purchasing Power Parity (PPP hereafter) can be understood as a measure of economic integration (Frenkel, 1981; Choudhury, McNown and Wallace, 1991; Wei and Parsley, 1995, and Laureti, 2001). Furthermore, under freedom of movements of currency between two countries, real interest rates should converge.

In this paper, we aim to analyse prices in a common currency and real

interest rates convergence in the Mercosur countries, i.e. Argentine, Brazil, Chile[1], Paraguay and Uruguay, following the Bernard and Durlauf (1995) definition of convergence and common trends.

2 Econometric Methodology

In defining convergence (both in goods and money markets) we follow Bernard and Durlauf (1995) definition of convergence. These authors establish that a set of countries $i = 1, ...n$ converge if the long-term forecasts of the variable of interest y_t are equal at a fixed time t:

$$\lim_{k \Rightarrow \infty} E(y_{1,t+k} - y_{i,t+k} | I_t) = 0. \tag{2.1}$$

In words, convergence implies that the countries have identical long-run trends, either stochastic or deterministic.

Rejection of convergence as defined in (2.1) does not necessarily imply that individual prices are explained exclusively by country-specific factors. Prices might still respond to the same common trends but with proportional rather than identical stochastic components. This gives to the following definition of common trends: if the long-term forecasts of the variable of

[1] Although Chile is only an associate member of Mercosur we have included it in the sample due to her high degree of economic interaction with the remaining countries of the South Cone.

interest y_t are proportional at a fixed time for two countries, i and j, say, then they share a common trend:

$$\lim_{k \Rightarrow \infty} E(y_{1,t+k} - \alpha y_{i,t+k} | I_t) = 0. \tag{2.2}$$

These definitions for convergence and common trends can be empirically tested using cointegration techniques (see Bernard and Durlauf, 1995). Thus, according to definition (2.1), for the individual price series to converge there must be one common (stochastic or deterministic) long-run trend, that is, $n-1$ cointegrating vectors, where n is the number of variables. If there are fewer than $n-1$ cointegrating vectors, there is evidence of common stochastic elements in the long-run behaviour of prices across countries, though not full convergence. Finally, absence of cointegration would lead to individual prices being explained exclusively by idiosyncratic factors.

Cointegration (and therefore convergence) in a pair of variables can be tested using unit root test (Camarero, Flôres and Tamarit, 2006): if the price differential between two countries i and j is stationary, convergence is accepted across both countries. A proper test for convergence requires, however, the use of multivariate techniques to test for either convergence or a common trend. Accordingly, in this paper we apply two groups of techniques. Firstly, we apply Ng and Perron (2001) and Kapetanios, Shin and

Snell (2003) (KSS hereafter) unit root tests. Ng and Perron (2001) propose modifications of several (linear) unit root tests in order to improve their performance, i.e. power and size. Kapetanios et al. (2003) develop a unit root test in order to take into account nonlinear adjustment of variables towards equilibrium. The reason for applying the latter is that linear unit root tests might suffer from lack of power in the presence of nonlinearities in the dynamics of the variables (Kapetanios et al., 2003) and, hence, they might not be able to distinguish between unit root and nonlinear stationary process. Thus, this test analyses nonstationarity under the null hypothesis against nonlinear but globally stationary exponential smooth transition autoregressive (ESTAR hereafter) processes under the alternative, i.e.

$$\Delta y_t = \gamma y_{t-1}\{1 - exp(-\theta y_{t-1}^2)\} + \epsilon_t \tag{2.3}$$

where $\epsilon_t \sim iid(0, \sigma^2)$. The test consists of analysing $H_0 : \theta = 0$ versus the alternative $H_1 : \theta > 0$. Nevertheless, in practice, this test cannot be performed directly, since γ is not identified under the null. Kapetanios et al. (2003) propose the following Taylor approximation to the ESTAR model under the null,

$$\Delta y_t = \delta y_{t-1}^3 + \omega_t \tag{2.4}$$

where ω_t is a stochastic error term. Therefore, it is possible to test the null of nonstationarity $H_0 : \delta = 0$ against nonlinear stationary ESTAR process, $H_1 : \delta > 0$.

Secondly, in order to analyse whether there is a unique common trend among all the countries, we apply Bierens (2000) nonlinear co-trending non-parametric test. Bierens (2000) shows that this test does not distinguish between nonlinear co-trending from cointegration. That means that if the variables are I(1) processes rather than stationary, the test becomes a cointegration test. The advantage of Bierens' approach is that, since it is a nonparametric test, nonlinear trends and any serial correlation process do not have to be specified.

3 Empirical Results

In order to test price convergence (in goods and money markets) in Mercosur we consider two types of variables; prices in common currency (US dollar), p_t say, and real interest rates, r_t say, in order to test convergence in prices in the markets of goods and services and convergence in the price of money in Argentine, Brazil, Chile, Paraguay and Uruguay.

