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**Switching from convergence to  
divergence in the European Union:  
A case study**

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## **Switching from convergence to divergence in the European Union: A case study**

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### **Abstract**

EU member states do not get much from participating in a regional trade agreement and economic integration regime: beside the questionable effects on growth perspectives (€-area grew since 1960 with a gradually smaller rate than the world economy), there is a clear evidence for a profound, unpleasant, structural change regarding convergence. During the first two decades of the period we studied, the coefficient of variation of per capita (p.c.) GDP fell strongly and labour remuneration grew substantially relative to non-labour income. Yet, this picture changed after 1980! The previous trend of closing the gap among the countries reversed completely: in 2005, coefficient of variation grew back to the levels of 1960. At the same time, all previous gains of labour vanished: in the period 1980-2005 real wages lost about 35% against p.c. GDP. A persisting period of continuous divergence emerged after 1980, probably due to permanent, structural developments!

**Keywords:** cross-country convergence, domestic inequality.

**JEL Classification:** O47, F15.

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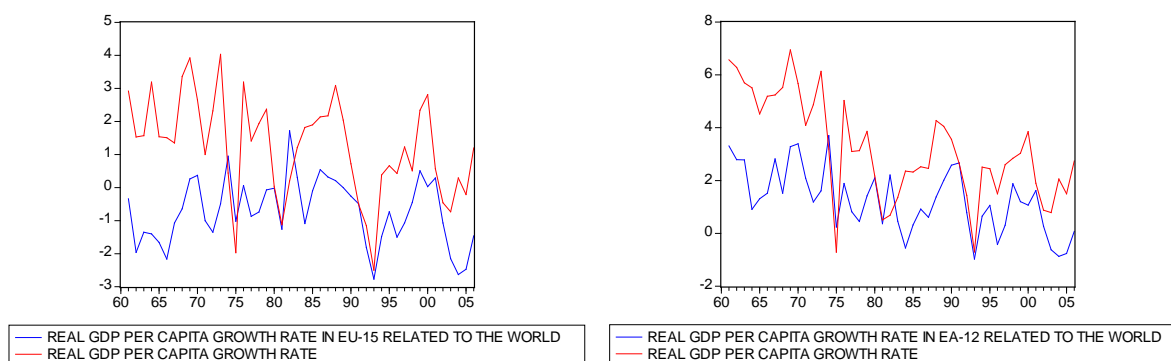
## 1. Introduction

Regarding the effectiveness of internationalisation, the neoclassical paradigm can be summarized as follow: opening the markets and enhancing the degree of international competition will boost economic growth and initiate convergence. Since the 1980s, a vigorous discussion was developed (Romer 1986) concerning the empirical investigation of growth effects resulting from trade, as well as the convergence tendencies in a progressively globalised environment. Subjective reasons – answering the specific questions relates strongly to various socio-political interests – but also objective ones, like differences in the underlying theoretical assumptions, the variables used, the sample and the statistical data, as well as the econometric techniques applied, generated a variety of partly controversial empirical results and arguments.

For instance, although the dominant position in the relevant literature seems to be that trade contributes significantly to the strengthening of growth, there are plenty of other studies, which either show no relation, or, worst, relate trade and growth in a significantly negative way. Both, the sign and the causality of the effects, vary with respect to country and to time period (Khalafalla and Webb, 2001), meaning that a range of time and region specific socio-economic conditions are of great importance (Levine and Renelt, 1992 and Chuang 2002).<sup>1</sup>

In the European Union itself, a region of gradually strengthening internationalisation, member states do not get much from participating in a regional trade agreement and economic integration regime. For instance, let us proceed with a quite simplistic comparison: we estimate the growth rate of EU-15 and €area, related to the growth rate of world economy, over time, during the gradual completion of European Union.<sup>2</sup> EU-15 and especially €area grew since 1960 with a gradually smaller rate than the world economy.

**Diagram 1:** Growth rates in EU-15 and €area, relative to the world economy.



The estimates presented in table A.1 in appendix are convincing: €area and 7 countries show an increasing hysteresis compared to the world-wide growth rates: Austria (ADF estimation), Belgium, France, Greece, Italy, Portugal and Spain (trend coefficients, estimated by KPSS method, are significantly negative). The opposite is true only for Luxemburg, the exceptional case of Ireland and the UK, which is relatively less integrated.

<sup>1</sup> Kali et al. (2007) gather all different thinkable reasons for having diversified empirical results. They refer to the work of Grossman and Helpman (1991), Matsuyama (1992), Walde and Wood (2005), Rodriguez and Rodrik (2001) and Yanikkaya (2003).

<sup>2</sup> This should be understood as an effort to depict the relative growth perspectives of EU, and not as a thorough study of trade / growth relations. First, the simplicity of our approach does not allow such reasoning. Even more, the evolution of growth rates in EU could be seen as the effect of creating a regional economic union, and not necessarily as the effect of an unlimited internationalisation process.

