



**International Economy**

Eleni F. KATSOULI,  
Nikos KAPOULAS

**CONVERGENCE ACROSS THE PIIGS  
MEMBER-STATES OF THE EURO-ZONE**

**Abstract**

This paper investigates unconditional and conditional convergence of GDP growth rate, labour productivity growth rate, unemployment rate, prices inflation rate, wages inflation rate, budget deficit, and government gross debt across the Euro-zone member-states of Portugal, Ireland, Italy, Greece, and Spain over the last thirty years. The findings showed that the speed of convergence varies depending on the period of reference (pre-Maastricht Treaty decade, after-Maastricht Treaty decade, and after the initiation of the Euro-zone decade). Budget deficit and general government gross debt showed some convergence in the pre-Maastricht Treaty decade only.

**Key words:**

Convergence, Unconditional, Conditional, Euro-zone.

**JEL:** O40, O47.

---

© Eleni F. Katsouli, Nikos Kapoulas, 2012.

Katsouli Eleni F., Dr., Professor of Economics, University of Macedonia, Thessaloniki, Greece.  
Kapoulas Nikos, Dr., Egnatia tel Group of Companies, Thessaloniki, Greece.

## 1. Introduction

Portugal, Ireland, Italy, Greece and Spain are considered to be the weaker economically countries in Euro-zone. PIIGS is an acronym that refers to these countries. Although this acronym has been criticized that is producing offensive connotations, still is used by economic organizations, analysts and academics. Since these countries joined the Euro-zone, lost cost competitiveness due to the fact that their prices and wages rose more quickly than the Euro-zone member-states average.

As the speed of the loss of competitiveness varied, the consequences varied in each country. Specifically, the economic growth rate reached in 2010 the level of 1.3 percent in Portugal, – 1.0 percent in Ireland, 1.3 percent in Italy, – 4.5 percent in Greece, and – 0.1 percent in Spain. Accordingly, the unemployment rate reached in 2010 the level of 11.0 percent in Portugal, 13.7 percent in Ireland, 8.4 percent in Italy, 12.6 percent in Greece, and 2.01 percent in Spain. Furthermore, the general government deficit and debt, as a percentage of GDP, reached in 2010 respectively the levels of -9.1 and 93.0 percents in Portugal, – 32.4 and 96.2 percents in Ireland, – 4.6 and 119.0 percents in Italy, – 10.5 and 142.8 percents in Greece, and – 9.2 and 60.1 percents in Spain (European Economy, 2011).

On May 10, 2010, the European finance ministers produced a three-year €750 billion stabilization package to support the Euro-zone weaker member-states. However, this package did not resolve the underlying structural difficulties that Portugal, Ireland, Italy, Greece and Spain were facing (Economist, 2010). Additionally, Memorandums of Economic and Financial Policies between Portugal, Ireland, and Greece, and the European Commission, the International Monetary Fund, and the European Central Bank, the so-called «Troika», was agreed, that outline the economic and financial policies that the governments of these three Euro-zone member-states will implement in the immediate coming period to strengthen market confidence and their fiscal and financial position during a difficult transition period toward a more open and competitive economy.

The core of these three Memorandums was based on policies, such as structural reforms in the public sector, liberalization of all sectors of the economy (e. g., transport sector, energy sector), more flexible rules in the labour market (e. g., licensing procedures, regulated professions), and more innovative investments, aiming at sustaining or even increasing the competitiveness of these countries. Other policies were clearly austerity policies, such as increasing direct and indirect taxation and cutting spending by decreasing the wages and pensions budget, aiming at decreasing budget deficits and government debt. How-

ever, it was criticized that these latter policies may lead to social inequalities and unrest without reducing deficits and debt.

It was finally criticized that the application of these common policies across these five Euro-zone member-states may be questionable because of the different effects that these policies may have on the five economies. This criticism was based on the argument that the context of these five Euro-zone member-states was rather different. Considering this criticism, the purpose of this paper is to investigate whether crucial economic variables, such as GDP growth rate, labour productivity rate, unemployment rate, prices inflation rate, wages inflation rate, budget deficit, and general government gross debt, of the Portugal, Ireland, Italy, Greece and Spain converge over time.

