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Institutional, Nominal and Real Convergence in Europe

by Enrico Marelli[*] and Marcello Signorelli[**]

Abstract[°]

Purpose of this paper is to assess institutional, nominal and real changes and convergences in Europe since 1989. The first part of the paper summarizes the different meanings of *institutional change/integration, nominal and real convergence* in the European context. This theoretical framework is then applied to the case of the current EU-27 countries in the last two decades. Many institutional changes occurred in Europe in that period; we especially highlight: (i) the collapse of the planned economies (since 1989) and the beginning of "transition"; (ii) the EU enlargements (1995, EU-15; 2004, EU-25, and 2007, EU-27) and the European Monetary Union creation (1999, EMU-11) and its subsequent extensions (leading to EMU-16 in 2009).

We then review and investigate the complex evolutions in terms of: (i) *institutional change/integration/convergence,* by (especially) considering the transition of 10 Central and Eastern countries towards market economy and EU membership, as well as the creation of the European Monetary Union; (ii) *nominal convergence,* by analysing the Maastricht's criteria for both current EMU's members and for the remaining EU countries; (iii) *real convergence,* by considering both sigma and beta dynamics in per-capita GDP, productivity, specialisation index, unemployment and employment rates. From the empirical analysis, based on descriptive statistics, cross section and panel regressions – including an investigation on the process of trade integration and output correlations across countries – we can infer the complex joint dynamics of (and feedbacks between) *institutional change/integration*, *nominal convergence* and *real dynamics*. Policy conclusions may be relevant for the different EU countries and aggregates.

Key words: European integration, nominal convergence, real convergence, old and new Europe
JEL codes: O47, O52, P27, P51, F43, F55

1. Introduction

A decade has already elapsed since euro's birth. Its success has been confirmed by the recent events following the financial and economic crisis of 2008. Most of EMU's members have been able to outlive the deepest phase of the crisis (despite some concerns about the most vulnerable countries) and the macroeconomic and financial instability has been worse in non-EMU countries. On the other hand, economic growth has been lower in Europe in all years of the new century (as was already in the 1990s) compared to other countries, such as the USA, not to speak of China, India and other emerging countries.

In the last decade, some other major events occurred in Europe. Besides the completion of the Single Market – with a closer trade integration within the EU – the two enlargements of 2004

[*] Full Professor of Economic Policy at the Faculty of Economics (University of Brescia, Italy). Department of Economics, University of Brescia, via San Faustino 74/B, 25122 Brescia (Italy). E-mail: emarelli@eco.unibs.it

[**] Associate Professor of Economic Policy at the Faculty of Political Sciences (University of Perugia, Italy). Vice-President of the European Association for Comparative Economic Studies (EACES). Department of Economics, Finance and Statistics, University of Perugia, via Pascoli, 20, 06123 Perugia (Italy). E-mail: signorel@unipg.it and marcello.signorelli@tin.it

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and 2007, the widest in EU's history, led to a close integration of Central and Eastern European countries (CEEC) with the European "core". Some New Members have already entered the EMU (Slovenia, Cyprus, Malta, Slovakia), although the question of the proper time of entry in the ERM-II firstly and in EMU afterwards is lively debated (as we shall see later).

The links between nominal convergence and real convergence are rather complex, can go in both directions, and may be different in the sort-run vs. the long-run. The literature's review comprehends such different aspects as long-run economic evolutions and convergence (in per-capita incomes and productivity), convergence in labour markets, homogeneisation of economic structures. The latter is relevant also for short-run economic performance, e.g. because of the effects on the symmetry of economic shocks; in fact, synchronisation of business cycles and closer trade integration are two additional aspects of real convergence. It is likely that the process of institutional integration enhanced such a real convergence, as maintained by the OCA's endogeneity hypothesis. A last issue is whether the mentioned process – including the final step of nominal convergence: euro's adoption – favours the implementation of market reforms (which in turn affects economic performance).

In this paper we illustrate the main features of both nominal and real convergence in the EU. We consider first some descriptive statistics, including an analysis of sigma and lowess-beta convergence. Then we run some regressions concerning the beta (unconditional and conditional) convergence analysis of: productivity, industrial specialisation, employment and unemployment rates; afterwards, the trade integration within the EU-27 is examined; an investigation of output correlations concludes the empirical section. The most original feature of our econometric estimates is the inclusion in the regressions of an "integration index", specifically computed, which tries to quantitatively summarise the progressive steps of institutional integration in Europe.

According to our results, the degree of real convergence seems satisfactory in EMU countries: this is the outcome of our analysis of output correlations, trade integration, (sigma and beta) convergence in productivity and labour market indicators; the only exceptions to this pattern of real convergence refer to the convergence (or divergence) in economic structures and in per capita GDP. On the other hand, the New Members have shown a generalised catching-up in terms of productivity and per-capita GDP toward the European average; this convergence is however obscured by the still different specialisations and consequently low output correlations, in addition to persisting problems in labour market performance. Moreover, these countries have encountered (in some cases) various difficulties in respecting nominal conditions of convergence, e.g. the Maastricht's criteria. These weaknesses have some implications for the proper time of euro's adoption.

The structure of the paper is the following. In Section 2 there is a review of the theoretical and empirical literature, focusing on the following issues: the institutional process of integration in Europe (§2.1); the long-run and short-run views of real integration (§2.2); the importance of convergence in economic structures (§2.3); the real convergence in labour markets, especially in their performance (§2.4); another aspect of short-run convergence: the business cycle synchronisation (§2.5); trade integration and trade specialisation (§2.6); the links between real and nominal convergence (§2.7); and, lastly, the relations between real convergence and institutional change (including structural reforms) (§ 2.8).

A preliminary descriptive analysis of nominal and real convergence is in Section 3. This includes the long-run evolution of nominal convergence, with particular reference to the Maastricht's parameters (§3.1); then a sigma and a lowess-beta analysis of some important "real" variables: per capita GDP, productivity, sectoral specialisation, employment rate, and unemployment rate (§3.2). The econometric investigations are presented and commented in Section 4: after an illustration of the data and of the computed indices (§4.1), we present the beta-convergence of productivity (§4.2), an "extended" beta-convergence analysis of economic structures (§4.3), a beta-convergence of employment and unemployment rates (§4.4). Finally, we scrutinize two more relevant variables suggested by OCA's literature: trade integration, explored by

means of panel estimations with fixed effects (§4.5), and output correlations (§4.6). Policy conclusions are drawn in Section 5.

2. Nominal and real convergence: theories and empirical assessments

In this Section we present a review of the main theoretical and empirical literature on nominal and real convergence issues.

2.1. The integration process in Europe

The integration process in the European continent has been wide-ranging and deep, although not always continuous and linear over time (as the halt in the processes of ratification of the Constitutional Treaty in 2005 and of the Lisbon Treaty in 2008 testifies). With reference to the *widening* process, starting from a community of six in 1958, we arrived – through the 2004-07 enlargements – to a community of 27, encompassing now most of the countries of the continent. The new (twelve) members underwent in the '90s a process of accession, after being formally considered as "candidate" countries.

Concerning the *deepening* aspect – after the common market and customs union, the single market (focusing on the "four" liberalisations of goods, services, capitals and people) – the European Economic and Monetary Union (EMU) established in 1999, with the circulation of the new common currency (the *euro*) since 2002, represents the most momentous achievement. An intermediate step toward the monetary union is represented by the Exchange rate mechanism (ERM) of the European Monetary System, which was launched in 1979 and, after the big crisis of 1992-93, still survives (as ERM-II) for the countries waiting to join the euro-zone.

The final goals of the EU[1] include *convergence of economic performance* and *economic and social cohesion*. This refers to convergence both between members (as the mention of solidarity indicates) and within individual countries, thus justifying regional policy measures. The instruments explicitly mentioned to achieve such goals include the *common market* and the *economic and monetary union.* It must be added that convergence in economic performance includes, especially since the launch of the European Employment Strategy and the ensuing Lisbon Agenda, convergence in labour markets.[2]

On one hand, the EMU is officially viewed as an instrument to achieve "real" convergence, i.e. convergence in economic performances. On the other hand, we can add that economic convergence is also a prerequisite to accomplish an effective EMU, as shown in the literature on "optimum currency areas" (OCA): *real convergence*, for instance in economic structures, rendering more symmetric the economic shocks, makes unnecessary the exchange rate instrument and raises the net benefits of EMU. This prerequisite goes beyond to the *nominal convergence* requirements established by the Maastricht Treaty as a pre-condition for candidate countries to enter the EMU.

It is known that such convergence criteria were, for the first time, verified at the beginning of May 1998, allowing to define a list of eleven members that in January 1999 gave birth to the euro. The subsequent tests for other countries resulted in further enlargements of the euro-zone, to Greece (since 2001), Slovenia (2007), Cyprus and Malta (2008), Slovakia (2009). The EU members not yet adopting the euro (but Denmark and the UK) are subject to a periodic revision about the

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[1] *'The Community shall have as its task, by establishing a common market and an economic and monetary union and by implementing common policies or activities referred to in Articles 3 and 3a, to promote throughout the Community a harmonious, balanced and sustainable development of economic activities, a high level of employment and of social protection, equality between men and women, sustainable and non-inflationary growth, a high degree of competitiveness and convergence of economic performance, a high level of protection and improvement of the quality of the environment, the raising of the standard of living and quality of life, and economic and social cohesion and solidarity among member states.'* (art. 2 of the Treaty establishing the European Community, as amended by the Treaty of Amsterdam, 1997).

[2] The European Employment Strategy (EES), launched in 1997 in the Luxembourg Council, is an important example of "open method of coordination of labour and employment policies" that has been reinforced in the Lisbon Council (2000) and Stockholm Council (2001), with the definition of three European objectives in terms of employment rates (total, female and 55-64) to be reached by 2010. Each year the EU countries present a Report on the national and regional labour policies adopted (according to the European general and specific guidelines) and on the "convergence" towards the above quantitative objectives.

"progress in the fulfilment of the requirements concerning the realization of EMU": to this end, both the EU Commission and the ECB prepare every two years specific "Convergence Reports". The ECB report includes an analysis, country by country, of convergence in prices, in public finances (deficit and debt), in exchange rates, in long-term interest rates, plus a discussion of progress in legislation harmonisation (e.g. relative to central bank independence).

It is interesting to note that many EMU members have in some cases relaxed their respect for the nominal criteria, after adopting the euro (also because the previous threat of exclusion disappeared). As to the *new EU members*, they initially showed a good rate of nominal convergence: inflation, interest rates, debt/GDP ratios, but with some imbalances in deficit/GDP ratios; this was accompanied by a growing trade openness, trade integration with EU15, significant reforms/changes in labour markets (with relatively high degrees of flexibility) and in institutions, and finally increasing business cycle synchronicity with the euro area. This account[3] must be completed by mentioning that the record is more mixed concerning some aspects of real convergence (growth, productivity, price levels), output specialisation and delays in the modernisation of financial systems.

In the latest (2008) ECB Convergence Report, a critical situation emerges at present with reference to the inflation condition (only three countries out of ten have an inflation rate lower than the reference value), while it is better in the case of long-term interest rates (three countries out of ten exceed the reference value). Also the situation of public finances – traditionally more critical in some countries of Central Europe – has been improving: four countries are under the "excessive deficit procedure", but only one (Hungary) presents in 2007 a deficit/GDP ratio greater than 3% and also a debt/GDP ratio greater than 60%. Concerning the exchange-rate, four countries (out of ten) join the ERM-II agreements.

Before ending this section, we must add that the most recent data, from the time when the financial and economic crisis peaked at the end of 2008, show a deeply deteriorated situation for many CEEC countries – both NMS and outside the EU – especially in terms of rising interest rates (because of considerable increases in default risks), growing deficits and debts, unbalances in foreign accounts, and depreciation of exchange rates.

2.2. Real convergence: long-run vs. short-run views

One important goal of the EU is "convergence of economic performances". Thus, a first meaning of *real convergence* evaluates it in terms of the similarity of final outcomes for real economic variables: production, income, employment, productivity, etc. In more general terns, differences (and changes over time) in development levels, competitiveness, macroeconomic and labour market performance, etc. may reveal the degree of real convergence. Moreover, convergence in outcomes is more likely if economic (and institutional) structures are (or become) more similar.

A *long-run view* of real convergence implies the narrowing of differences in the structural conditions of different countries (or regions), thus allowing the achievement of similar performances of real variables; or, more precisely, a catching-up – in the transition period – of backward countries, in terms of standard of living, productivity, etc. The theoretical and empirical model of "conditional convergence" is appropriate in this case: the narrowing of structural conditions mean that the steady-states become closer, thus permitting similar performances in the long run.