If anything, it seems that, despite (or because of) a regionally constrained process of internationalisation, the prospects of €area to grow have been affected in a negative way.<sup>3</sup>

On the other hand, the literature on convergence is even more contradictory! Some authors concentrate on  $\sigma$ -convergence in Europe and provide evidence for closing the gaps. Yin et al. (2003) study  $\sigma$ -convergence of real GDP per capita for the period 1960-1995. Driven by the different integration levels within this period, they distinguish among EU-6, EU-9, EU-12 and EU-15 and provide evidence for convergence, except for the period 1980-1985. Also Hoen (2000), who uses data on six core European countries (Germany, France, Italy, the Netherlands, Belgium and Denmark), provides results, which are in accordance with the neoclassical paradigm: GDP per capita is converging in the period 1970-1985. Barro and Sala-i-Martin (1991, 1995) found the same, among European regions for a wider period (1950-1990). Veiga (1999), who focuses on 12 European countries with regions belonging at the NUTS II level, provides also evidence for convergence till the late 1970s.

On the contrary, a wide range of studies reject the convergence hypothesis for the European Union. Most of them show an unclear development of standard deviation in time,<sup>4</sup> while others (for instance, Neven 1995) identify different patterns of convergence in northern and southern Europe, especially during the period 1975-1990.

The contradictory results arises from using dissimilar sets of countries, but, basically, from covering different time periods.<sup>5</sup> The picture we get from the aforementioned relevant studies is that something is going on with the 1980s! Many of the researches anticipated it,<sup>6</sup> but they thought of it as the result of a temporary effect: the big 1980-1982 recession, resulting from the continuously growing oil's prices, or the accession of southern European countries (Greece, Portugal and Spain),<sup>7</sup> were thought to be the underlying reasons. Truly, this could be a conclusion for someone who covers a period lasting, the most, till the beginning of the 1990s. In the present paper, we take into consideration annual data till 2005. Thus, we show that the problem with the 1980s is not a short-term break of a continuous trend, but a complete alteration of the process, a structural change of a previously long-lasting convergence into a persisting period of continuous divergence!

In the present paper, the European Union serves as a historical experiment for the formation of a nearly perfectly internationalised environment. Bearing in mind the subsequent institutional steps that have been taken in the last 5 decades, we consider EU-15 as the outcome of a *regionally evolving* internationalisation process.<sup>8</sup> After presenting the data

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<sup>3</sup> Andriamananjara and Hillberty (2001) also noticed that trade relations with different countries strengthen domestic growth, especially when they apply to “third” countries, outside the borders of the area of a regional trade agreement regime (like the European Union). Similarly, Wooster et al. (2008) find that trade within the countries of EU-13 has less, yet still positive, effect on economic growth compared to the effect from trade with non-EU countries. Nevertheless, they do not report a negative effect! Standard theory provide us with a range of arguments for why the unconditional, regionally unlimited expansion of trade is preferable compared to the one that results within the borders of regional agreements, but it does not necessarily imply a negative effect on growth.

<sup>4</sup> Neven and Gouyette (1994), Neven (1995), López-Bazo et al. (1999), Barrios and Strobl (2005), Cappelen et al. (2003) and Basile et al. (2001).

<sup>5</sup> Moreover, there are studies that look at the standard deviation of many different measures. For instance, Boldrin and Canova (2001) study several indicators, such as labor productivity, income per capita and GDP per capita in the EU-15, and find support for the convergence hypothesis.

<sup>6</sup> Giannias et al. (1999), for instance, speak for a convergence process, which is disrupted in the early 1980s.

<sup>7</sup> Neven and Gouyette 1994.

<sup>8</sup> Opposite to Yin et al. (2003), we consider all these countries together, over the whole period (1960-2006), regardless the time of accession. Economic and political co-operation evolves always much earlier than the official agreement. The reason for not taking all 25 countries is also straightforward: political reasons kept the newest members completely apart from the core European Union till the late 1990s.

and the methodology, we focus on two distinct questions: Can we observe any convergence among the member states? Do we see a narrowing of inequalities, or not? Finally, we proceed with a panel regression and we draw the respective conclusions.

## 2. Data and Methodology

For the needs of the present paper, we employ mainly data on real GDP per capita (level and the rate of change) and on real wages (real compensation per employee), for EU-15 as a whole and for each country-member as well, in the period 1960-2006. We used the database of Eurostat,<sup>9</sup> combined with that of OECD.<sup>10</sup> Especially for employees' compensation, we used AMECO database, the annual macro-economic database of the European Commission's Directorate General for Economic and Financial Affairs.<sup>11</sup> Additionally, we also considered data on the annual real GDP growth per capita for the world economy as a whole. For that reason, we used the *World Development Indicators 2007* (The World Bank – WDI dataset).<sup>12</sup>

Our approach is quite simple, yet it serves the ultimate goal of the present study in a satisfactory way. At the end we conclude on some crucial facts and paradoxes, which lead to subsequent, more sophisticated questions for further research. The analysis can be divided in two parts. In the first part, we try to get some indications regarding the validity of projections made by the neoclassical paradigm. Initially, we study the development of cross-country inequalities. We estimate the coefficient of variation (standard deviation divided by the mean) of real GDP per capita among the different countries of EU-15 and the €area, on an annual basis, and we check the characteristics of the derived time series (1960-2006). Similarly, we proceed with analysing  $\sigma$ -convergence for real wages.