## 2. Model and methodology

Three general approaches for testing convergence of variables are usually identified in the literature;  $\beta$ -convergence,  $\sigma$ -convergence, and time-series convergence. « $\beta$ -convergence» refers to the negative relationship between the growth of related variables and their initial levels across different contexts. « $\sigma$ -convergence» refers to the decreasing trend of a dispersion measure of related variables across different contexts over time. «time-series-convergence» refers to time-series tests of the stationarity of differences in related variables over time, usually based on unit root and cointegration tests. Examples of  $\beta$ -convergence and  $\sigma$ -convergence comprise Baumol (1986), Barro and Sala-i-Martin (1991; 1992), Mankiw, Romer and Weil (1992) and Sala-i-Martin (1996). Examples of time-series-convergence, contain Bernard and Durlauf (1995), Carlino and Mills (1993), and Evans (1997; 1998). However, these approaches are not necessarily presented as being alternatives (Freeman and Yerger, 2001). This is because each approach depends on special assumptions referring to the characteristics of the series of data used (Bernard and Durlauf, 1995). For example, although the fundamental point of debate was the assumption that  $\beta$ -convergence was a necessary precondition for  $\sigma$ -convergence, later it was recognized that  $\beta$ -convergence is a necessary but not a sufficient condition for  $\sigma$ -convergence to happen (Quah, 1996).

The model used in this paper refers to  $\beta$ -convergence and it is generally based on Barro and Sala-i-Martin (1991; 1992). This model is written as follows.

$$\Delta Y_{it} = \alpha_i + \beta Y_{i,t-1} + \sum_{j=1}^k \gamma_j \Delta Y_{i,t-j} + \sum_{j=0}^{m_1} \delta_{1j} X_{1i,t-j} + \dots + \sum_{j=0}^{m_h} \delta_{hj} X_{hi,t-j} + \varepsilon_{it} \quad (1)$$

where  $Y_{it}$  is the variable under investigation for convergence,  $X_{hit}$  are exogenous variables that may determine the dependent variable  $Y_{it}$ , and  $\varepsilon_{it}$  are assumed to

be mutually independent idiosyncratic disturbance.  $\alpha_i$  (context fixed effects),  $\beta$ ,  $\gamma_j$  and  $\delta_{hj}$  are parameters to be estimated,  $i$  indicates levels (different contexts),  $h$  refers to exogenous variables,  $t$  presents time, and  $\Delta$  denotes first difference.

For variable  $Y_{it}$  to be converging among  $i$  contexts (say countries) in a given time period, parameter  $\beta$  in equation (1) must be negative. This means that given  $Y_{i,t-1}$ , the difference  $\Delta Y_{it}$  is becoming smaller through time. The signs of the parameters  $\gamma_j$  and  $\delta_{hj}$  should have the signs explained in the relevant theory. Furthermore, we may distinguish two types of convergence; unconditional and conditional convergence. «*Unconditional convergence*» refers to the cases where the exogenous variables  $X_{hit}$  do not appear in equation (1). «*Conditional convergence*» refers to the cases where the exogenous variables  $X_{hit}$  do appear in equation (1).

Considering that in this paper we will investigate the convergence of some economic variables in the PIIGS Euro-zone member-states, the identification of these variables used in equation (1), and the units of measurement used in estimation, is as follows:

$g_{it}$  = GDP growth rate in country  $i$  at year  $t$  (annual percentage change of Gross Domestic Product at 2000 market prices);

$q_{it}$  = labor productivity growth rate in country  $i$  at year  $t$  (annual percentage change of Gross Domestic Product at 2000 market prices per person employed);

$u_{it}$  = unemployment rate (total);

$p_{it}$  = price deflator of GDP at market prices in country  $i$  at year  $t$  (annual percentage change);

$w_{it}$  = nominal compensation per employee in country  $i$  at year  $t$  (annual percentage change);

$b_{it}$  = budget deficit in country  $i$  at year  $t$  (percentage of GDP at market prices of net lending (+) or net borrowing (–) of general government);

$d_{it}$  = general government gross debt in country  $i$  at year  $t$  (percentage of GDP at market prices).