Data have been obtained from the *International Financial Statistics* CD-Rom, from the IMF. Consumer Price Indices have been transformed to a

common currency, p_t, using nominal exchange rates versus the US dollar. The frequency of the data is monthly and spans from 1980:1 to 2006:4. The real interest rate, r_t, has been computed as nominal interest rate minus inflation. The nominal interest rates considered for the analysis are the following; for Argentine, Brazil and Paraguay, *Money Market Rate*; for Chile and Uruguay, *Deposit Rate* and *Discount Rate* respectively. We have also used monthly data and spans from 1990:10 to 2006:4.

In Tables 1 and 2 we display the results for the Ng and Perron (2001) and KSS unit root tests[2] for the price differential, dp_t, and real interest rate differential, dr_t, versus the benchmark country, Argentine. The results show that for the price differentials there is poor evidence of convergence, since we are only able to reject the unit root hypothesis with the KSS test for the case of Brazil. The opposite results are found for the interest rate differential. We reject the null hypothesis of unit root with the KSS test in all cases and also with the Ng and Perron's test in Brazil and Uruguay. Therefore, taking into account the possibility of nonlinear adjustment of the real interest rate differential, we find evidence of convergence in real interest rates.

We next present the results of the multivariate analysis, i.e. Bierens' (2000) co-trending analysis. Previously, applying Bierens (1997) unit root

[2]Note that only an intercept has been included as deterministic component in the auxiliary regressions of the tests, since the introduction of a time trend and the rejection of the null in this case will not imply convergence, i.e. the series must be stationary, not only in variance but also in mean.

test, the order of integration of the variables has been tested, since, in order to perform this analysis, all the variables have to be integrated of the same order. The results[3], indicate that all the variables in levels are unit root processes. In this case, the nonparametric co-trending analysis becomes a nonparametric cointegration test (Bierens, 2000). The null hypothesis of this test is that there are r cointegrating vectors versus the alternative of $r-1$. The results are displayed in Table 3 and point to the existence of four cointegrating vectors ($r=4$) and one common stochastic trend for both variables, hence, the existence of a unique common trend implies a certain degree of convergence in prices and real interest rates in Mercosur.

This conclusion highlights the fact that the elimination of trade barriers and the opening of the capital account have boosted price convergence in the South Cone.

4 Conclusions

In this paper, we have analysed whether there exists price convergence (in goods and money markets) among Mercosur countries, applying nonlinear unit root tests and co-trending analysis. The results support the hypothesis of price convergence, not only in the markets of goods but also in the money

[3]Available on request to the authors.

markets for this group of countries.

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Table 1: Ng and Perron (2001) unit root tests results

Country	Variable	MZ_α^{GLS}	MZ_t^{GLS}	MSB^{GLS}	MP_T^{GLS}
Brazil	dp_t	1.48	1.16	0.78	50.07
	dr_t	**-22.31**	**-3.33**	**0.14**	**1.11**
Chile	dp_t	1.95	2.00	1.02	86.93
	dr_t	0.01	0.01	1.09	65.73
Paraguay	dp_t	-1.37	-0.57	0.41	12.14
	dr_t	0.15	0.19	1.25	87.68
Uruguay	dp_t	-1.37	-0.57	0.41	12.14
	dr_t	**-9.60**	**-2.11**	**0.22**	**2.85**

Note: The order of lag to compute the test has been chosen using the modified AIC (MAIC) suggested by Ng and Perron (2001). Rejection of the null hypothesis is given in bold. The critical values for the above tests have been taken from Ng and Perron (2001):

Model with constant

	MZ_α^{GLS}	MZ_t^{GLS}	MSB^{GLS}	MP_T^{GLS}
1%	- 13.80	-2.58	0.17	1.78
5%	-8.10	-1.98	0.23	3.17
10%	-5.70	-1.62	0.27	4.45

Table 2: KSS nonlinear unit root test results

Country	Variable	lags	KSS statistic
Brazil	dp_t	11	**-2.97**
	dr_t	3	**-10.09**
Chile	dp_t	0	-1.15
	dr_t	2	**-5.12**
Paraguay	dp_t	0	-1.15
	dr_t	2	**-4.78**
Uruguay	dp_t	0	-1.18
	dr_t	5	**-4.43**

Note: The test has been computed including only a constant as deterministic component. The order of lag for the auxiliary regression has been selected by the AIC. Critical values at the 10%, 5% and 1% are -2.62, -2.92 and -3.50, respectively and have been computed by Monte Carlo simulation with 5,000 replications. Rejection of the null hypothesis is given in bold face.

Table 3: Bierens (2000) nonlinear co-trending analysis

Variable	r	Test statistic	Critical Value 10%	Critical Value 5%
p_t	1	**0.043**	0.351	0.465
	2	**0.073**	0.535	0.674
	3	**0.176**	0.703	0.860
	4	**0.407**	0.861	1.034
	5	1.677	1.014	1.219
r_t	1	**0.043**	0.351	0.465
	2	**0.075**	0.535	0.674
	3	**0.133**	0.703	0.860
	4	**0.327**	0.861	1.034
	5	1.801	1.014	1.219

Note: The null hypothesis is the existence of r co-trending vectors against the alternative that there are $r-1$ co-trending vectors. Acceptation of the null in bold.

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