Next we consider annual GDP per capita ( $y$ ) and compensation per employee ( $w$ ), in real terms, in order to look at the broad development of inequalities within each country. We use the ratio  $w/y$  as an indicator for the degree of evenly distributed income. When  $w/y$  increases (decreases), real wages become higher (lower) relative to per capita income, which means that the labour's remuneration comes closer (falls behind) to non-labour income. Note that, under very specific assumptions,  $w/y$  could be seen as an expression for elasticity of production with respect to labour. If we assume a quasi perfectly competitive labour market, real wage should be equal to the marginal product of labour:  $w=dY/dL$ . Therefore,  $w/y$  could be also written as  $(dY/dL)/(Y/L)$ .<sup>13</sup> In that sense,  $w/y$  should follow the trend of (marginal) productivity of labour. Nevertheless, as we will see in the following paragraphs,  $w/y$  falls noticeably during the last 25 years, although the tendency of labour productivity was undoubtedly positive.

In the second part of the main study, we proceed with a co-integration analysis (Vector Error Correction Model), checking in as how much the degree of equal distribution within each country ( $w/y$ ) can be related to the country's growth rate, governmental spending and social expenditures, the country's degree of openness, as well as its status as an EU-member.

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<sup>9</sup> "European Economy - Annual Economic Report for 1997, No 63, 1997", European Commission, Directorate General for Economic and Financial Affairs;

<sup>10</sup> "OECD Factbook 2008: Economic, Environmental and Social Statistics", [www.oecd.org](http://www.oecd.org) .

<sup>11</sup> [http://ec.europa.eu/economy\\_finance/indicators/annual\\_macro\\_economic\\_database/ameco\\_en.htm](http://ec.europa.eu/economy_finance/indicators/annual_macro_economic_database/ameco_en.htm)

<sup>12</sup> <http://web.worldbank.org/WBSITE/EXTERNAL/DATASTATISTICS>

<sup>13</sup> Note that we also consider population to be approximately equal to the sum of workers,  $L$ .

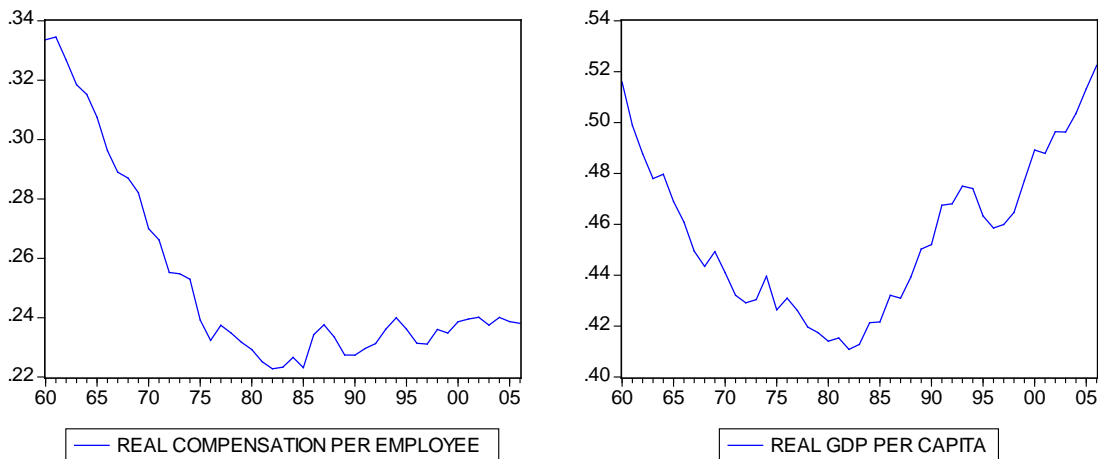
### 3. Inequalities and growth dynamic in the European Union

#### 3.1 Real wage & GDP convergence

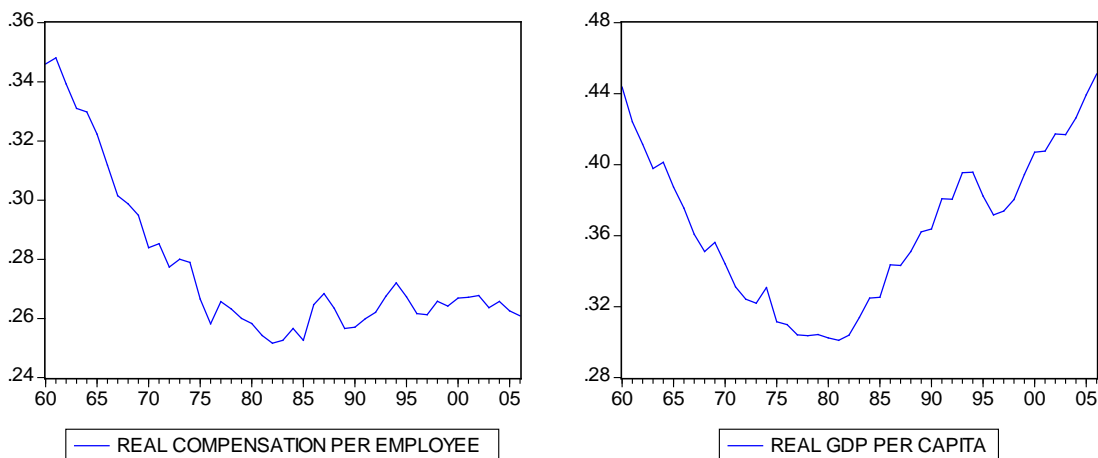
Standard theory declares that as the process of internationalisation evolves, cross-regional inequalities fade out. From a static point of view, mainstream trade analysis implies for open economies the equalization of factors' remuneration in real terms. At the same time, in terms of a dynamic approach, steady state of all participating economies becomes more and more similar. Therefore, convergence is a straightforward conclusion. Does this imply for the core of the European Union (EU-15 and €area)?