### 3. The empirical results

Table 1 presents the results of the estimates of equation (1) using pooled least squares, via Eviews 6. The data used were annual, covering the period 1981-2010 for the five countries (Portugal, Ireland, Italy, Greece, and Spain), and were taken from European Economy (2011). The results refer to unconditional convergence (I), and to conditional convergence (II). Furthermore, Tables 2 to 4

present the results of the estimates of equation (1) using the three sub-periods of 1981–1990, 1991–2000, and 2001–2010. The first period refers to the decade before the Maastricht Treaty, the second period refers to the decade immediately after the Maastricht Treaty, and the third period refers to the first decade of Euro-zone. The presentation below follows the convergence investigation for each of the seven variables separately.

**GDP growth rate:** Labour productivity growth rate is assumed to be an exogenous variable that positively influences GDP growth rate, by referring to the production technological conditions captured by labour productivity (Solow, 1956). From the results in Table 1 it is seen that GDP growth rate converges both unconditionally and conditionally among the five countries in the last thirty years. From the results in Tables 2 to 4 it is seen that this convergence was faster in the decade after the Maastricht Treaty, compared to the decades before the Treaty and after joining the Euro-zone.

**Labour productivity growth rate:** Unemployment rate is assumed to be an exogenous variable that positively influences labour productivity growth rate (Okun, 1962). From the results in Table 1 it is seen that labour productivity growth rate converges both unconditionally and conditionally among the five countries in the last thirty years. From the results in Tables 2 to 4 it is seen that this convergence was faster in the decade after the Maastricht Treaty, compared to the decades before the Treaty and after joining the Euro-zone.

**Unemployment rate:** Wages inflation rate is assumed to be an exogenous variable that negatively influences unemployment rate (Phillips, 1958). From the results in Table 1 it is seen that labour wages inflation rate converges both unconditionally and conditionally among the five countries in the last thirty years. From the results in Tables 2 to 4 it is seen that this convergence was faster in the decade before the Maastricht Treaty, and it remained stable for the period after the Treaty.

**Prices inflation rate:** Labour productivity growth rate and wages inflation rate are assumed to be exogenous variables that negatively and positively influence prices inflation rate, respectively (Dornbusch and Fischer, 1990). From the results in Table 1 it is seen that prices inflation rate converges both unconditionally and conditionally among the five countries in the last thirty years. From the results in Tables 2 to 4 it is seen that this convergence was much faster in the decade after joining the Euro-zone, compared to the decades before and immediately after the Maastricht Treaty.

**Wages inflation rate:** Labour productivity growth rate and prices inflation rate are assumed to be exogenous variables that positively influence wages inflation rate (Dornbusch and Fischer, 1990). From the results in Table 1 it is seen that wages inflation rate converges both unconditionally and conditionally among the five countries in the last thirty years. From the results in Tables 2 to 4 it is seen that this convergence was much faster in the decade after joining the Euro-zone, compared to the decades before and immediately after the Maastricht Treaty.