Long-run growth and structural change issues have been specifically tackled in the models of economic growth. Many empirical studies have been carried out, both at the national and at the regional level, following the well-known approaches of *absolute* and *conditional convergence*.[4] In empirical studies, standard "*sigma*" and "*beta*" convergence estimates are generally used.

[3] See Angeloni et al. (2005), who argue that, while waiting for full monetary integration with the adoption of the euro, some exchange rate flexibility may be a useful shock absorber. Concerning labour markets, also Boeri and Garibaldi (2005) argue that the NMS are not more rigid than the old member states, despite the persistence of some structural problems and large pools of unemployment; in particular, the Baltic states exhibit high degrees of labour market flexibility.

[4] See Barro and Sala-I-Martin (1995).

Many empirical studies show that in Europe, even within the euro area, *real convergence* is far from complete. The most recent empirical investigations show that, while a convergence process has characterised national developments, absence of convergence or even divergence has been found at the national level: a trade-off between international convergence and interregional divergence has been a common outcome (especially among the new members of EU).[5]

A *short-run view* of real convergence stresses, on the contrary, the business cycle features of (comparative) economic growth of different countries.[6] The above mentioned OCA theories maintain that the real effects of economic shocks within a monetary union depend on the degree of asymmetry of shocks; furthermore, after the shock has occurred, the degree of flexibility of markets or the effectiveness of other adjustment mechanisms (labour mobility, fiscal transfers, etc.), alternative to the exchange-rate instrument, become a key factor.

The (a)symmetry of shocks depends, in turn, on the similarity of sectoral structures; e.g., sectoral shocks, common to many countries, may lead to different responses in diverse countries when structures differ, at least in terms of the intensity of the (direct and indirect) effects. If shocks are more symmetric across countries, then real variables tend to respond more similarly: this can be evaluated considering the degree of synchonisation of business cycles between countries. In the case of the EU, empirical analysis of this sort have been carried out not only after the launch of the EMU, but even before it, in order to see whether the European countries were "ready" for this jump in the integration process (as a matter of fact the ERM of the European Monetary System may have affected the synchronicity of business cycles).

2.3. Convergence in economic structures

Convergence in economic structures is, first of all, important in the long-run view of real convergence, as we have anticipated before. National and regional specialisations are a key factor for economic growth, but at the same time they are themselves influenced by the level of development.

Structural convergence was analysed – even before the neoclassical (including the conditional convergence variant) and endogenous growth approaches – by the development economists (Chenery, Clark, Hirschman, Kaldor), who were also prone to investigate the interaction between structural and institutional convergence. According to these contributions, there is a close relation between the stage of development, on one hand, and the productive structure of each country, on the other: the well-known *three sectors law* is a good starting point to understand the importance of the sectoral structure.[7] More sophisticated investigations of sectoral structures distinguish economic sectors in terms of differences in capital intensity, economies of scale, inter-sector links, technical progress, use of human capital, knowledge intensity, and many other features.

Relating structural convergence to economic growth models is easy in the "conditional convergence" approaches. If the structural conditions of economic systems become progressively similar, then the steady states will be equalised, allowing to achieve similar per capita output levels. On the opposite side, in certain "endogenous growth" models increasing specialisation and diverging paths for different economic systems is a possible outcome.

Even in a short-run approach, the process of "structural homogenisation" is, on one hand, an important feature of real convergence and, on the other hand, one of the determinants of the asymmetry of shocks and, consequently, of macroeconomic performance in the short run, for instance visible in the increasing synchronisation of business cycles (as discussed in the following sub-section).

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[5] See Martin (2006), Marelli (2007), Marelli and Signorelli (2008a).

[6] The two views – long-run and short-run – of real convergence were already illustrated in Marelli (2007). Part of the review of the literature in this section is from this paper.

[7] Even today, in many lagging regions of Southern and Eastern Europe there is still a large primary sector; at the same time, while in some regions of Europe the tertiarisation process has been continuing for decades, in others the peak of industrialisation has not yet been reached. See Marelli (2004).

But how is structural convergence related to the process of economic (and monetary) integration? According to Krugman (1993) such relation is mainly negative: economic integration is likely to lead – because of scale economies, externalities, agglomeration effects, etc. – to *increased specialisation*, diverging economic structures, asymmetric developments, and widening differences in growth rates. If we assume increasing returns (or agglomeration economies), firms of one industry tend to cluster in a particular country or region, e.g. where the final market for a certain product is larger. The theoretical explanations follow the "endogenous growth" models with many sectors and international trade, or the spatial models of the new economic geography.

This "pessimistic" view[8] has been opposed by the consideration that the degree of similarity of economic systems has been (and will be) enhanced by increased competition and integration of markets, thanks to the single market, the liberalisation of capital flows and the working of EMU itself (as will be explained when dealing of cycle synchronisation). Furthermore, the *empirical evidence* on structural convergence is mixed.[9]

Thus, even if we should not be too pessimist about long-run structural convergence (or divergence)[10], structural differences are important for short-run performance. An interesting empirical investigation is provided by Imbs (1999), who plays down the impact of trade on real convergence and rather focuses on the role of bilateral differences in sector structures (together with differences in GDP levels). Specialisation may be important because a high degree of specialisation (following Krugman's assumption) causes increased *inter-industry trade* and then asymmetric shocks may appear; the opposite will result from lower specialisation and *intra-industry trade*. In any case, luckily enough, the latter type of trade has developed most after introduction of the euro (Böwer and Guillemineau, 2006).

2.4. Convergence in labour market performance

In this section we briefly highlight some (empirical, policy and theoretical) reasons for considering - within the real convergence analysis - also key variables of labour market performance.

First of all, it is useful to recall that per capita GDP may be decomposed into productivity (GDP/E) and employment rate (ER=E x 100/ $P_{15\text{-}64}$) (plus a residual demographic indicator, $P_{15\text{-}64}$/P), in both static and dynamic frameworks.

$$\frac{GDP}{P} = \frac{GDP}{E} \times \frac{E}{P} = \frac{GDP}{E} \times ER \times \frac{P_{15-64}}{P} \times \frac{1}{100}$$

In dynamic terms, considering a group of countries (or regions), per capita GDP changes and per capita GDP convergence/divergence trends can be the result of many different and complex combinations in the dynamics and convergence/divergence processes of both labour productivity[11] and employment rate (ER). This is a first reason for not excluding the ER variable from the real convergence investigations. In addition, within the context of the European Employment Strategy

[8] Many economists are willing to concede that Krugman's hypothesis of growing sector specialisation is more realistic regionally than nationally: regions are not only more open but *more specialised* than national economic systems. Even when the average productive structures of two countries appear similar, regional specialisations may be very different. As a consequence, the probability that sector-specific shocks are asymmetric is much higher at a regional level.

[9] See Hallet (2002), Marelli (2007). The former study, by following a shift-share approach, discovers that – if structural change is included in the analysis – the narrowing disparities in productivity are largely accounted for by labour shifts from low-productivity sectors to high-productivity ones. In the latter study, the evolution of simple specialisation indices (like the Krugman index presented in section 4.1) is investigated, providing at an aggregate level an outcome of prevalent decreasing specialisation across European countries (and regions); but considering a detailed breakdown within the industrial sector and within market services specialisation trends are more mixed.

[10] Anyway, even if Krugman would be right, the asymmetric shocks could be counteracted, in the monetary union, by the market adjustment mechanisms (price flexibility and labour mobility) and by appropriate economic policies (fiscal transfers and the like).

[11] In addition, labour productivity may be decomposed into hourly productivity (GDP/H) and the average working time per employed person (H/E), obtaining: $\frac{GDP}{P} = \frac{GDP}{H} \times \frac{H}{E} \times ER \times \frac{P_{15-64}}{P} \times \frac{1}{100}$; with $ER = \frac{E \times 100}{P_{15-64}}$; E=Employment.

(EES)[12], the Lisbon Council (2000) and Stockholm Council (2001) defined three quantitative objectives, to be reached by 2010: (i) a total ER at 70%, (ii) a female ER higher than 60% and (iii) a 55-64 ER higher than 50%. The EES general and specific guidelines are especially addressed to the improvement of the worst performing countries in order to produce a process of convergence towards the ER objectives by 2010[13].

Considering the traditional labour market performance indicator, i.e. the unemployment rate (UR), and its definition[14], it is not immediate to derive its dynamic and convergence processes simply by those of ER, due to the role of the participation rate (PR) variable. So, ER and UR do not necessarily exhibit opposite dynamics; also the convergence/divergence processes may be significantly different.

In short, "empirical reasons" together with the recent European policy-making framework suggest the consideration of key labour market performance variables (especially ER, but also UR and LTUR) in addition to traditional ones (per capita GDP and productivity) for a better understanding of the multidimensional features of real convergence dynamics.

Some empirical studies highlighted different aspects of real convergence/divergence processes for the "long period of prevailing job-less growth and divergent labour market performance dynamics in EU countries" (Bean, 1994; Padalino and Vivarelli, 1997; Solow, 2000; Garibaldi and Mauro, 2002; Sapir, 2004; Blanchard, 2005; Perugini and Signorelli, 2004 and 2007; Marelli, 2000 and 2007) and the "more recent dynamics characterised by a job-rich (low-)growth and prevailing (beta) convergence trends in EU-15 labour market performance" (e.g. Perugini and Signorelli, 2004 and 2007; Marelli, 2007).

However, from a theoretical point of view, while the idea of per capita GDP and productivity *beta* convergence is well rooted in economic theory, starting from Solow's contribution (1956), and a lively debate on the topic is still one of the core issues of development economics, the transfer of this conceptual framework to labour market dynamics is not simple and the derivation of a theory of employment/unemployment beta convergence has not been attempted, and is clearly beyond the scope of this paper[15]. Partially different considerations may be made with reference to a theoretical background for *sigma* convergence of labour market performances, considering that institutional harmonisation and employment policy coordination, together with labour mobility and wage flexibility, could contribute to theoretically explain the possible tendency towards a reduction of performance disparities.

Obviously, there are many other fields of theoretical and empirical literature that explicitly consider the complex dynamic relationships between per capita GDP (and/or productivity) from one side and (un)employment indicators from the other side. Here we just recall the theoretical debate around the so-called "Okun law" and the empirical investigations on the role of institutions,

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[12] The European Employment Strategy (EES) was lanced in the Luxembourg Council (1997) for changing the persistent "jobless-growth" of many European countries characterised by high (total and long-term) unemployment rates and low employment rates.

[13] It should be noted that, since the Lisbon Council, the ER became the favourite labour market performance indicator rather than the UR, but long-term UR still maintain a remarkable importance. For a discussion on the labour market performance indicators and their relations, see Perugini and Signorelli (2007). Here, we just recall that ER can be also considered as one of the key indicators for assessing the (social and financial) sustainability of the European "social model" and of the welfare systems.

[14] $UR = \frac{U \times 100}{LF} = \left(1 - \frac{ER}{PR}\right) \times 100$; with $PR = \frac{(E+U) \times 100}{P_{15-64}}$; E=Employment and U=Unemployment. It should be noted the importance of an additional investigation of the weight and dynamics of long-term unemployment rate (LTUR), since the same unemployment rate can be the result of (very) different combinations of short and long term URs, due to differences regarding "inflows", "outflows" and "average permanence" in unemployment status.

[15] In this direction, a preliminary condition would be the definition and acceptance of a concept, corresponding to the "steady state" in growth theory, of a common long-term labour market equilibrium. This concept is of course copiously available in the literature (see the so-called "natural rate of unemployment" in its many versions), but its validity may be challenged from many perspectives. Following Solow (1990), we reject the restrictive hypotheses of the existence of a single long-term unemployment rate in favour of the more realistic possibility of a range of values that unemployment (and employment) rates may assume, across countries/regions, even in the long term, according to the effects of several economic, social and institutional factors and policies. We argue that the above hypotheses on the existence of a range of "equilibrium" (un)employment rates (according to countries/regions and over time) allows us to analyse the dynamics of labour market performance, rejecting the strict assumption of convergence to a single "natural equilibrium", but without excluding the possibility of a more general convergence process.

wage/price and policies as determinants of co-movements and feedbacks regarding GDP, productivity and (un)employment.

In addition, the theoretical debate on OCA has been also focused on the labour market pre-conditions (mobility and wage flexibility[16]) for realising an effective monetary union. Then, a decade of evidences on the European monetary union[17] can be useful for assessing if the endogeneity of OCA's criteria proposition could be extended - in a certain sense - also to the labour market flexibility.

So, considering some of the above empirical and theoretical reasons, we argue that the extension of (sigma and beta) real converge analysis to ER and UR should be very useful and, at least, functional in (i) highlighting the contribution of labour market performance to a wider real convergence approach[18] and (ii) assessing the process of convergence towards EU employment policy objectives.