Table A.2 in the appendix provides stationarity tests and trend estimations for the annual coefficient of cross-country variation ( $\sigma/\mu$ ) of real wages per employee ( $w$ ) and real GDP per capita ( $y$ ), in EU-15 and €area, for the period 1960-2006. In case of real wages, the KPSS-test provides us with a significantly estimated negative trend, meaning a convergence tendency. Quite different is the picture for  $\sigma/\mu$  of real GDP per capita: especially for the case of EU-15, we have the reproduction of a significant positive trend, meaning divergence, with all four different methods.

**Diagram 2:**  $\sigma$ -convergence of  $w$  and  $y$  in EU-15.



**Diagram 3:**  $\sigma$ -convergence of  $w$  and  $y$  in €area.



Yet, trend estimations alone can lead us to incomplete conclusions. The picture we get from diagrams 2 and 3 is convincing: there are two obviously different periods. In 1960s and 70s, a convergence took place for real wages, as well as for per capita income. Yet, from

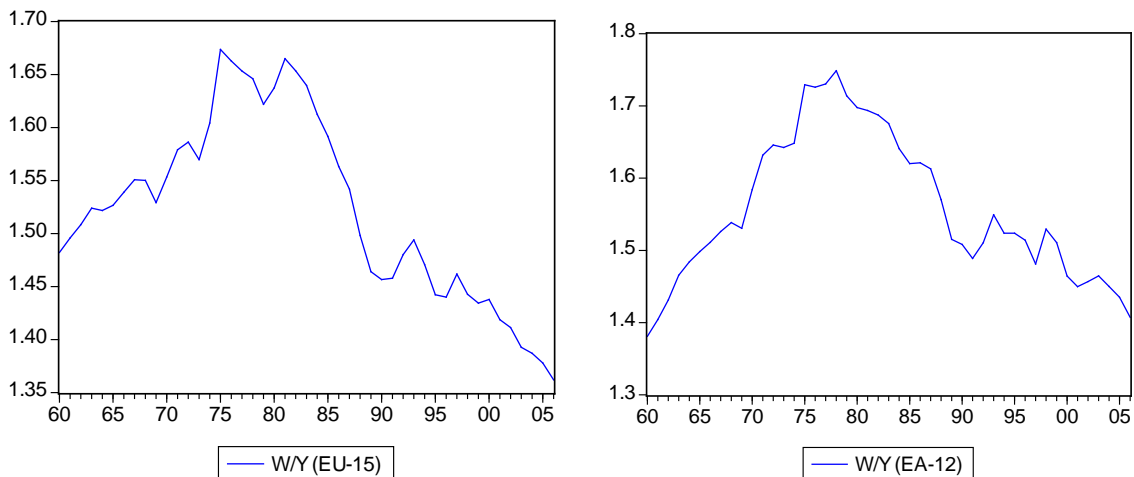
beginning of the 1980s, the picture changes dramatically: the coefficient of variation of  $w$  shows a noticeable stagnation. In the case of  $y$ , starting again from the 1980s,  $\sigma/\mu$  rebounds and follows an upward tendency of divergence, so strong that the trend we estimated for the whole period is slightly positive. Putting all these together, there is an apparent structural change after 1980: cross-country inequality starts to rise again, above any previous convergences. Using Perron-test, structural change appears in 1982 in all cases, except for  $\sigma/\mu$  of  $y$  in €area, where structural change is estimated for 1981.

### 3.2 Domestic distribution of income

Recently, OECD published a study saying that economic growth in developed countries goes together with a deepening of domestic inequality within the different countries (OECD 2008). The following diagrams depict the annual development of  $w/y$  for the Union as a whole (once for EU-15 and then for €area). As already mentioned, this ratio serves as an indicator for the degree of evenly distributed income.

Diagram 4 confirms the findings of OECD, yet only for the second half of the period: being in remarkable conformity with the development of cross-country inequality, domestic inequality is getting better only during the first two decades of the period we study. Starting from the 1980s, European labourers get a progressively smaller part from produced output. Perron test shows also here a significant structural change in the development of  $w/y$  around 1981 (1978 for the case of €area).