Table 1

## Convergence results: 1981–2010

	GDP growth rate		Labour productivity growth rate		Unemployment rate		Prices inflation rate		Wages inflation rate		Budget deficit		General government gross debt	
	I	II	I	II	I	II	I	II	I	II	I	II	I	II
<b>Dependent variable</b>														
	$\Delta(g_t)$	$\Delta(g_t)$	$\Delta(q_t)$	$\Delta(q_t)$	$\Delta(u_t)$	$\Delta(u_t)$	$\Delta(p_t)$	$\Delta(p_t)$	$\Delta(w_t)$	$\Delta(w_t)$	$\Delta(b_t)$	$\Delta(b_t)$	$\Delta(d_t)$	$\Delta(d_t)$
C	1.297 [0.000]	0.814 [0.001]	1.148 [0.000]	1.132 [0.000]	1.298 [0.000]	1.200 [0.000]	0.391 [0.111]	0.364 [0.113]	0.999 [0.006]	0.851 [0.165]	-0.864 [0.007]	-0.698 [0.019]	5.164 [0.001]	1.190 [0.240]
$Y_{i,t-1}$	-0.483 [0.000]	-0.302 [0.000]	-0.646 [0.000]	-0.652 [0.000]	-0.127 [0.000]	-0.121 [0.000]	-0.138 [0.000]	-0.114 [0.000]	-0.202 [0.000]	-0.164 [0.000]	-0.133 [0.012]	-0.104 [0.034]	-0.060 [0.004]	-0.011 [0.436]
$\Delta(Y_{i,t-1})$	0.178 [0.093]	0.237 [0.005]			0.630 [0.000]	0.609 [0.000]					0.233 [0.024]	0.228 [0.019]	0.647 [0.000]	0.755 [0.000]
<b>Conditional variables</b>														
$\Delta(g_t)$												0.295 [0.000]		-0.700 [0.000]
$\Delta(q_t)$		0.671 [0.000]						-0.206 [0.006]		0.207 [0.024]				
$\Delta(u_t)$				0.177 [0.034]										
$\Delta(p_t)$										0.300 [0.002]				
$\Delta(w_t)$						-0.058 [0.009]		0.195 [0.001]						
$\Delta(b_t)$														-1.039 [0.000]
<b>Fixed effects</b>														
Portugal	-0.079	-0.015	0.314	0.321	-0.383	-0.368	0.220	0.188	0.431	0.342	0.136	0.123	-0.995	-0.064
Ireland	0.923	0.557	0.696	0.713	0.064	0.064	-0.488	-0.437	-0.395	-0.274	-0.328	-0.371	-0.342	-0.720
Italy	-0.521	-0.340	-0.402	-0.385	-0.155	-0.141	-0.218	-0.184	-0.416	-0.329	0.084	0.111	1.578	0.547
Greece	-0.364	-0.220	-0.307	-0.336	-0.088	-0.103	0.471	0.430	0.569	0.432	-0.277	-0.184	1.555	0.731
Spain	0.040	0.018	-0.301	-0.313	0.562	0.548	0.015	0.004	-0.189	-0.171	0.385	0.323	-1.797	-0.494
<b>Diagnostics</b>														
Adj. $R^2$	0.166	0.490	0.314	0.337	0.362	0.390	0.118	0.215	0.146	0.199	0.036	0.126	0.393	0.768
DW	1.978	2.178	1.996	2.029	1.818	1.806	2.201	2.389	2.005	2.158	1.759	1.747	2.038	2.468

Notes: I = unconditional convergence; II = conditional convergence;

X = lagged dependent variable (for each equation);

 $\Delta$  = difference.