2.5. Synchronisation of business cycles

We have previously shown that real convergence in Europe, after some decades of catching-ups and reversals, is far from complete. We could now ask whether at least the business cycles have become more synchronised. In empirical studies, this is verified by looking at correlations of output, GDP, industrial production or employment; in some researches, correlations of exports, consumption, services are also investigated. An increasing correlation of real variables would mean that shocks have become more symmetric across European countries.

Possible determinants of the degree of synchronicity between countries include the following elements: (i) homogeneity of sectoral structures and specialisation[19], (ii) additional structural indicators (e.g. competitiveness), (iii) international trade deepening, (iv) existence of a common border and the variables suggested by gravity models (relative size and geographical distance between countries), (v) exchange rate regimes and coordination of macroeconomic policies, (vi) institutional agreements (tariff and non-tariff barriers).

For example, in the recent decades the similarity of economic systems in Europe has increased thanks to the *coordination of macroeconomic policies* and the attainment of the Single Market, in the ‘80s and early ‘90s: a stronger co-movement of business cycles within the European Monetary System (EMS) has been detected by Artis and Zhang (1999). Synchronisation has increased in the ‘90s in the EU, especially in the (future) euro area, thanks to higher trade intensity.

In the case of EU integration, the link is probably (as will be shown in the next sub-section) from EU’s *institutional integration* to *trade deepening* and then to *cycle correlation*. The interaction between institutional integration and trade deepening appeared well before the currency union: in fact, we can go back to the impact of the custom union, the Single Market, the EMS (with reduced exchange rate volatility), the coordination of economic policies. Of course, the monetary union is the final step in the institutional integration process (so far), since it represents a serious and durable commitment.

As to the empirical studies[20] on synchronisation, the results in case of EU countries are mixed, since they depend on data sets, time intervals and investigation methods. A firm conclusion is nevertheless that euro area countries correlate amongst themselves more than with the rest of the

[16] The situation is various in NMS. According to a recent paper by Moore and Pentecost (2006), wage flexibility is higher in Hungary and the Czech republic compared to Poland and Slovakia; however, the degree of wage flexibility of the latter countries is similar to the Italian one.

[17] It is noticeable that 16 countries are now EMU members and other EU members will probably adopt the euro in the next years.

[18] Boldrin and Canova (2001) stress how the gap between the various convergence/divergence theories (predicting labour productivity dynamics) and empirical tests (which broadly adopt per capita incomes) is simply bridged by assuming full employment, neglecting the roles played by labour market performance dynamics. In particular, for the EU regions, Boldrin and Canova (2001) consider convergence patterns for per capita GDP as a whole and for labour productivity and unemployment rates separately.

[19] Even at the regional level, it has been found that regional growth (e.g. in terms of employment) is more synchronised when regions look alike in the sectoral structure, where the latter can be analysed by using synthetic “similarity indicators” (see Belke and Heine, 2004).

[20] In addition to simple (linear) correlations, structural VAR procedures have been extensively used in recent research.

world[21] (despite the recent emergence of a world business cycle due to globalisation). Furthermore, output variance within the euro area is mainly explained by common shocks, while idiosyncratic shocks although persistent tend to be small: stabilization policies at the national level do not have a large role to play (Giannone and Reichlin, 2006).

Empirical studies have shown that synchronicity has increased not only within the euro-zone or the EU15 group, including some "peripheral" countries (therefore making the concept of a "core" of European countries less meaningful), but also between "old" and "new" Europe. In particular, trade relations of new members developed significantly even before the official EU accession, thanks to their robust growth rates, the large economic weight of the euro area and the geographical proximity (Bussière et al., 2005)[22]. Concerning output correlations, Hungary, Poland and Slovenia are the most correlated with the euro area, comparably to some "core" EU15 countries and more than EU15 peripheral countries (Greece, Portugal, Spain, Ireland, and Finland); the lowest correlations, close to zero, are found for the Baltic states (Darvas and Szapáry, 2005; Fidrmuc and Korhonen, 2006).[23]

2.6. Trade integration and trade specialisation

The OCA theories argue that the benefits of a monetary union augment with the increasing openness of the countries and with their (reciprocal) *trade integration*: thus, fully or highly integrated countries are in the best condition to grasp the benefits of the monetary union. This condition is for instance satisfied by most CEE countries, new members of the EU.

Also in this case the link is sometimes reversed: the *endogeneity of OCA's criteria* proposition maintains that even if such criteria are not satisfied ex-ante, they come to be endogenously confirmed ex-post, following the creation of a monetary union. Frankel and Rose (1998), followed by Rose (2000), considering a large sample of industrialised and developing countries and using gravity models (controlling for geographic, historical, linguistic and other determinants of bilateral trade), emphasized the positive effects of the establishment of monetary unions on the increase of foreign trade (and consequently on the degree of synchronicity of business cycles); although, according to the critics (e.g. Frankel, 2008), the magnitude of Rose's effect – whereby trade among union members can augment threefold – depends on the small size of the countries (the small countries are much more trade dependent) belonging to the monetary unions in his sample.

The original source of "real integration" between countries may even be the process of institutional integration. In fact, Mongelli et al. (2005) have shown that the link between *institutional integration* and *trade deepening* runs both ways, although the link departing from institutional integration is more pronounced. Thus, trade integration has been the final outcome of the custom union, the Single Market, the EMS and the coordination of economic policies.

What about the effects of EMU? For sure, it is too early to infer significant trends, because of the limited horizon (ten years since EMU's birth) and the lags in data availability. Earlier studies (e.g. De Grauwe and Mongelli, 2005) considered unlikely a dramatic surge of trade in the immediate period after the union, both because trade has already risen over the last 50 years reaching in some cases sizeable levels and for the reason that it takes time (about 15-20 years) to

[21] However Fatàs (1997), while confirming a rising correlation of national cycles in Europe, discovered declining co-movements across regions.

[22] The authors use a *gravity model* (relating trade flows not only to economic size and distance, but also to other explanatory variables such as common border, common language, being historically part of the same territory, participation in free trade agreements, and valuation effects captured by the real exchange rate) as a benchmark of what would constitute "normal" trade relationships, to gauge the potential for further trade integration. The main result is that trade integration between most of CEEC and the euro area is already well advanced, since for the largest CEEC trade with the euro area already nearly 60% of their total trade (there is scope for further strengthening only for the Baltic countries and the South-Eastern European countries); deeper integration with more distant industrialised countries and emerging economies is however an opportunity to be exploited.

[23] This rank is confirmed by many other empirical studies; sometimes, in addition to the three mentioned countries (Hungary, Poland and Slovenia), also the Czech Republic is found to exhibit high correlations. More specific studies, by distinguishing between supply and demand shocks, demonstrate that the latter have converged, thanks to the endogeneity processes, while asymmetries have prevailed in supply shocks (Babetskii, 2005).

appreciate the trade creating effects of a monetary union (as shown by theoretical studies). The empirical evidence is however that, after the introduction of the euro, intra-euro trade has already risen by five to ten percent, without any evidence of trade diversion (Mongelli and Vega, 2006). A positive trade effect around 10-20%, which however has levelled off in the recent (2003-06) years, is confirmed for a long (eight-year) period by the latest investigation of Frankel (2008).[24]

The endogeneity argument has been extended in later studies, not only from trade deepening to institutional convergence, but also considering the changes in the flexibility of product and labour markets (with effects on wages' moderation), the process of equalization of prices (or convergence in inflation rates), fiscal integration and financial convergence (direct and portfolio investments may benefit from convergence in interest rates), and many other features.

Turning back to the trade characteristics, in addition to trade integration (or deepening) also trade specialisation may be relevant. A recent empirical study (Böwer and Guillemineau, 2006) concludes that *trade specialisation* is more important than *productive specialisation* in determining the symmetry of business cycles; the authors note that high trade openness and low trade specialisation create a high degree of intra-industry trade.[25] While broad economic structures have not converged in Europe, differences in trade specialisation have declined dramatically and continuously[26]; these different evolutions can be explained by the presence of non-tradables and the increasing importance of services (that now account for 70% or more of GDP in many countries).

2.7. Real convergence and nominal convergence

There are different definitions of real and nominal convergence. If we refer to standard macroeconomic models, real variables generally refer to real output or income (Y) and related variables, nominal variables to the price level (P) or the inflation rate. The relative weight put on the latter variables compared to the former – in the central bank's function – distinguishes the conservative central banks from the "wet" ones.

In some empirical studies, the interdependences between the two types of convergence have been investigated. For example, Carré (1997), by adopting both a sigma-convergence and a beta-convergence analysis (with two equations representing the nominal and real convergence processes), found that in the '80s nominal and real convergence were negatively correlated (with real divergence and nominal convergence), while in the '90s they were characterised by simultaneous convergence movements.[27]

Coming now to the studies closer to the monetary union literature, referring to *real convergence* as convergence in economic structures and defining *nominal convergence* as the ultimate adoption of a common currency, we have already seen that the OCA theories suggest that the former (real or structural convergence) may facilitate the establishment of a successful monetary union.

Nevertheless, in the institutional process leading to the creation of EMU, the link *between nominal convergence and real convergence has been reversed*. In fact, the admission of European countries to the *euro* club was (and is) conditioned by the compliance with the "Maastricht's

[24] The much lower impact compared to the original Rose's estimates (and more similar in magnitude to the results of Micco et al., 2005) is mainly justified by the sample size (Frankel uses a large sample with many countries and a long period, 1948-2006), rather than other explanations, such as the country size effect (the European countries are much bigger than members of past currency unions), or lags (the euro is still very young and even 30 years may not be a long run effect), or possible endogeneities of the decision to adopt a common currency. It is important to note that the trade effect shows up *"in 1998, the year before EMU… It is likely that currency unions… can start to have substantial effects on trade patterns even before they have formally gone into effect"* (Frankel, 2008, p. 9).

[25] The specificities of vertical intra-industry trade, in the relations between the "old" EU and the CEE countries, are investigated by Gabrisch (2009).

[26] It is worth noting the dramatic evolution in some of the new member states: they have been able to change their specialisation rapidly toward medium and high-tech products (including machinery and transport equipment), for which the world demand is growing quickly. These countries can take advantage of high skilled labour force, huge FDI inflow, restructuring in production and modernisation of the capital stock (Zaghini, 2005).

[27] If this is true, the implication is that Mastricht's nominal convergence criteria – applied in the '90s – have *not* negatively affected real economic convergence.

criteria", concerning inflation rate, interest rate, exchange rate, public sector debt and deficit; for incumbent members, the public sector requirements are also endorsed by the Growth and Stability Pact. All of these are nominal criteria: if a country was (will be) able to achieve such nominal convergence, it would have been (will be) admitted to the club.

What is the rationale behind this approach, i.e. the relation between *nominal convergence* and *real convergence*? According to economists close to the EU Commission (e.g., Buti and Sapir, 1998), nominal convergence gradually leads to real convergence, thanks to the advantages of macroeconomic stability (price stability and fiscal discipline), the removal of the exchange-rate risk, the reduction of uncertainty concerning inflation and interest rates, the spur of investment and international trade, all benefits finally leading to stronger economic growth (which may even become permanent thanks to dynamic scale effects). Because such benefits may be more important for formerly "deviating" economies (characterised by greater macroeconomic instability) or lagging countries, a real convergence is likely to occur in the long run.

It is worth to stress the importance of the *time horizon* in assessing real and nominal interdependences. In the candidate countries, especially in formerly deviating countries, the stringency of the nominal conditions slowed *in the short run* their growth rates; in this way, such countries have been punished for their previous "vices" (undisciplined public finances, inflation-prone behaviour, etc.), with the ultimate threat of being left out of EMU. However, the same countries have been simultaneously rewarded by the gains of EMU itself: disinflation, lower interest rates and debt service (in addition to the common benefits of monetary unions in terms of lower transaction costs, smaller uncertainty, reinforced competition, etc.): such benefits are important for a sustained growth *in the long run*.

We must also say, at this point, that not all the economists view the Maastricht's criteria as necessary or even sensible prerequisites for the euro's adoption. For example, Buiter (2004) underplays the role of inflation and interest convergence, and of exchange rate management (e.g. within the ERM-II in the case of the transition countries aiming to join the euro club): such nominal targets are, according to him, too many and inconsistent; just fiscal sustainability is a decisive requirement.

A specific issue, widely discussed in the literature, refers to the implications of the *Balassa-Samuelson* effect. The lagging EU countries, with particular reference to the new EU members, characterised by lower per-capita income levels and consequent strong catching-up processes, will inescapably have – in the transition to EMU and in the first period of euro adoption – higher *inflation* rates (because of productivity differences between sectors and high inflation in the non-tradable sector). Hence for such countries the inflation criterion should be abandoned; alternatively according to De Grauwe and Schanbl (2005), who emphasize the conflict between nominal and real convergence during the run-up to EMU, the required *real appreciation* could be achieved by a nominal appreciation of the exchange rate, thus discarding the condition about stability of *exchange rates*.[28] Appreciations of the exchange rates are enhanced by capital inflows associated with the huge FDIs (which compensate for the current account deficits).