**Diagram 4:** Domestic inequality in EU-15 and €area.



## 4. A closer look into domestic patterns of inequality

The main message of the above paragraphs is the structural break that took place around the beginning of the 1980s: a previous period of converging differences gave place to a profound cross country divergence and a worsening of labour's relative remuneration. There is no way to justify this complete alteration of the process by any temporary effect. 1980-1982 recession or the accession of southern European countries (Greece, Portugal and Spain) could be blamed only for short-term breaks of a continuous trend. We suspect that the basic underlying reason is the gradual transition of the European free trade area into an economic and monetary union, accompanied by the prevalence of a specific policy. In this last part of the paper, we take a closer look into cross time development of  $w/y$  in each EU-15 country, focusing on the following explanatory variables:

$$(w_i/y_i)_t = a + b_1g_{i,t} + b_2(E_i/P_i)_t + b_3gov_{i,t} + b_4soc_{i,t} + b_5open_{i,t} + c_1MS_i + c_2MT_i + c_3EU_{i,t} + d_1t + e$$

where  $g$  is the growth rate of real GDP per capita in country  $i$ ,  $E/P$  is the rate of dependent employment,<sup>14</sup>  $gov$  and  $soc$  gives the rate of government spending and social expenditures over GDP,  $open$  is the country's degree of openness,  $MS$ ,  $MT$  and  $EU$  are dummies showing the creation of European Monetary System, the agreement upon Maastricht criteria and the country's accession to EU respectively. Last,  $t$  stands for time and  $e$  for error term.<sup>15</sup>

There are two main difficulties in estimating the above equation: first, there are enough reasons for suspecting endogeneity and second, panel unit root tests proved the non-stationary character of our variables.<sup>16</sup> Therefore, after we verified co-integration,<sup>17</sup> we applied a Vector Error Correction Model (VECM) (Greene, 2003).

The following table provides the estimated coefficients (results of *co-integrating equation* are available by request). Note that we have four different versions depending on the inclusion of  $t$  and  $E/P$ .

**Table 1:** VECM estimates –  $w/y$  in EU-15 countries, sample (adjusted) 1971-2006<sup>18</sup>

Dependent Variable: $(w_i/y_i)_t$				
Explanatory Variables:	Estimated Coefficients ( <i>standard errors in small italics</i> )			
Growth rate of real p.c. GDP, $g_{i,t}$	0,085 <i>0,086</i>	-0,090 <i>0,096</i>	<b>-0,137</b> <i>0,085</i>	<b>-0,150</b> <i>0,097</i>
Rate of (dependent) employment, $E_i/P_{i,t}$	-	-0,131 <i>0,291</i>	-	-0,158 <i>0,294</i>
Government spending over GDP, $gov_{i,t}$	-0,181 <i>0,163</i>	-0,181 <i>0,171</i>	-0,189 <i>0,165</i>	-0,193 <i>0,174</i>
Social expenditures over GDP, $soc_{i,t}$	<b>0,311</b> <i>0,151</i>	<b>0,330</b> <i>0,153</i>	<b>0,333</b> <i>0,152</i>	<b>0,352</b> <i>0,155</i>
Degree of openness, $open_{i,t}$	<b>-0,234</b> <i>0,100</i>	<b>-0,239</b> <i>0,102</i>	<b>-0,249</b> <i>0,100</i>	<b>-0,253</b> <i>0,104</i>
European Monetary System (dummy), $MS_i$	<b>-0,028</b> <i>0,008</i>	<b>-0,026</b> <i>0,009</i>	<b>-0,015</b> <i>0,007</i>	-0,012 <i>0,008</i>
Maastricht (dummy), $MT_i$	<b>-0,018</b> <i>0,006</i>	<b>-0,019</b> <i>0,006</i>	-0,003 <i>0,004</i>	-0,002 <i>0,004</i>
EU accession (dummy), $EU_{i,t}$	-0,007 <i>0,005</i>	-0,008 <i>0,005</i>	-0,005 <i>0,005</i>	-0,005 <i>0,005</i>
Time, $t$	<b>0,001</b> <i>0,000</i>	<b>0,001</b> <i>0,000</i>	-	-
<b>Adjusted R-squared</b>	0,231	0,214	0,218	-0,193
<b>F-statistic</b>	12,43	10,13	12,76	9,81
<b>Mean of Dependent</b>	-0,011	-0,012	-0,011	-0,012
<b>S.D. of Dependent</b>	0,033	0,033	0,033	0,033

First think to notice is that as real GDP growth strengthens, wages fall stronger behind (compared to non-labour income)! The conclusion of OECD for an unequally growing economy is being confirmed (in estimations where time is excluded). At the same time, degree of openness has a much clearer and stronger negative effect: the more domestic production competes with foreigners the less is  $w/y$ . This is not surprising, if we consider

<sup>14</sup> It is the part of employment rate that refers to employees, after we took out those who are self-employed.

<sup>15</sup> Note that the panel we are using is an unbalanced one. Yet, this should not be a problem, because missing observations do not relate to an idiosyncratic, time-varying error.

<sup>16</sup> Unit root tests are available by request. Using ADF-Fisher and PP-Fisher tests and asymptotic Chi-square distribution, we found that all variables are stationary in first diff's, with the exception of  $g$ .

<sup>17</sup> Panel co-integration tests are available by request. We used Kao residual co-integration tests based on the Akaike and Schwarz criteria.

<sup>18</sup> Provided tests confirm absence of autocorrelation, multicollinearity and heteroskedasticity.



that European firms compete, among other things, with low-wage economies. Third, government spending seems to be completely irrelevant, but, quite opposite, social expenditures improve strongly the relative position of labour income. On the contrary, the formation of EMU and the agreement upon Maastricht criteria have a significantly negative effect (especially when time is included).