Table 2

Convergence results: 1981–1990

	GDP growth rate		Labour productivity growth rate		Unemployment rate		Prices inflation rate		Wages inflation rate		Budget deficit		General government gross debt	
	I	II	I	II	I	II	I	II	I	II	I	II	I	II
<b>Dependent variable</b>														
	$\Delta(q_t)$	$\Delta(q_t)$	$\Delta(q_t)$	$\Delta(q_t)$	$\Delta(u_t)$	$\Delta(u_t)$	$\Delta(\rho_t)$	$\Delta(\rho_t)$	$\Delta(w_t)$	$\Delta(w_t)$	$\Delta(b_t)$	$\Delta(b_t)$	$\Delta(d_t)$	$\Delta(d_t)$
C	0.526 [0.000]	0.833 [0.004]	1.957 [0.000]	1.892 [0.000]	3.668 [0.001]	3.420 [0.002]	2.6566 [0.016]	2.039 [0.086]	4.724 [0.000]	4.777 [0.001]	-2.127 [0.001]	-2.275 [0.000]	9.344 [0.001]	7.964 [0.000]
$Y_{it-1}$	-0.349 [0.002]	-0.217 [0.025]	-0.839 [0.000]	-0.817 [0.000]	-0.352 [0.000]	-0.329 [0.001]	-0.270 [0.000]	-0.210 [0.025]	-0.393 [0.000]	-0.390 [0.000]	-0.267 [0.002]	-0.277 [0.000]	-0.125 [0.001]	-0.106 [0.001]
$\Delta(Y_{it-1})$					0.523 [0.000]	0.552 [0.000]					0.530 [0.000]	0.514 [0.000]	0.429 [0.003]	0.495 [0.000]
<b>Conditional variables</b>														
$\Delta(g_t)$												0.138 <sub>t-1</sub> [0.013]		-0.476 [0.009]
$\Delta(q_t)$		0.536 [0.000]						-0.247 [0.162]		0.363 [0.017]				
$\Delta(u_t)$				0.310 [0.191]										
$\Delta(\rho_t)$						0.005 [0.767]				0.179 [0.153]				
$\Delta(w_t)$								0.157 [0.313]						
$\Delta(b_t)$														-0.944 [0.001]
<b>Fixed effects</b>														
Portugal	0.526	0.204	1.252	1.336	-1.176	-1.088	1.430	1.189	2.237	2.041	0.346	0.369	-2.202	-1.496
Ireland	0.349	0.388	1.156	1.050	1.597	1.487	-2.480	-2.127	-2.392	-2.087	0.332	0.355	3.179	3.427
Italy	-0.240	-0.166	-0.369	-0.396	-0.655	-0.609	-0.873	-0.693	-1.348	-1.247	-1.011	-1.026	2.805	2.276
Greece	-0.832	-0.790	-1.567	-1.580	-1.400	-1.309	2.523	2.165	2.712	2.398	-0.687	-0.734	-0.206	-1.058
Spain	0.197	0.364	-0.472	-0.410	1.634	1.519	-0.601	-0.534	-1.209	-1.105	1.019	1.037	-3.576	-3.148
<b>Diagnostics</b>														
Adj. $R^2$	0.138	0.542	0.409	0.417	0.597	0.527	0.190	0.201	0.398	0.428	0.424	0.548	0.526	0.702
DW	2.009	2.180	1.905	1.914	1.835	1.922	2.299	2.446	2.148	2.414	1.793	1.857	2.305	2.608

Notes: I = unconditional convergence; II = conditional convergence;

X = lagged dependent variable (for each equation);

$\Delta$  = difference.