However a formal derogation of (one of) the Maastricht criteria must be excluded. This explains why few new members have been (so far) ready for euro adoption (although the question of the proper time of entry in the ERM-II firstly and in EMU afterwards includes many other issues): as we have seen (section 2.1) even now seven countries do not satisfy the inflation criterion. For the future, some of them have probably to undergo a new "transitional recession" to depress inflation (by means of either tighter fiscal policies or non-inflationary wage polices); the nominal appreciation looks a more feasible alternative, at least within the ±15% band allowed by the ERM-II

[28] The empirical evidence presented by De Grauwe and Schanbl (2005) shows that the magnitude of real appreciations – achieved by either higher inflation or nominal exchange-rate appreciations – is inversely related to the initial level of development: for instance, it has been lowest for Cyprus, Malta and Slovenia. For many new members (joining the EU in 2004) differences in terms of both GDP per-capita and the price level are still large (both variables are less than half than the EU15 level): as a consequence, in the future the catch-up and convergence processes will take a long period of time.

agreements (this correction has the advantage to be automatic, i.e. not requiring a discretionary public intervention).

The NMS, which at the beginning of the '90s had some kind of soft pegs, moved recently to either flexible exchange rate regimes with inflation targeting (the big countries) or to currency boards or hard pegs (the small ones).[29] It is interesting to note that the big countries – such as Poland, Hungary and the Czech Republic – which as we have seen do exhibit the highest output correlations with the European "core", have not yet entered the ERM-II and will have to wait much longer for euro adoption.

Another recent paper devoted to new members is by Michelis and Koukouritakis (2007): the authors try to assess whether the new (2004) EU members are ready to join the EMU, by investigating common trends of the *nominal convergence* criteria (the five Maastricht's criteria) as well as two specific *real variables*: real exchange rates and real per capita GDPs[30]; they adopt cointegration analysis (thus referring to long run equilibrium relationships) and use France and Germany, the two "core" euro countries, as a benchmark. According to the results, these countries are partially ready to join the eurozone, although they need further adjustments in their fiscal policies (only for the deficit/GDP and debt/GDP ratios the results indicate lack of cointegration).

2.8. Real convergence and institutional change

Many theoretical studies have examined the joint concepts of growth, (real) convergence and institutional change. The positive role of institutional change on economic growth has also been assessed in many empirical works. In the case of the EU, a possible question is whether (and how) economic growth and convergence have been affected by the steps toward an increasing institutional integration (e.g. the ones summarized in section 2.1): this is one of the empirical issues we shall tackle in section 4. In the literature, we can find many works devoted to the links between institutional integration, trade deepening and then business cycle synchronisation (see sections 2.5 and 2.6 above).

Institutional change, from this point of view, is important for all countries, including the "old" EU countries, also because there might be feedbacks from the process of European integration to changes in laws, regulations and institutions at the national level: this is the case of "market reforms" leading to liberalisations or increased competitiveness in specific markets. Some authors have tried to verify whether such reforms are affected by the process of institutional EU integration.

For example, a recent paper by Alesina et al. (2008), after reviewing the theoretical arguments that may link the adoption of the euro and "structural reforms" (e.g. incentives to reform and so gain competitiveness in the absence of devaluations), have found that the adoption of the euro has been associated with an acceleration of the pace of structural reforms in the product markets (deregulations), while no significant connection has been detected in case of labour market reforms (either liberalizations or deregulations). Similar results were previously found in other papers (reviewed by Alesina et al.) concerning the effects of the European Single Market.

Institutional change has been particularly important in new EU members, i.e. in "transition countries".[31] The transition process to a market economy has implied heavy restructuring in many industries, reallocation of labour between sectors (particularly from old sate-owned branches to new private activities), with net job destructions accompanied by a "transitional" (or transformational) recession in the early stages of transition. In the first decade, market reforms have been beneficial to economic growth and convergence, to productivity levels and dynamics but with a negative impact

[29] Flexible exchange-rate regimes have been recently chosen by Poland, Hungary and the Czech Republic; four countries have joined the ERM-II agreements (the three Baltic states and Denmark, of course in addition to the countries, like Slovenia, Slovakia, Cyprus and Malta, now adopting the euro); Estonia, Lithuania, partially Latva (and in the past Slovenia) have opted also for hard pegs to the euro (with a narrow bandwith). See also Rinaldi-Larribe (2008).

[30] Differently from absolute and conditional convergence approaches, in the cointegration and common trends context convergence means that there exist long run relationships among a set of variables that tie them together in the long run without necessarily attaining the same value.

[31] The complexities and peculiarities of the transformations occurred in Central and Eastern European Countries since the collapse of the Berlin Wall in 1989 are illustrated in a long-term historical/comparative perspective by Kornai (2006).

on employment; in the long run, however, employment dynamics seems positively related to institutional change.[32]

3. Nominal and real convergence: a preliminary analysis

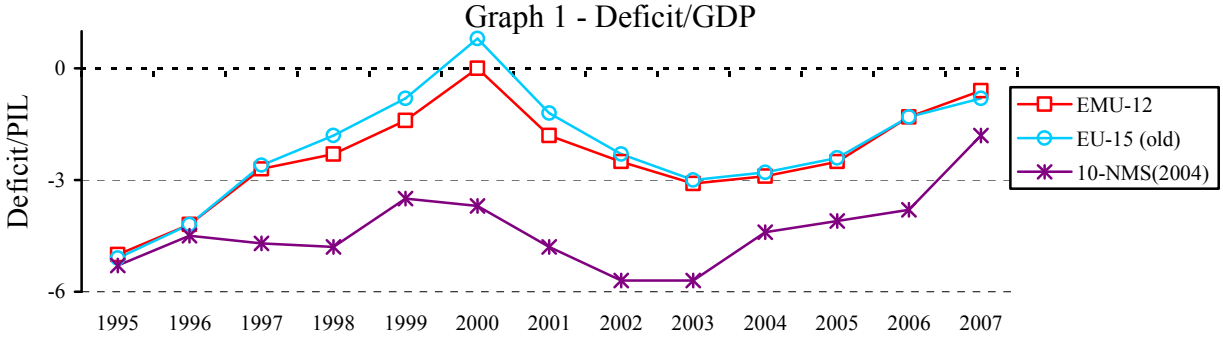
Before considering the results of some econometric investigations, we think it is useful to illustrate and discuss here some preliminary evidences on nominal and real convergences. We shall consider, on one hand, the four Maastricht parameters and, on the other hand, the following variables related to real convergence: per capita GDP, productivity, specialisation index, unemployment rate and employment rate. The analysis refers mostly to the 1992-2007 period.

3.1. Nominal convergence: some evidences

Since the early 1990s, the advent of the Maastricht's Treaty and subsequent developments, the European debate has been dominated by *nominal convergence*, as defined by: (i) the Maastricht's criteria[33] for entering into the Monetary Union (EMU); (ii) the "Growth and Stability Pact" conditions[34]; and (iii) the ECB inflation target[35]. In this section we briefly present the key evidence on nominal convergence by considering the 4 indicators of the Maastricht criteria for few EU aggregations, especially for the euro area[36].

Considering the first Maastricht parameter (Graph 1 and Table A1 in Appendix) for the EMU-12 aggregate, a remarkable reduction in the *deficit/GDP* ratio occurred in the second half of 1990s (from 5% in 1995 to 0% in 2000), followed by a significant worsening in the first three years of the new Century (up to 3% in 2003) and, finally, a new reduction in this parameter occurred in the years 2003-2007. The EU-15 aggregate showed a very similar trend. As for the aggregate of 2004-new-member-states (10-NMS-2004), the deficit/GDP ratio showed a significantly different dynamics, remaining for the whole period (last year excluded) in the range from 3 to 6%; however, a significant reduction occurred since 2003 and especially in 2007.

Graph 1 - Deficit/GDP



Source: our elaboration on Eurostat database. Net lending (+)/Net borrowing (-) under the EDP (Excessive Deficit Procedure) - General government - Percentage of GDP. Legend: EMU-12 (the aggregate include the 11 members of monetary union in 1999 plus Greece); EU-15 (old) = EU members before 2004; 10-NMS(2004) = new EU members in 2004.

[32] Marelli and Signorelli (2008a), in addition to featuring a thorough review on the relations between institutional change and economic performance, considering the eight CEEC (new EU members in 2004) and a territorial breakdown at the NUTS-3 level, found that *institutional change* (as measured by the EBRD synthetic transition index) had positive effects on economic convergence; this proxy of institutional change had also in the recent period (after 2000) a positive impact on employment. This result is confirmed in Marelli and Signorelli (2008b), since in a sample of EU27 countries the same proxy contributes (together with human capital and some other control variables) in explaining differences in productivity levels across countries; among the other control variables, also the "global competitiveness index" (published by the World Economic Forum) exhibits a positive effect on productivity: this is interesting because it means that market reforms have been important for economic performance in all European countries, old and new.

[33] As well-known the Maastricht criteria refer to deficit/PIL (below 3%), debt/PIL (below 60% or decreasing), inflation rate and long-term interest rate. The permanence for at least two years in the ERM is the fifth parameter.

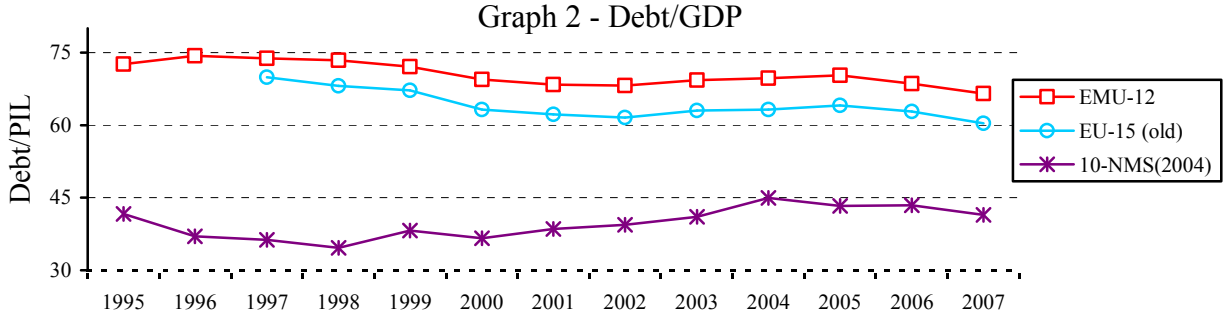
[34] Especially stressing the Maastricht deficit/PIL criteria with the related exceeding deficit procedure (reformed in 2005), including the long-term warning for a "zero deficit".

[35] The ECB initially defined the price stability as an inflation rate between 0 and 2 per cent; a more recent definition refers to an inflation rate "below but near 2%".

[36] EMU includes now 16 members. 11 countries created EMU in 1999, followed by Greece in 2001, Slovenia in 2007, Cyprus and Malta in 2008 and Slovakia in 2009.

The trends in the second parameter (Graph 2) reflect the strict relations with the first Maastricht condition. In the EMU aggregate the *Debt/GDP* ratio decreased in 1996-2002 and, after three years of increase, in the period 2005-2007. The EU-15 aggregate showed a similar dynamics and a level (near 5% of GDP lower than EMU-12) that declined up to 60% in 2007. The level of 10-NMS (2004) remained below 45% for the whole period, but a gradual reduction of the remarkable distance with "old-EU members" was interrupted only in more recent years.

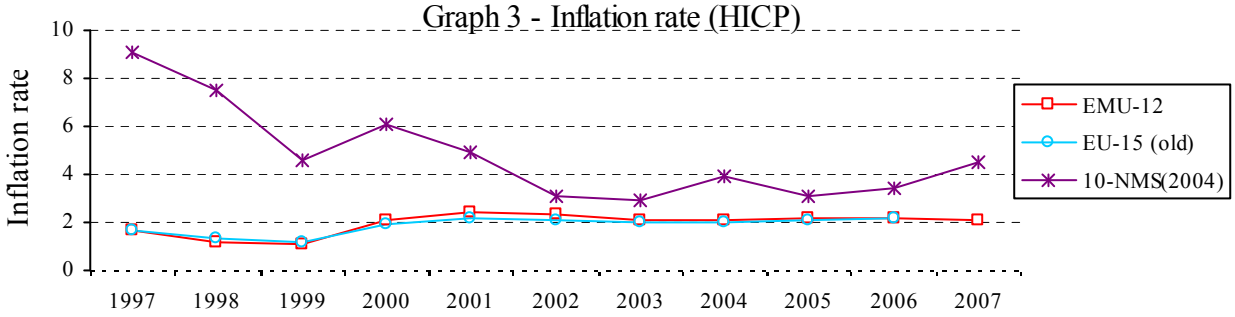
Graph 2 - Debt/GDP



Source: our elaboration on Eurostat database. Legend: EMU-12 (the aggregate include the 11 members of monetary union in 1999 plus Greece); EU-15 (old) = EU members before 2004; 10-NMS(2004) = new EU members in 2004.