## 5. Conclusions

In general, the present paper tests the validity of standard theoretical expectations regarding the benefits of a more internationalized economic environment, by focusing on the historical example of European Union. Member states do not seem to get much from participating in a regionally evolving regime of trade agreements and economic integration. Apart from the exception of Ireland, €area grew since 1960 with a gradually smaller rate than the world economy. Moreover, in accordance to recent OECD publications, European economies' development goes hand in hand with a deepening of inequality: as the growth rate is getting stronger,  $w/y$  ratio falls significantly.

Last but not least, there is clear evidence for a *profound structural change* regarding the distributional patterns that took place in the first half of the 1980s. During the first two decades of the period we studied (1960s and 1970s), both inter- and intra-regional inequality narrowed: the coefficient of variation of p.c. GDP fell strongly and labour remuneration grew substantially relative to non-labour income. This picture changed fully after 1980! The previous trend of closing the gap among the countries reversed completely: in 2005, coefficient of variation grew back to the levels of 1960. At the same time, all previous gains of labour vanished: in the period 1980-2005 real wages lost about 35% against p.c. GDP.

In the last part of this paper we contribute to the discussion regarding the reasons lying behind this structural change. In 1974, ECU (European Currency Unit) was defined and on the 13th March 1979, European Monetary System (EMS) entered into force, according to an agreement celebrated the same day between the central banks of the member-countries. Overall empirical conclusions are simply and clear-cut: EMS and "Maastricht" occurred just before the emergence of a persisting period of continuous divergence. On the other hand, cutting down social expenditures is highly related to the relative worsening of labour's income. In fact, empirical findings support our main suspicion: the gradual transition of the European free trade area into an economic and monetary union, accompanied by the prevalence of a specific policy could be one of the main reasons behind the period of deepening inequality.

## References List

- Andriamananjara, S., Hillberry, R., 2001. Regionalism, trade and growth: the case of the EU-South Africa Free Trade Arrangement. Office of Economics Working Paper, U.S. IT Commission, No. 2001-07-A.
- Barrios, S., Strobl, E., 2005. The dynamics of regional inequalities. Economic Papers of the European Commission 229, Brussels.
- Barro, R., Sala-i-Martin, X., 1991. Convergence across States and Regions. Brooking Papers on Economic Activity 1, 107-158.
- Barro, R.J., Sala-i-Martin, X., 1995. *Economic growth*, McGraw Hill, New York
- Basile, R., de Nardis, S., Girardi, A., 2001. Regional Inequalities and Cohesion Policies in the European Union. ISAE Working Paper, No.23.
- Boldrin, L., Canova, F., 2001. Inequality and Convergence in Europe's Regions. Reconsidering European Regional Policies. Economic Policy 16 (32), 205-253.
- Cappelen, A., Castellacci, F., Fagerberg, J., Verspagen B. 2003. The impact of EU regional support on growth and convergence in the European Union, Journal of Common Market Studies, 41, 4, 621-644.
- Chuang, Y., 2002. The trade-induced learning effect on growth: cross-country evidence. Journal of Development Studies 39 (2), 137-154.
- Giannias, D., Liargovas, P., Manolas, G., 1999. Quality of Life Indices for Analysing Convergence in the European Union. Regional Studies 33, 27-35.
- Greene, W.H., 2003. *Econometric Analysis*, 5<sup>th</sup> ed. London, Prentice Hall.
- Grossman, G., Helpman, E., 1991. Innovation and growth in the global economy. MIT Press, Cambridge MA.
- Hoer, A.R., 2000. Convergence and Divergence in the European Union. Paper presented at the 40<sup>th</sup> European Congress of the European Regional Science Association, Barcelona.
- Kali, R., Méndez, F., Reyes, J., 2007. Trade structure and economic growth. The Journal of International Trade & Economic Development 16 (2), 245-169.
- Khalafalla, K.Y., Webb, A.J., 2001. Export-led growth and structural change: evidence from Malaysia. Applied Economics 33 (13), 1703-1715.
- Levine, R., Renelt, D., 1992. A sensitivity analysis of cross-country growth regressions. American Economic Review 82 (4), 942-963.
- López-Bazo, E., Vayá, E., Mora, A.J, Suriñach, J., 1999. Regional economic dynamics and convergence in the European Union. Annals of Regional Science 33, 343-370.
- Matsuyama, K., 1992. Agricultural productivity, comparative advantage, and economic growth. Journal of Economic Theory 58 (2), 317-334.
- Neven, D.J., 1995. Regional Convergence in the European Union. Journal of Common Market Studies 33, 47-65.
- Neven, D.J., Gouyette, C., 1994. Regional Convergence in the European Community. CEPR Discussion Paper 914, London.
- OECD 2008. Growing Unequal? Income Distribution and Poverty in OECD Countries. [www.oecd.org](http://www.oecd.org).
- Rodriguez, F., Rodrik, D., 2001. Trade policy and economic growth: a sceptic's guide to the cross-national evidence. NBER Macroeconomics Annual 2000, MIT Press, Cambridge MA, pp. 261-324.
- Romer, P.M., 1986. Increasing returns and long run growth. Journal of Political Economy 94, 1002-1037.
- Veiga, F.J., 1999. Real Convergence in the European Union. CEEG, Documento de Trabalho 2/1999, Universidade do Minho.
- Walde, K., Wood, C., 2005. The empirics of trade and growth: where are the policy recommendations? International Economics and Economic Policy 1 (2-3), 275-292.
- Wooster, R.B., Banda, T.M., Dube, S., 2008. The contribution of intra-regional and extra-regional trade to growth: Evidence from the European Union. Journal of Economic Integration 23 (1), 161-182.