Table 3

## Convergence results: 1991–2000

	GDP growth rate		Labour productivity growth rate		Unemployment rate		Prices inflation rate		Wages inflation rate		Budget deficit		General government gross debt	
	I	II	I	II	I	II	I	II	I	II	I	II	I	II
<b>Dependent variable</b>														
	$\Delta(g_t)$	$\Delta(g_t)$	$\Delta(q_t)$	$\Delta(q_t)$	$\Delta(u_t)$	$\Delta(u_t)$	$\Delta(p_t)$	$\Delta(p_t)$	$\Delta(w_t)$	$\Delta(w_t)$	$\Delta(b_t)$	$\Delta(b_t)$	$\Delta(d_t)$	$\Delta(d_t)$
C	2.003 [0.000]	1.621 [0.001]	2.182 [0.000]	2.365 [0.000]	2.963 [0.000]	2.793 [0.000]	0.685 [0.096]	0.728 [0.071]	2.180 [0.011]	1.668 [0.033]	1.149 [0.023]	0.392 [0.355]	10.868 [0.033]	4.316 [0.275]
$Y_{i,t-1}$	-0.575 [0.000]	-0.470 [0.001]	-1.081 [0.000]	-1.150 [0.000]	-0.284 [0.000]	-0.272 [0.000]	-0.215 [0.001]	-0.198 [0.003]	-0.396 [0.000]	-0.281 [0.007]	0.055 [0.481]	-0.054 [0.456]	-0.139 [0.031]	-0.042 [0.405]
$\Delta(Y_{i,t-1})$		0.239 [0.065]			0.802 [0.000]	0.812 [0.000]					-0.293 [0.070]		0.406 [0.007]	0.577 [0.000]
<b>Conditional variables</b>														
$\Delta(g_t)$												0.199 [0.028]		-0.691 [0.012]
$\Delta(q_t)$		0.489 [0.000]						-0.121 [0.214]		0.337 [0.036]				
$\Delta(u_t)$				0.414 [0.004]										
$\Delta(p_t)$										0.580 [0.013]				
$\Delta(w_t)$						-0.059 [0.008]		0.196 [0.004]						
$\Delta(b_t)$														-1.563 [0.000]
<b>Fixed effects</b>														
Portugal	-0.408	-0.126	0.328	0.364	-1.393	-1.356	-0.154	-0.140	0.608	0.610	-0.539	-0.271	-3.647	-2.120
Ireland	2.214	1.662	1.425	1.841	0.273	0.325	0.599	0.451	0.015	-0.418	-0.193	0.266	-3.398	-2.314
Italy	-1.015	-0.773	-0.447	-0.574	-0.023	-0.029	-0.374	-0.325	-1.060	-0.753	0.605	0.234	5.429	2.421
Greece	-0.455	-0.528	-0.312	-0.610	-0.339	-0.356	0.020	0.084	1.095	1.136	0.608	0.094	3.700	2.889
Spain	-0.336	-0.235	-0.993	-1.021	1.483	1.415	-0.091	-0.069	-0.657	-0.574	-0.481	-0.323	-2.084	-0.876
<b>Diagnostics</b>														
Adj. $R^2$	0.240	0.494	0.553	0.600	0.571	0.640	0.267	0.367	0.207	0.305	0.009	0.060	0.312	0.583
DW	1.693	2.006	1.662	1.856	1.783	2.076	2.685	2.799	2.341	2.515	2.048	2.556	2.133	2.561

Notes: I = unconditional convergence; II = conditional convergence;

X = lagged dependent variable (for each equation);

$\Delta$  = difference.