The *inflation rate* (Graph 3) in EMU-12 and EU-15 aggregates remained very similar and quite stable around 2% for the whole period (1997-2007), with some country differences (Table A3 in Appendix). As for the 10-NMS(2004) aggregate, the remarkable decline of the 1990s was followed by a stabilisation around 3-4% since 2002.

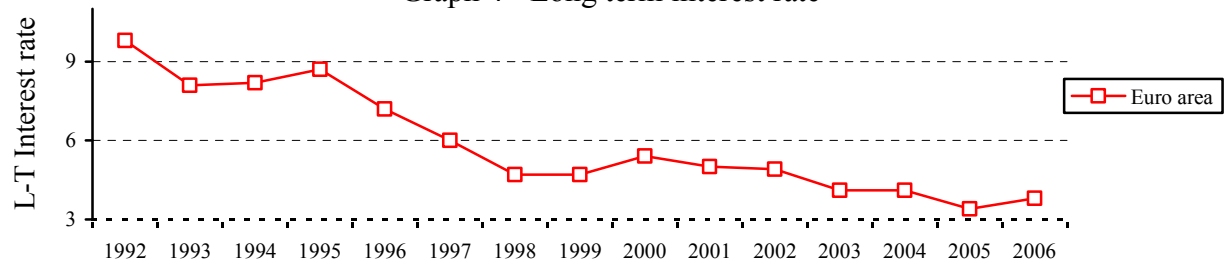
Graph 3 - Inflation rate (HICP)



Source: our elaboration on Eurostat database. Legend: EMU-12 (the aggregate include the 11 members of monetary union in 1999 plus Greece); EU-15 (old) = EU members before 2004; 10-NMS(2004) = new EU members in 2004.

Finally, the long-term *interest rate* (Graph 4) for the Euro-area declined from a value higher than 9% in 1992 to a level close to 3% in 2006, with a strong reduction in the period 1995-1998.

Graph 4 - Long term interest rate



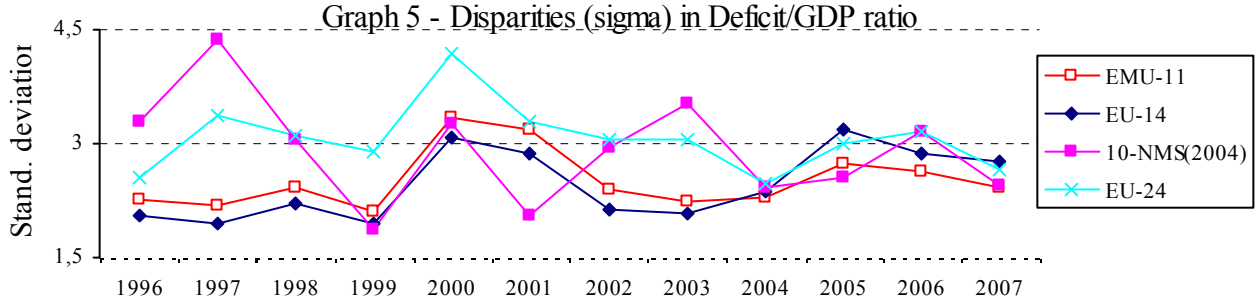
Source: our elaboration on Eurostat database. Legend: Euro area (countries member of European monetary union).

The above tendencies of the four Maastricht's parameters for the main EU aggregates have been the result of quite different national dynamics (see Tables A1, A2, A3 and A4 in Appendix).

Considering sigma convergence (see Graphs 5, 6, 7 and 8), the following evidences can be briefly highlighted: (i) high (but decreasing) instability over time appears in deficit/GDP ratios disparities, without clear tendencies (a significant convergence trend occurred only for the larger EU aggregate - i.e. EU-24 - from 2000 to 2004); (ii) sigma divergence in debt/GDP ratios emerged

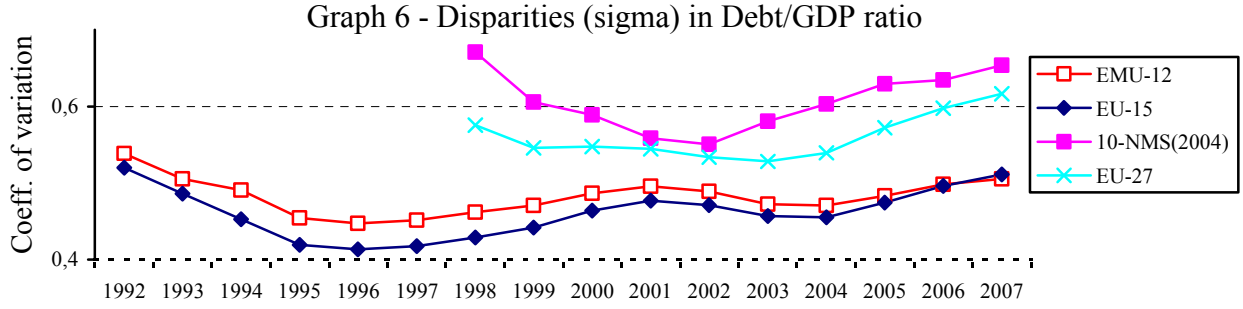
in recent years for all the main EU aggregates, while in the previous periods opposite tendencies prevail for EU-27 (1998-2003), 10-NMS-2004 (1998-2002), EU-15 and EMU-12 (especially from 1992 to 1996); (iii) remarkable sigma convergence in national inflation rates occurred in EU-27 countries and, less evidently, for EU-15 and EMU-12 aggregates; (iv) significant reductions in the disparities in long term interest rates emerged for EMU aggregate(s) in the 1990s.

Graph 5 - Disparities (sigma) in Deficit/GDP ratio



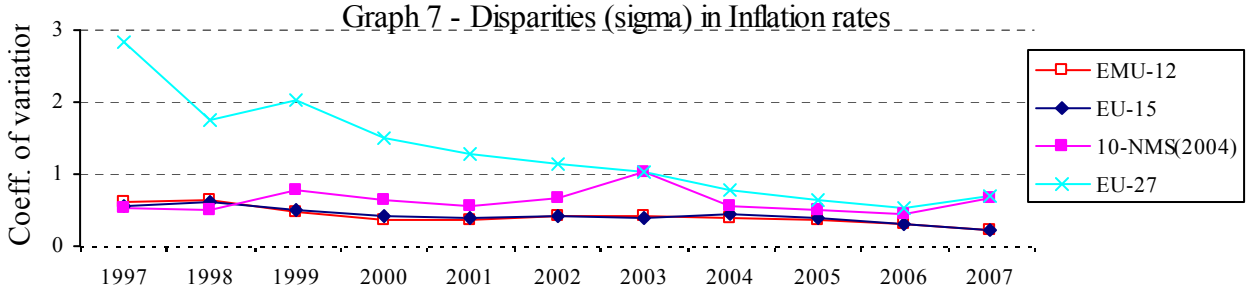
Source: our elaboration on Eurostat database. Standard deviation of country data. Legend: EMU-11 (11 members of monetary union in 1999); EU-14 (old) = EU members before 2004 (Greece excluded); 10-NMS(2004) = new EU members in 2004. EU-24= EU-27 (Greece, Cyprus and Bulgaria excluded). Note: the existence of both positive and negative values suggested to use standard deviation data.

Graph 6 - Disparities (sigma) in Debt/GDP ratio



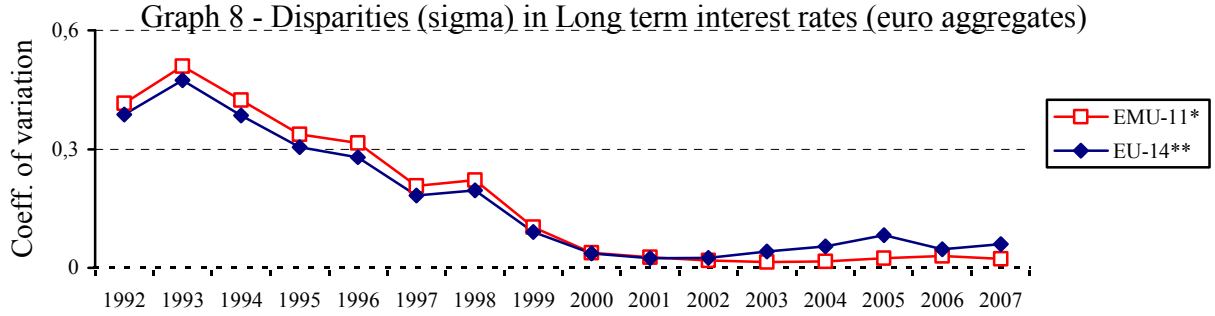
Source: our elaboration on Eurostat database. Coefficient of variation of country data. Legend: EMU-12 (11 members of monetary union in 1999 plus Greece); EU-15 (old) = EU members before 2004; 10-NMS(2004) = new EU members in 2004.

Graph 7 - Disparities (sigma) in Inflation rates



Source: our elaboration on Eurostat database. Coefficient of variation of country data. Legend: EMU-12 (11 members of monetary union in 1999 plus Greece); EU-15 (old) = EU members before 2004; 10-NMS(2004) = new EU members in 2004.

Graph 8 - Disparities (sigma) in Long term interest rates (euro aggregates)



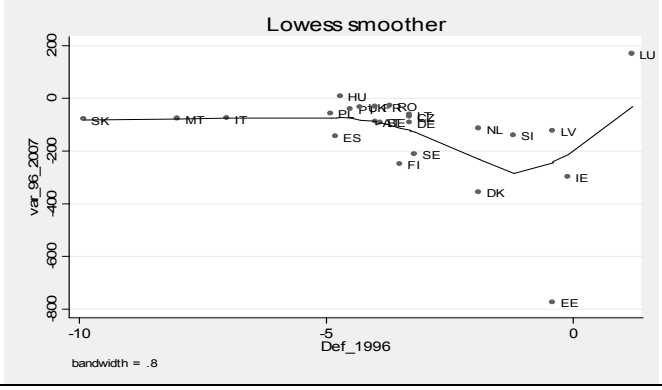
Source: our elaboration on Eurostat database. Coefficient of variation of country data. Legend: EMU-11*= EMU-12 (LU excluded due to lack of data); EU-14**= EU-15 (LU excluded due to lack of data).

EMU members experimented a strong lowess beta convergence in all the four parameters (Graph 9), but especially in inflation rate and long term interest rate. A clear lowess beta

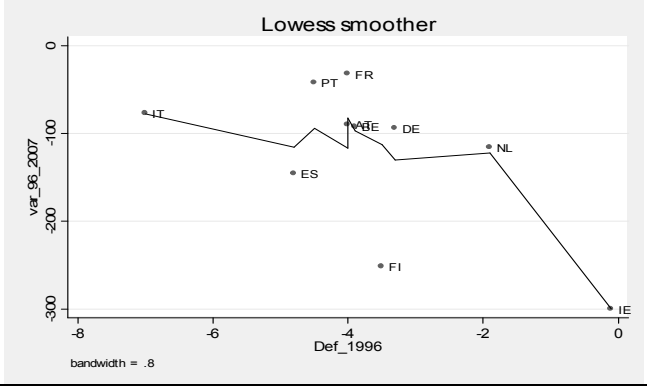
convergence in inflation rates emerged also for EU-27 countries, but this aggregate did not showed a significant beta convergence in the first two parameters (Graph 9).