- Yanikkaya, H., 2003. Trade openness and economic growth: a cross-country empirical investigation. *Journal of Development Economics* 72, 57-89.
- Yin, L., Zestos, G.K., Michelis, L., 2003. Economic convergence in the European Union. *Journal of Economic Integration*, 18 (1), pp, 188-213.

## APPENDIX

**Table A.1:** GDP per capita growth by country, in EU-15 and €area, relative to world growth evolves over time.

	Stationarity				Estimation of trend							
	ADF (AIC)	ADF (SIC)	PP	KPSS	ADF (AIC)		ADF (SIC)		PP		KPSS	
					coefficient	t-statistic	coefficient	t-statistic	coefficient	t-statistic	coefficient	t-statistic
Austria	-3.400 <sup>†</sup>	-6.259 <sup>§</sup>	-6.304 <sup>§</sup>	0.255	-0.040	-1.839 <sup>*</sup>	-0.023	-1.224	-0.023	-1.224	-0.024	-1.361
Belgium	-4.112 <sup>‡</sup>	-6.970 <sup>§</sup>	-6.965 <sup>§</sup>	0.060	-0.031	-1.711 <sup>*</sup>	-0.030	-1.807 <sup>†</sup>	-0.030	-1.807 <sup>†</sup>	-0.028	-1.855 <sup>†</sup>
Denmark	-6.600 <sup>§</sup>	-6.600 <sup>§</sup>	-6.600 <sup>§</sup>	0.054	0.001	0.068	0.001	0.068	0.001	0.068	-0.004	-0.239
Finland	-2.120	-4.226 <sup>§</sup>	-4.092 <sup>§</sup>	0.085	0.002	0.071	0.006	0.242	0.006	0.242	-0.004	-0.147
France	-5.911 <sup>§</sup>	-5.911 <sup>§</sup>	-5.916 <sup>§</sup>	0.048	-0.038	-2.629 <sup>**</sup>	-0.038	-2.629 <sup>**</sup>	-0.038	-2.629 <sup>**</sup>	-0.041	-3.208 <sup>***</sup>
Germany	-5.239 <sup>§</sup>	-4.081 <sup>§</sup>	-3.821 <sup>§</sup>	0.253	-0.018	-1.232	-0.018	-1.232	-0.013	-0.875	-0.021	-1.352
Greece	-2.184	-5.721 <sup>§</sup>	-5.942 <sup>§</sup>	0.196 <sup>‡</sup>	-0.017	-0.479	-0.047	-1.346	-0.047	-1.346	-0.068	-2.081 <sup>**</sup>
Ireland	-1.497	-5.094 <sup>§</sup>	-5.166 <sup>§</sup>	0.068	0.123	1.613	0.082	2.510 <sup>**</sup>	0.082	2.510 <sup>**</sup>	0.100	3.579 <sup>***</sup>
Italy	-6.042 <sup>§</sup>	-6.042 <sup>§</sup>	-6.022 <sup>§</sup>	0.146 <sup>‡</sup>	-0.051	-2.433 <sup>**</sup>	-0.051	-2.433 <sup>**</sup>	-0.051	-2.433 <sup>**</sup>	-0.063	-3.465 <sup>***</sup>
Luxembourg	-5.558 <sup>§</sup>	-5.558 <sup>§</sup>	-5.558 <sup>§</sup>	0.110	0.071	2.071 <sup>**</sup>	0.071	2.071 <sup>**</sup>	0.071	2.071 <sup>**</sup>	0.084	2.759 <sup>***</sup>
Netherlands	-1.672	-5.235 <sup>§</sup>	-5.243 <sup>§</sup>	0.084	0.000	0.037	-0.004	-0.268	-0.004	-0.268	0.002	0.139
Portugal	-1.627	-4.203 <sup>§</sup>	-4.492 <sup>§</sup>	0.061	-0.043	-0.967	-0.079	-2.216 <sup>**</sup>	-0.062	-1.896 <sup>†</sup>	-0.081	-2.621 <sup>**</sup>
Spain	-4.618 <sup>§</sup>	-4.618 <sup>§</sup>	-4.591 <sup>§</sup>	0.127 <sup>†</sup>	-0.016	-0.813	-0.016	-0.813	-0.016	-0.813	-0.054	-2.491 <sup>**</sup>
Sweden	-3.058 <sup>‡</sup>	-5.444 <sup>§</sup>	-4.851 <sup>§</sup>	0.101	0.023	0.872	0.014	0.767	0.013	0.711	0.011	0.572
UK	-5.102 <sup>§</sup>	-5.026 <sup>§</sup>	-4.888 <sup>§</sup>	0.124 <sup>†</sup>	0.035	1.917 <sup>*</sup>	0.033	1.909 <sup>*</sup>	0.033	1.909 <sup>*</sup>	0.044	2.838 <sup>**</sup>
EU-15	-3.774 <sup>§</sup>	-3.774 <sup>§</sup>	-3.815 <sup>§</sup>	0.177	-0.003	-0.387	-0.003	-0.387	-0.003	-0.387	-0.007	-0.673
€area	-5.267 <sup>§</sup>	-5.267 <sup>§</sup>	-5.274 <sup>§</sup>	0.060	-0.039	-2.849 <sup>***</sup>	-0.039	-2.849 <sup>***</sup>	-0.039	-2.849 <sup>***</sup>	-0.053	-4.852 <sup>***</sup>