Table 4

Convergence results: 2000–2010

	GDP growth rate		Labour productivity growth rate		Unemployment rate		Prices inflation rate		Wages inflation rate		Budget deficit		General government gross debt	
	I	II	I	II	I	II	I	II	I	II	I	II	I	II
<b>Dependent variable</b>														
	$\Delta(q_{it})$	$\Delta(q_{it})$	$\Delta(q_{it})$	$\Delta(q_{it})$	$\Delta(u_{it})$	$\Delta(u_{it})$	$\Delta(p_{it})$	$\Delta(p_{it})$	$\Delta(w_{it})$	$\Delta(w_{it})$	$\Delta(b_{it})$	$\Delta(b_{it})$	$\Delta(d_{it})$	$\Delta(d_{it})$
C	1.510 [0.032]	0.686 [0.186]	0.646 [0.010]	0.548 [0.026]	2.668 [0.000]	2.537 [0.002]	1.053 [0.028]	1.080 [0.025]	2.115 [0.007]	2.401 [0.002]	-1.423 [0.025]	-0.849 [0.195]	1.016 [0.880]	2.052 [0.544]
$Y_{it-1}$	-0.749 [0.000]	-0.360 [0.025]	-0.679 [0.001]	-0.682 [0.000]	-0.287 [0.000]	-0.275 [0.006]	-0.428 [0.005]	-0.440 [0.004]	-0.622 [0.001]	-0.644 [0.000]	-0.073 [0.626]	0.038 [0.808]	0.013 [0.893]	-0.026 [0.589]
$\Delta(Y_{it-1})$	0.493 [0.056]	0.429 [0.019]			0.735 [0.000]	0.675 [0.000]	0.598 [0.007]	0.588 [0.009]					0.731 [0.000]	0.874 [0.000]
<b>Conditional variables</b>														
$\Delta(g_{it})$												0.347 [0.013]		-0.658 [0.000]
$\Delta(q_{it})$		1.006 [0.000]						-0.059 [0.413]						
$\Delta(u_{it})$				0.201 [0.040]										
$\Delta(p_{it})$										0.703 <sub>t-1</sub> [0.005]				
$\Delta(w_{it})$						-0.094 [0.131]								
$\Delta(b_{it})$														-0.929 [0.000]
<b>Fixed effects</b>														
Portugal	-0.741	-0.435	-0.047	-0.088	-0.414	-0.376	0.032	0.042	-0.342	-0.354	0.491	0.486	0.201	0.315
Ireland	1.080	0.540	0.403	0.315	-0.649	-0.635	-0.468	-0.486	0.100	0.479	-2.356	-2.451	3.121	-0.952
Italy	-1.031	-0.472	-0.653	-0.521	-0.335	-0.318	-0.123	-0.116	-0.353	-0.612	0.819	0.672	-1.586	0.955
Greece	0.343	0.495	0.143	0.219	0.430	0.344	0.254	0.226	0.477	0.431	0.245	0.746	-0.849	0.478
Spain	0.349	-0.128	0.154	0.074	0.969	0.985	0.305	0.333	0.117	0.056	0.801	0.546	-0.887	-0.797
<b>Diagnostics</b>														
Adj. $R^2$	0.206	0.607	0.259	0.319	0.421	0.439	0.111	0.109	0.184	0.269	0.008	0.110	0.435	0.897
DW	1.736	2.395	1.873	1.977	1.849	2.002	1.846	1.890	1.870	2.128	1.591	1.577	2.001	2.410

Notes: I = unconditional convergence; II = conditional convergence;

X = lagged dependent variable (for each equation);

$\Delta$  = difference.

**Budget deficit:** GDP growth rate is assumed to be an exogenous variable that negatively influences budget deficit. However, although the results in the tables below indicate positive association, this should be considered with care because the sign before the budget deficit data is negative. Thus, these findings are in accordance with theory (Lipsey, Courant, Purvis, and Steiner, 1992). From the results in Table 1 it is seen that budget deficit converges both unconditionally and conditionally among the five countries in the last thirty years. From the results in Tables 2 to 4 it is seen that this convergence was true only in the decade before the Maastricht Treaty, and that we cannot observe any convergence after the Treaty.

**General government gross debt:** GDP growth rate and budget deficit are assumed to be exogenous variables that negatively and positively influence the general government gross debt, respectively (Lipsey et al., 1992). With respect to the budget deficit influence we should be careful considering the negative sign before the budget deficit data. From the results in Table 1 it is seen that government gross debt shows a very small unconditional convergence, and a conditional non convergence, among the five countries in the last thirty years. From the results in Tables 2 to 4 it is seen that convergence was true only in the decade before the Maastricht Treaty, and that generally, we cannot observe any convergence after the Treaty.

#### 4. Conclusions

The main conclusions of this paper may be summarized as follows:

(i) Labour productivity positively influences economic growth. Unemployment positively determines labour productivity. Wages have negative pressure on unemployment. Wages have a positive pressure whilst labour productivity has negative pressure on prices. Prices and labour productivity positively influence wages. Economic growth has a negative pressure on the budget deficit. Economic growth has a negative pressure whilst budget deficit has a positive pressure on government debt.

(ii) Over the last thirty years (1981–2010) it is found that the major variables of GDP growth rate, labour productivity growth rate, unemployment rate, prices inflation rate, wages inflation rate, and budget deficit converge both unconditionally and conditionally. General government gross debt although is converging unconditionally, it is the only variable that is not converging conditionally.