Graph 9 - Nominal Lowess beta convergence

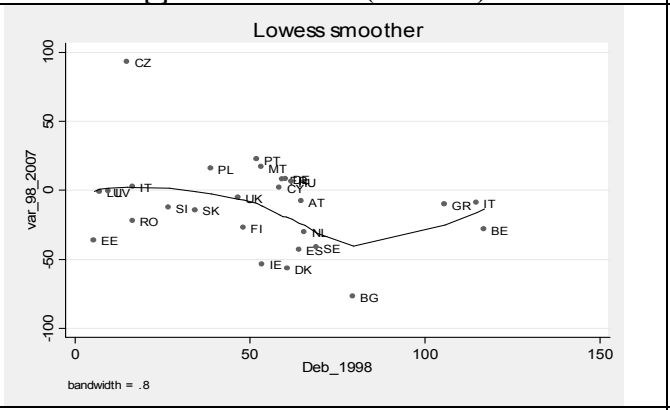
[a] Defitic/GDP EU-24 (GR, BG and CY excluded) (1996-2007)



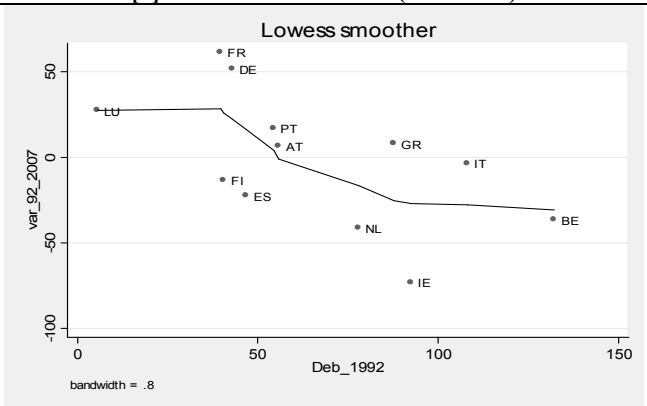
[b] Deficit/GDP EMU-10 (LU excluded) (1996-2007)



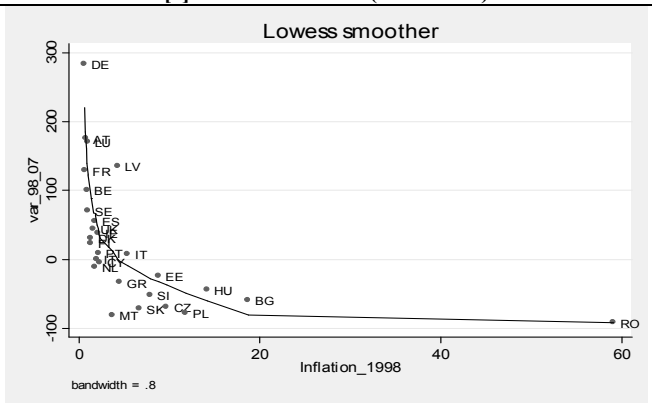
[c] Debt/GDP EU-27 (1998-2007)



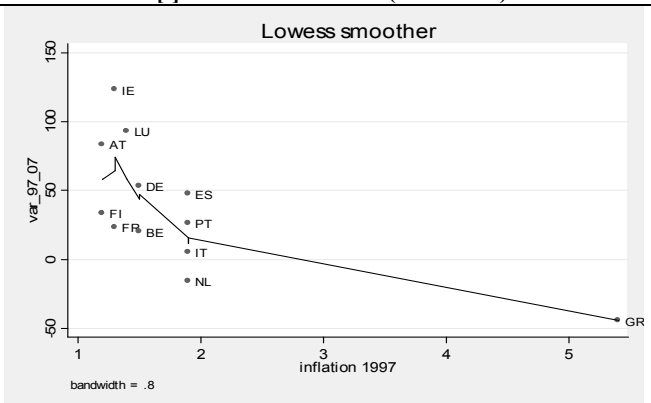
[d] Debt/GDP EMU-12 (1992-2007)



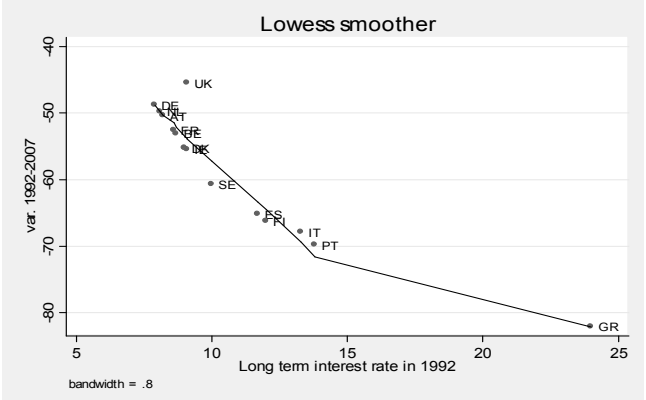
[e] Inflation EU-27 (1998-2007)



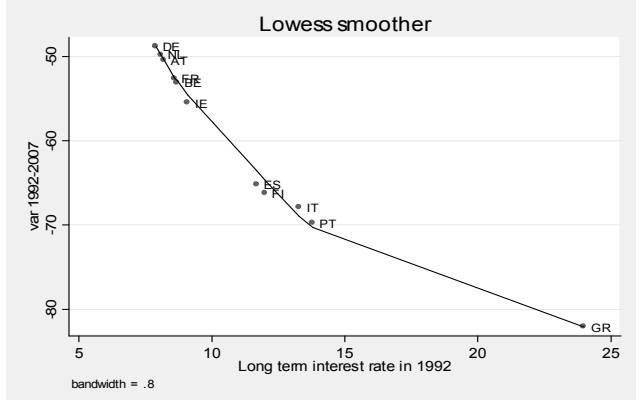
[f] Inflation EMU-12 (1997-2007)



[g] Long term interest rate EU-14 (LU excluded) (1992-2007)



[h] Long term interest rate EMU-11 (LU excluded) (1992-2007)



Source: our elaboration on Eurostat database.

3.2. Real convergence: some evidences

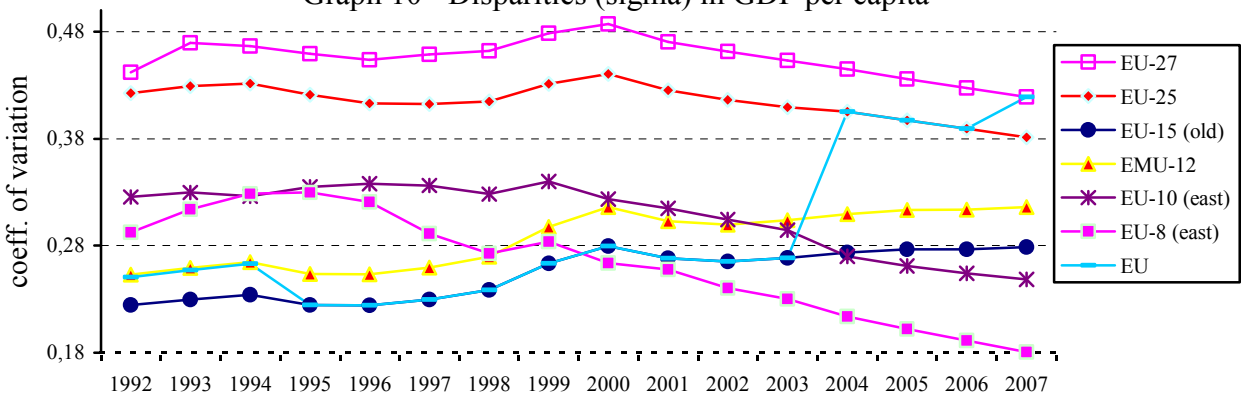
In this section we analyse, first of all, the traditional variables considered in real convergence investigations: per capita GDP and productivity. Then we focus on a specialisation index (KSI) and two labour market performance indicators: unemployment rate (UR) and employment rate (ER). In particular, we investigated sigma[37] and (lowess) beta[38] convergence/divergence dynamics for the main EU aggregates since the early 1990s.

Considering sigma convergence/divergence, the EMU-12 and EU-15 aggregates showed: (i) a weak sigma divergence in national per capita GDP (especially in the period 1996-2000 and in more recent years), (ii) low but persisting disparities in productivity and KSI, (iii) significant sigma convergence in unemployment rate, but only after 1999 and (iv) remarkable sigma convergence in employment rate since early 1990s.

Differently, the aggregates the aggregates EU-8-east (and EU-10-east in parenthesis when different) experimented: (i) a significant sigma convergence[39], since 1994, in per capita GDP (but only after 1999 for EU-10-east), (ii) a convergence in productivity, especially since 1999, (iii) a remarkable increase in the disparities in specialisation index, (iv) a persistence in UR disparities during the 1990s, followed by a 2-3 years of divergence, although sigma convergence clearly prevail in more recent years, (v) persistent disparities in ER in recent years.

Obviously the dynamics in disparities for EU-25 and EU-27 aggregates reflect the above various trends; in particular: (i) a sigma convergence in per capita GDP emerged only since 2000 (obviously, a remarkable increase in disparities occurred in the EU aggregate as consequence of the 2004 enlargement), (ii) a sigma convergence in productivity occurred in the whole period, (iii) an increase in the disparities regarding the KSI (especially for EU-27 aggregate), (iv) the persistence in UR disparities in the 1990s was interrupted by a 2-year divergence and a remarkable convergence since 2001, (v) since 2001 a clear sigma convergence in ER emerged.

Graph 10 - Disparities (sigma) in GDP per capita



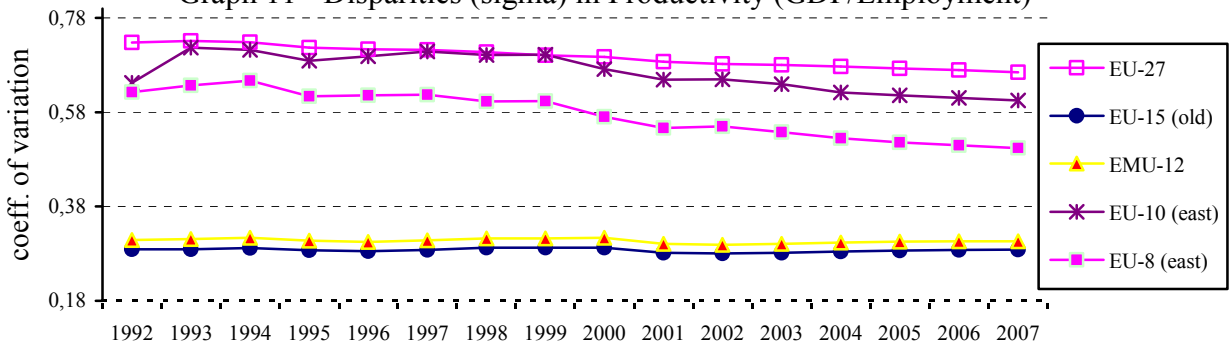
Source: our elaboration on Cambridge Econometrics (CE) database. Legend: EU-15 (old) = EU members before 2004; EMU-12 members of monetary union (11 in 1999 plus Greece); EU-10 (east) = new eastern EU members (2004 and 2007); EU-8 (east) = new eastern EU members (2004); EU = 12 (1990-94), 15 (1995-2003), 25 (2004-2006) e 27 (2007).

[37] Sigma convergence is usually measured by considering the (decreasing) trend in the coefficient of variation (standard deviation divided by the mean).

[38] Lowess beta investigations permit a graphical analysis of beta convergence and highlight the position of each country. It should be recalled that the existence of beta convergence is a necessary but not sufficient condition for sigma convergence.

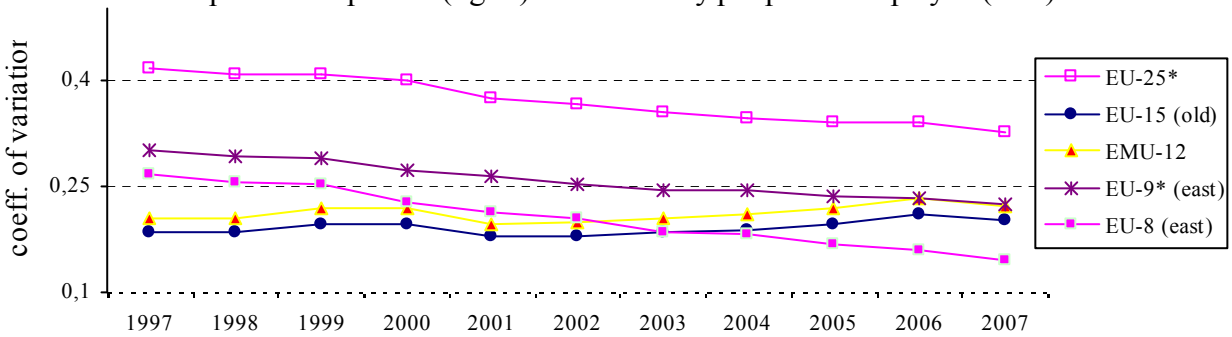
[39] As for the existence of convergence between countries accompanied by regional divergence within countries, see Marelli and Signorelli (2008).