Notes: †, ‡ and § denotes rejection of the 0-hypothesis of unit roots for Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests and rejection of the 0-hypothesis of stationarity for the KPSS (Kwiatkowski-Phillips-Schmidt-Shin) test at the 10%, 5% and 1% significance level, respectively.  
\*, \*\* and \*\*\* denotes statistical significance at 10%, 5% and 1% significance levels, respectively.

**Table A.2:**  $\sigma$ -convergence of real wages per employee and real GDP p.c. over time

		Stationarity				Estimation of trend							
		ADF (AIC)	ADF (SIC)	PP	KPSS	ADF (AIC)		ADF (SIC)		PP		KPSS	
						coefficient	t-statistic	coefficient	t-statistic	coefficient	t-statistic	coefficient	t-statistic
EU-15	$\sigma/\mu$ of $w$ (GDP deflator) <sup>19</sup>	-1.511	-1.511	-1.570	0.223 <sup>§</sup>	0.000	1.533	0.000	1.533	0.000	1.533	-0.002	-7.478 <sup>***</sup>
	$\sigma/\mu$ of $y$	-2.199	-2.199	-2.210	0.225 <sup>§</sup>	0.001	5.740 <sup>***</sup>	0.001	5.740 <sup>***</sup>	0.001	5.740 <sup>***</sup>	0.001	2.123 <sup>**</sup>
	$\sigma/\mu$ of $y$ growth rate	-8.208 <sup>§</sup>	-8.208 <sup>§</sup>	-9.560 <sup>§</sup>	0.143 <sup>†</sup>	0.014	0.873	0.014	0.873	0.014	0.873	0.010	0.687
€area	$\sigma/\mu$ of $w$ (GDP deflator)	-1.942	-1.942	-2.099	0.216 <sup>§</sup>	0.000	0.567	0.000	0.567	0.000	0.567	-0.001	-7.109 <sup>***</sup>
	$\sigma/\mu$ of $y$	-2.288	-2.288	-2.255	0.218 <sup>§</sup>	0.001	5.985 <sup>***</sup>	0.001	5.985 <sup>***</sup>	0.001	5.985 <sup>***</sup>	0.001	2.170 <sup>**</sup>
	$\sigma/\mu$ of $y$ growth rate	-7.336 <sup>§</sup>	-7.336 <sup>§</sup>	-7.444 <sup>§</sup>	0.148	0.019	0.577	0.019	0.577	0.019	0.577	0.015	0.489

Notes: †, ‡ and § denotes rejection of the 0-hypothesis of unit roots for Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests and rejection of the 0-hypothesis of stationarity for the KPSS (Kwiatkowski-Phillips-Schmidt-Shin) test at the 10%, 5% and 1% significance level, respectively.  
\*, \*\* and \*\*\* denotes statistical significance at 10%, 5% and 1% significance levels, respectively.

<sup>19</sup> We estimate real wages by deflating the nominal compensation per employee in two ways: once we use GDP deflator and then final consumption deflator. Results do not differ significantly.

**Table A.3:**  $w/y$  in EU-15 and the €area over time.

	Stationarity				Estimation of trend											
	ADF (AIC)		ADF (SIC)		PP		KPSS		ADF (AIC)		ADF (SIC)		PP		KPSS	
	coefficient	t-statistic	coefficient	t-statistic	coefficient	t-statistic	coefficient	t-statistic	coefficient	t-statistic	coefficient	t-statistic	coefficient	t-statistic	coefficient	t-statistic
$w/y$ in EU-15	-1.767	-1.767	-1.660	0.199 <sup>‡</sup>	-0.001	-2.464 <sup>**</sup>	-0.001	-2.464 <sup>**</sup>	-0.001	-3.139 <sup>***</sup>	-0.001	-3.139 <sup>***</sup>	-0.003	-5.006 <sup>***</sup>	-0.003	-5.006 <sup>***</sup>
$w/y$ in €area	-1.853	-1.757	-1.772	0.195 <sup>‡</sup>	-0.001	-2.692 <sup>**</sup>	-0.001	-3.380 <sup>***</sup>	-0.001	-3.380 <sup>***</sup>	-0.001	-3.380 <sup>***</sup>	-0.003	-3.570 <sup>***</sup>	-0.003	-3.570 <sup>***</sup>

Notes: †, ‡ and § denotes rejection of the 0-hypothesis of unit roots for Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests and rejection of the 0-hypothesis of stationarity for the KPSS (Kwiatkowski-Phillips-Schmidt-Shin) test at the 10%, 5% and 1% significance level, respectively.  
\*, \*\* and \*\*\* denotes statistical significance at 10%, 5% and 1% significance levels, respectively.