(iii) With respect to the pre-Maastricht Treaty decade (1981–1990), the after-Maastricht Treaty decade (1991–2000), and the after the initiation of the Euro-zone decade (2001–2010) the speed of convergence of these variables is as follows: (a) High speed of convergence in the pre-Maastricht decade has been

found for the unemployment rate. (b) High speed of convergence in the after-Maastricht decade has been found for the GDP growth rate and the labour productivity growth rate. (c) High speed of convergence in the after the initiation of the Euro-zone decade has been found for the prices inflation rate and the wages inflation rate.

(iv) The budget deficit and the general government gross debt showed some convergence in the pre-Maastricht Treaty decade, whilst convergence of these variables is rather questionable for both decades after the Treaty. Thus, policies aiming both at decreasing the budget deficit and the general government gross debt and guiding the speed of convergence of these two variables across countries should be taken.

Finally, it must be noted here that the conclusions above depend on the  $\beta$ -convergence methodology followed in this paper. Future research should compare these conclusions with the results that may be obtained by following the  $\sigma$ -convergence and the time-series convergence methodologies.

### Bibliography

1. Barro, Robert J. and Sala-i-Martin, X. 1991, «Convergence across states and regions», *Brookings Papers on Economic Activity*, 1, pp. 107–182.
2. Barro, R. J. and Sala-i-Martin, X. 1992, «Convergence», *Journal of Political Economy*, 100(2), pp. 223–251.
3. Baumol, W. J. 1986, «Productivity growth, convergence and welfare: What the long run data show», *American Economic Review*, 76(5), pp. 1072–1085.
4. Bernard, A. B. and Durlauf, S. N. 1995, «Convergence in international output», *Journal of Applied Econometrics*, 10, pp. 97–108.
5. Carlino, G. A. and Mills, L. O. 1993, «Are U.S. regional incomes converging?», *Journal of Monetary Economics*, 32, pp. 335–346.
6. Dornbusch, R. and Fischer, S. 1990, *Macroeconomics*, New York: McGraw-Hill.
7. Economist. 2010, The PIIGS that won't fly: A guide to the euro-zone's troubled economies, May 18th 2010. <http://www.economist.com/node/15838029>.
8. European Economy. 2011, *Statistical Annex of European Economy*, Spring 2011, European Commission.
9. Evans, P. 1997, «How fast do economies converge?» *Review of Economics and Statistics*, 79, pp. 219–225.

10. Evans, P. 1998, «Using panel data to evaluate growth theories», *International Economic Review*, 39 (2), pp. 295–306.
11. Evans, P. and Karras, G. 1996, «Do economies converge? Evidence from a panel of U.S. States», *Review of Economics and Statistics*, 78, pp. 384–389.
12. EViews. 2007, *Eviews User's Guide*. Irvin CA: Quantitative Micro Software.
13. Freeman, D.G. and Yerger, D.B. 2001, «Interpreting cross-section and time-series tests of convergence: the case of labor productivity in manufacturing», *Journal of Economics & Business*, 53, pp. 593–607.
14. Mankiw, N. G., Romer, R. and Weil, D. N. 1992, «A contribution to the empirics of economic growth», *The Quarterly Journal of Economics*, 107, pp. 407–438.
15. Okun, A. M. 1962, «Potential GNP: Its measurement and significance. In: Proceedings of the Business and Economics Section», *American Statistical Association*, Washington D.C. pp. 98–104.
16. Phillips, A. W. 1958, «The relation between unemployment and the rate of change of money wage rates in the United Kingdom», *Economica*. 25. November.
17. Sala-i-Martin, Xavier. 1996, «The classical approach to convergence analysis», *The Economic Journal*, 106, pp. 1019–1036.
18. Solow, R.M. 1956, «A contribution to the theory of economic growth», *Quarterly Journal of Economics*, 70, pp. 65–94.
19. Quah, D. T. 1996, «Twin peaks: Growth and convergence in models of distribution dynamics», *The Economic Journal*, 106, pp. 1045–1055.

The article was received June 5, 2012.