Graph 11 - Disparities (sigma) in Productivity (GDP/Employment)



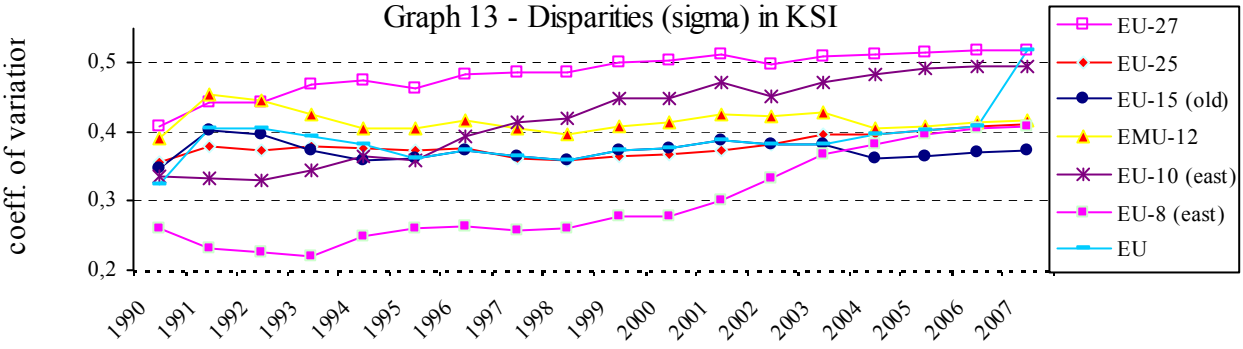
Source: our elaboration on CE database. Legend: EU-15 (old) = EU members before 2004; EMU-12 members of monetary union (11 in 1999 plus Greece); EU-10 (east) = new eastern EU members (2004 and 2007); EU-8 (east) = new eastern EU members (2004).

Graph 12 - Disparities (sigma) in Productivity per person employed (PPS)



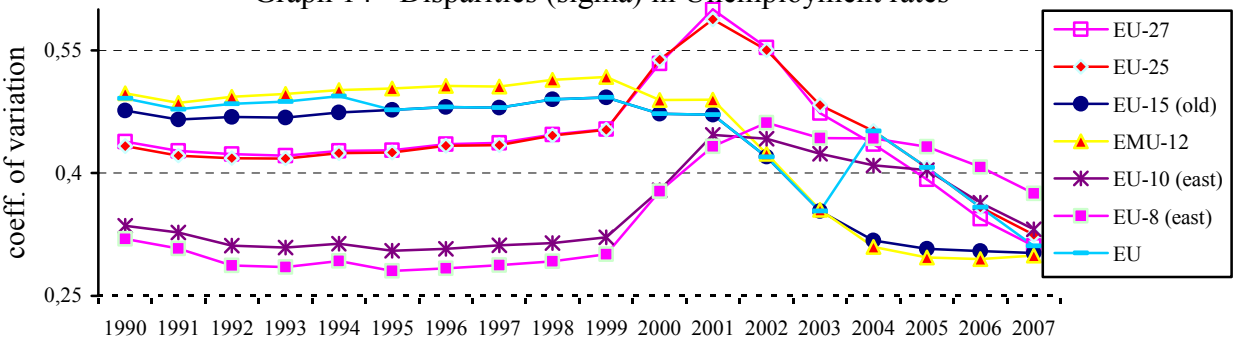
Source: our elaboration on Eurostat database. Labour productivity per person employed - GDP in Purchasing Power Standards (PPS) per person employed relative to EU-27 (EU-27 = 100). Legend: EU-25* = EU-27 minus Romania and Malta; EU-15 (old) = EU members before 2004; EMU-12 members of monetary union (11 in 1999 plus Greece); EU-10 (east) = new eastern EU members (2004 and 2007); EU-8 (east) = new eastern EU members (2004).

Graph 13 - Disparities (sigma) in KSI



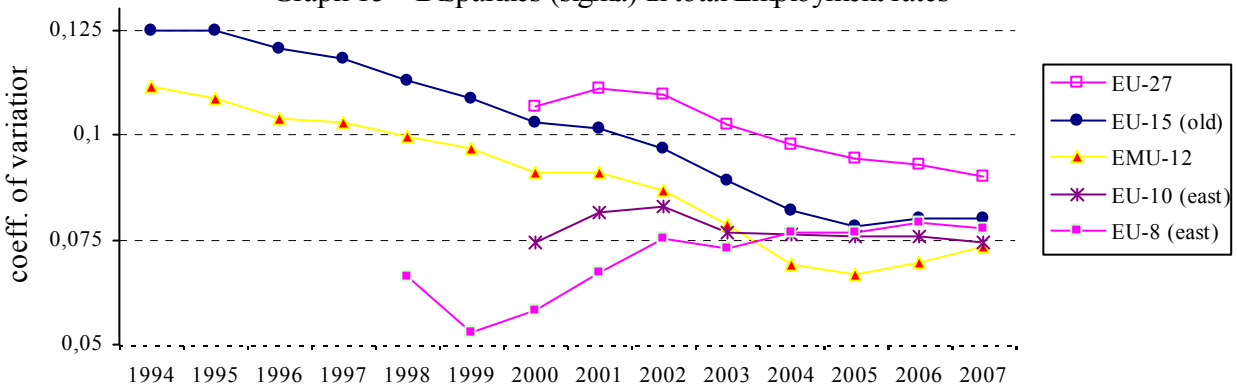
Source: our elaboration on Cambridge Econometrics (CE) database. Legend: KSI = Krugman specialisation index; EU-15 (old) = EU members before 2004; EMU-12 members of monetary union (11 in 1999 plus Greece); EU-10 (east) = new eastern EU members (2004 and 2007); EU-8 (east) = new eastern EU members (2004); EU = 12 (1990-94), 15 (1995-2003), 25 (2004-2006) e 27 (2007).

Graph 14 - Disparities (sigma) in Unemployment rates



Source: our elaboration on CE and Eurostat database. Legend: EU-15 (old) = EU members before 2004; EMU-12 members of monetary union (11 in 1999 plus Greece); EU-10 (east) = new eastern EU members (2004 and 2007); EU-8 (east) = new eastern EU members (2004); EU = 12 (1990-94), 15 (1995-2003), 25 (2004-2006) e 27 (2007).

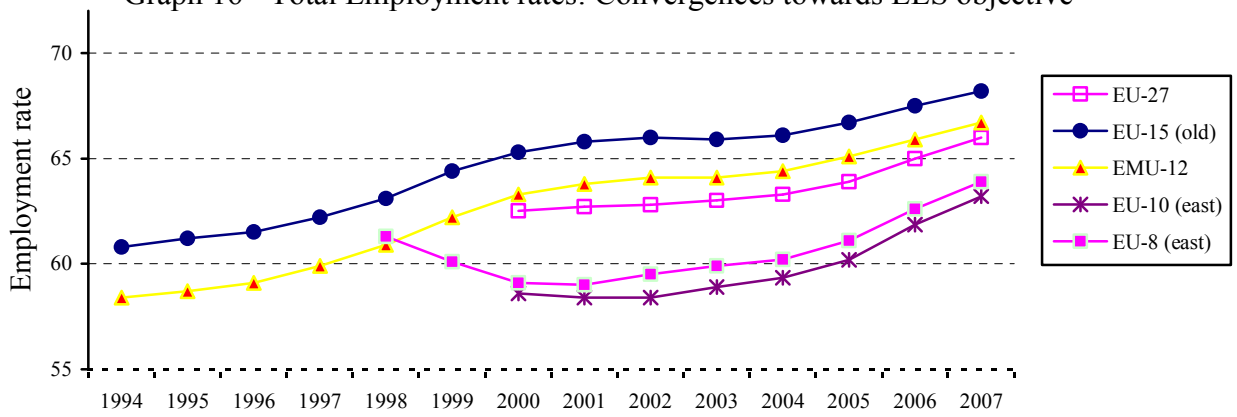
Graph 15 - Disparities (sigma) in total Employment rates



Source: our elaboration on Eurostat database. Legend: EU-15 (old) = EU members before 2004; EMU-12 members of monetary union (11 in 1999 plus Greece); EU-10 (east) = new eastern EU members (2004 and 2007); EU-8 (east) = new eastern EU members (2004).

Concerning the employment rate (ER), a clear convergence towards the main quantitative objective of the European Employment Strategy (EES) emerged (Graph 16) for EU-15 and EMU-12 since mid 1990s, and for Eastern aggregates in more recent years[40].

Graph 16 - Total Employment rates: Convergences towards EES objective



Source: our elaboration on Eurostat database. Legend: EES objective=70%; EU-15 (old) = EU members before 2004; EMU-12 members of monetary union (11 in 1999 plus Greece in 2001); EU-10 (east) = new eastern EU members (2004 and 2007); EU-8 (east) = new eastern EU members (2004).

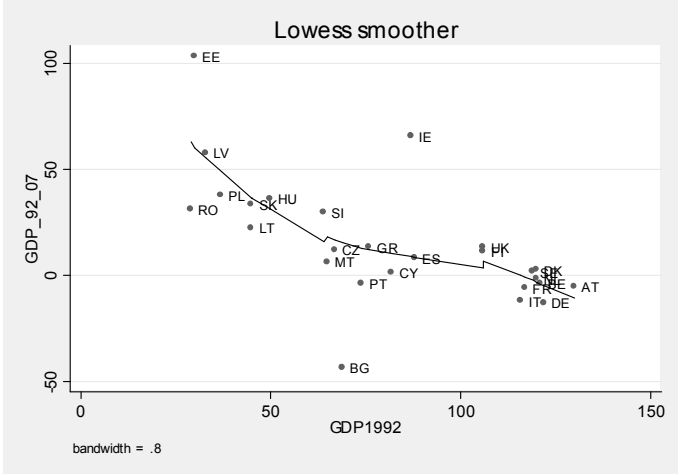
As for the (lowess) beta convergence/divergence, the results can depend on both the initial year and the aggregate considered. With reference to the whole available period (usually 1990 or 1992 as initial year, but 2000 for ER), the EU-27 aggregate showed a clear convergence in all the considered variables, but some interesting outlier emerged (Graph 17). The (lowess) beta convergence in per capita GDP was stronger in the EU-8-east aggregate, in case of both 1992 and 2004 as initial years (see Graph A1 in Appendix) and a clear beta convergence in productivity emerged only within the same aggregate (Graph A2). A beta convergence in UR emerged for all the aggregates, not affected by the choice of the initial year (Graph A4 in Appendix). Concerning the ER variable, a strong beta convergence emerged only for the EMU and EU-15 aggregates (initial year 1994 and 1997; see Graph A6 in Appendix).

As for the two labour market performance variables, kernel densities (Graph A5 and A7 in Appendix), by comparing initial and final years of the considered period, permitted to better highlight the significant improvements occurred, the prevailing concentration/convergence dynamics and - for some aggregates - the emerging of two cluster of countries.

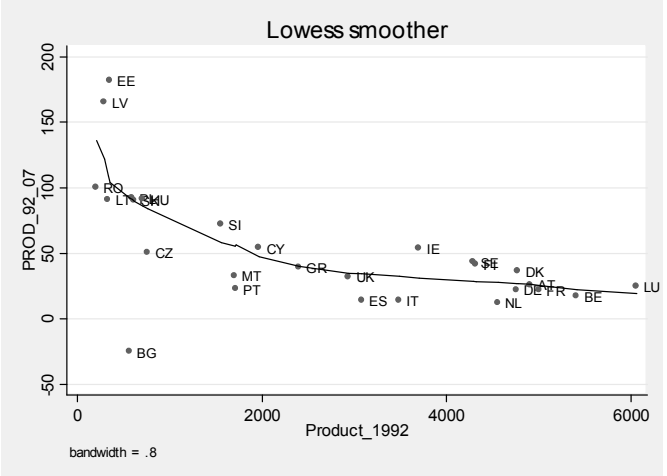
[40] As for EU-8 (east) and EU-10 (east) aggregates, the ER decreases in early stage of transition have been followed by a partial recovery. As for the "U shaped" ER dynamics, see Perugini and Signorelli (2004).

Graph 17 - Real Lowess beta convergence

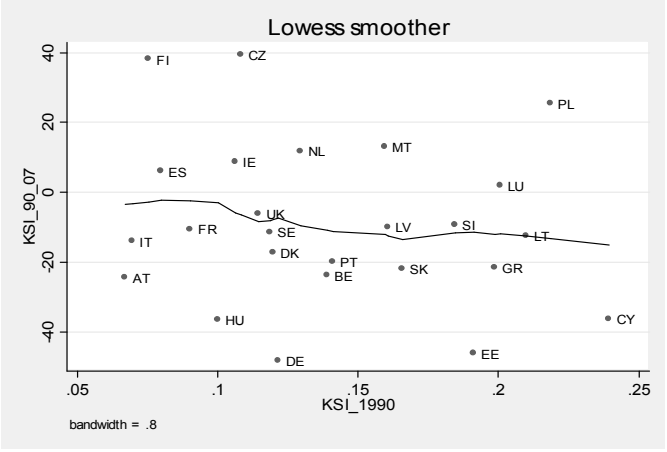
[a] per capita GDP in EU-27 (1992-2007) - CE database



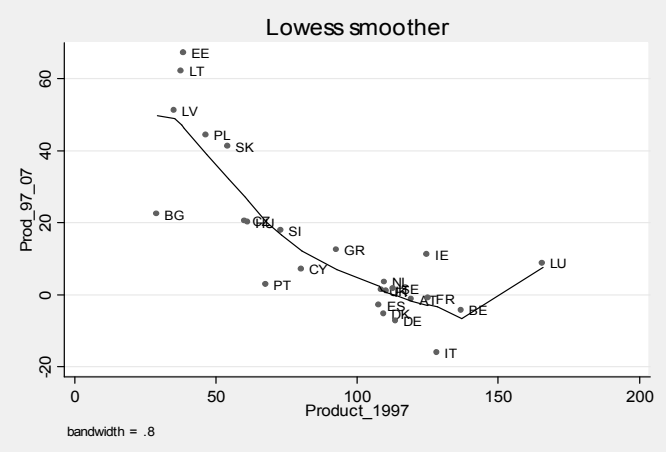
[b] Productivity in EU-27 (1992-2007) - CE database



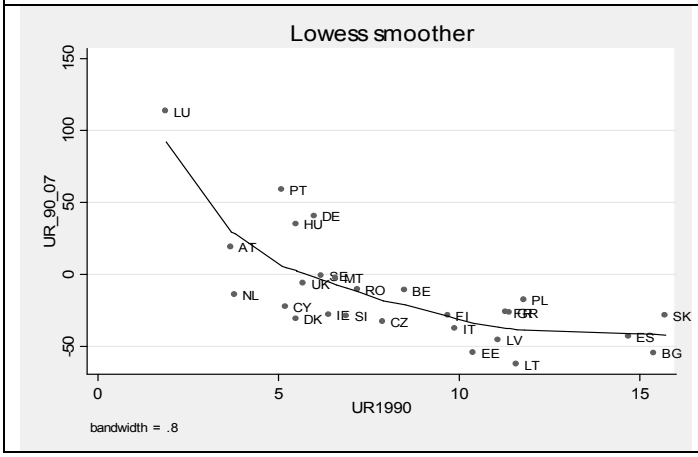
[c] KSI in EU-25 (1990-2007) - CE database



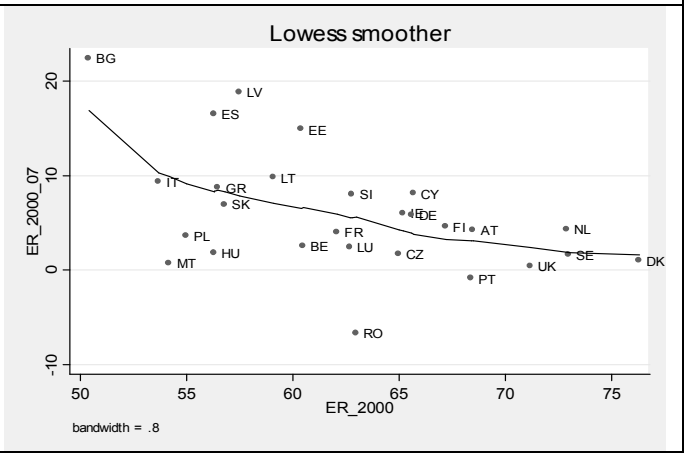
[d] Productivity in EU-25* (EU-27 minus RO and MT) (1997-2007) Eurostat database



[e] Unemployment rate in EU-27 (1990-2007) - CE + Eurostat databases



[f] Employment rate in EU-27 (2000-2007) - Eurostat database



Source: elaboration on Cambridge Econometrics and Eurostat databases.

4. Nominal and real convergence: some econometric investigations

After the illustration of some basic data about nominal and real convergence – including an analysis of both sigma-convergence and lowess-beta convergence of the most significant variables, we present in this section the results of some econometric investigations. They refer especially to different aspects of *real convergence*, but will be indirectly useful to assess – e.g. by considering different intervals or aggregates of countries – how real convergence may be affected by nominal or institutional convergence.

We shall start with an investigation of beta *convergence in productivity* levels, which is probably the most important variable suitable to summarize "real convergence" in the long run (in economic growth studies productivity is often considered more important than per capita income). *Convergence in economic structures* is a second key element, as suggested by OCA theories: if there is convergence, the likelihood of asymmetric shocks diminishes and so a monetary union can be more effective. *Trade integration* is another variable suggested by the same theories: the net benefits of a monetary union are higher when the individual countries exhibit narrower trade links with the rest of the union. Finally, the analysis of *output correlations* is a simple way to assess whether real convergence is achieved in the short run, i.e. from a business cycles point of view.

4.1 Data and sources

The empirical investigations refer the *EU27 countries*. The period of the analysis depends on data availability: in some investigations includes the full 1990-2007 period, in some others it is restricted to the period after 2000.

The data concerning *value added* (at constant prices) and *employment* are taken from Cambridge Econometrics (CE).[41]

Eurostat (on-line) statistics have been used for the *Gross domestic product* (at current prices) and for *Trade* (at current prices) of the individual countries *with the EU*, both imports and exports. We have taken from Eurostat also the price index of Exports (2000=100), in order to deflate the nominal value of Exports to get a proxy for *real exports* of individual countries toward the EU.[42] Employment data from CE have also been used at a sectoral level, particularly to compute the *"Krugman specialisation index"* (KSI):

$$KSI_j = \Sigma_i \left| s_{i,j} - s_{i,0} \right|$$

where $s_{i,j}$ is the share of sector i out of total employment in country j and $s_{i,0}$ is the corresponding share in the reference country, in our case the EU-27 average.[43] Its numerical value ranges from 0 (the country has the same sector structure as the European average) to 2 (the sector structure is totally different).

As a proxy for *human capital* we have used Eurostat's "Total population (aged 25-64) having completed at least upper secondary education".[44]

Finally, we needed a proxy to compute an "*institutional integration index*". This is an index (I) whose numerical values are between 0 and 1; it has been computed as follows:

a) I = 0 for non-EU members,
b) I = 0.25 for non-EU members formally recognized as "candidate" countries,
c) I = 0.5 for EU members,
d) I = 0.75 for EU members belonging the ERM (or ERM-II) agreements,
e) I = 1 for Eurozone members.

In the regressions we have used both the index computed in this way and an "*adjusted*" index, where some linear interpolations have been considered, in particular between 0.25 and 0.5 (a candidate country must show progresses toward full membership) and between 0.75 and 1 (the ERM members progressively satisfy the Maastricht's criteria to adhere to EMU).

---

[41] In the case of *productivity* data for the full period (1992-2006), we have followed a mixed procedure. From Eurostat we have taken the index numbers (EU-27=100) of *labour productivity* (per worker), available since the mid '90s; then, we used Cambridge Econometrics data (gross value added divided by employment), both to estimate the 1992 index numbers (whenever missing data were found for some countries) and to compute the nominal values (in constant euros).

[42] Notice that the export deflator refers to "total exports" rather than "exports to the EU", but in the case of exports we can assume that this approximation is satisfactory (we cannot make a similar assumption in case of imports, this is why a similar procedure has not been replicated in case of imports).

[43] The KSI index has been computed considering the most detailed sectors available for each country: generally, they are 15, but Bulgaria and Cyprus (9 sectors) and Romania (5 sectors only). Moreover, for the period 1990-91 (or 1990-92 for some countries), the number of available sectors is less than 15, generally 9, for many other CEEC countries (Czech Republic, Estonia, Latvia, Lithuania, Hungary, Slovenia).

[44] Since for some countries and some years (especially the new members in the '90s) the data were missing, they were estimated according to the trends resulting from the Barro-Lee data (http://www.cid.harvard.edu/ciddata/ciddata.html).

4.2 Beta convergence of productivity

The first aspect of real convergence in the long run refers to the economic performance of economic systems, e.g. in terms of gdp per-capita or productivity (the latter variable is to be preferred according to many studies in the empirical literature on convergence). The question is: is productivity of different countries converging to a unique level? (this is the absolute convergence approach). A similar question is: is productivity of different countries converging to a steady-state level, taking into account the structural differences of individual countries? (this is the conditional convergence approach).

The regression can be specified as follows (following a *cross section* method of estimation where i is the individual country):

$$1/n \log (Q_{it} /Q_{i\,0}) = \alpha + \beta \log (Q_{i\,0}) + \gamma Z + \varepsilon$$

where Q is productivity (in our case real value added divided by employment), 0 is the initial, t is the final year and n is the number of years from 0 to t. If Z is not in the equation and β is negative and significant, then there is *absolute convergence*. The variable Z identifies one (or more) control variables: if the latter are included, a negative and significant β means that there is *conditional convergence*.

Table 1 shows that in the case of the EU-27 countries productivity has indeed converged, both in the 1992-2006 period and in the more recent 1998-2006 period (regressions [1a] and [1d]): in fact, the *β* coefficient is negative and highly significant in the absolute convergence case. It means that productivity growth over time is negatively related to the initial productivity level. This is in accordance with previous empirical results concerning convergence in Europe, especially at the country level.[45]

Turning now to a *β-conditional approach*, a possible control variable is human capital, i.e. the education level. In fact, in many growth models education is a key element in explaining productivity growth; moreover empirically, we can observe that backward countries or regions suffer in general for a lack of human capital; lastly, on the policy side, EU's institutions – starting from the Lisbon's strategy – emphasize knowledge and education as the main instruments for achieving growth and competitiveness.[46] By adding in the regressions this control variable, we obtain the results [1b] and [1e] for the two sub-periods. Education[47] turns out to be positive and significant, and the convergence outcome still holds.

If we add a second control variable, i.e. the integration index[48], we obtain the results [1c] and [1f]. We can see that the effect of institutional integration within the EU is positive, but it is statistically significant only for the full period (not for the recent 1998-2006 years).

Table 1 – Absolute and conditional convergence: productivity per worker (1992-2006 and 2000-2006)

	[a]	[b]	[c]	[d]	[e]	[f]
Period	1992-2006	1992-2006	1992-2006	1998-2006	1998-2006	1998-2006
n. obs.	27	27		27	27	27
Explanatory variables:						
Initial productivity^{+}	-0.028***	-0.025***	-0.028***	-0.027***	-0.024***	-0.028***
Education^{+}		0.012**	0.014***		0.014**	0.017***
Integr.index			0.016*			0.016
Adj. R2	0.722	0.753	0.762	0.510	0.567	0.569

Note: Change in productivity: dependent variable. + in logs. Significance levels: 1%***, 5%**, 10%*; constant not reported.

[45] At the *regional* level the pattern is less clear. Although an absolute β-convergence in productivity across all the NUTS-2 regions of EU25 was found in Marelli (2007), the statistical significance becomes lower in the most recent period. Moreover, in the CEEC, new EU members in 2004, divergence takes places in the recent years, particularly at the NUTS-3 level (see Marelli and Signorelli, 2008). Thus, *convergence across countries* may coexist with *divergence across regions* within the same countries.

[46] The role of human capital in the explanation of productivity differences across EU27 countries has been investigated in Marelli and Signorelli (2008b).

[47] The education level refers to 1998 (no better results are derived by considering the 1990 or 2006 levels).

[48] The adjusted integration index is used in all the following regressions.

A different approach can be followed by using the annual data. This is the so-called "*extended beta convergence approach*"[49], which tries to exploit the full time-series information of the panel and implies, in a certain sense, that each country may convergence to its own steady-state. The equation to be estimated is the following:

$$\log (Q_{it} / Q_{i\,t-1}) = \alpha + \beta \log (Q_{i\,t-1}) + \varepsilon$$

In this case, all the annual observations (for the 2000-06 period) are used in a *pooled estimation*, with fixed effects. The results are presented in Table 2. Convergence in productivity in European countries is confirmed if we control for education and institutional integration: the effect of the latter variables is confirmed to be positive and highly significant.

Table 2 – Extended beta convergence: productivity per worker (2000-2006)

	[a]	[b]	[c]	[d]
n. obs.	27*6	27*6	27*6	27*6
Explanatory variables:				
Initial productivity^{+}	0.003	-0.030**	-0.047***	-0.076***
Education^{+}		0.0013***		0.0011***
Integr.index			0.044***	0.042***
Adj. R2	0.793	0.738	0.807	0.779

Note: Change in productivity: dependent variable. + in logs. Significance levels: 1%***, 5%**, 10%*; constant and fixed effects not reported.

4.3 Convergence in economic structures

Concerning convergence in economic structures, we have already seen – from lowess-beta convergence – that they do not convergence in all aggregates of countries and for all periods. Now we can apply the above *extended beta convergence* procedure to the Krugman specialisation index (KSI). This index has been computed on *employment data*, for the full period and for the sectors already specified (see section 4.1). The equation to be estimated (pool with fixed effects) is the following:

$$\log (KSI_{it} / KSI_{i\,t-1}) = \alpha + \beta \log (KSI_{i\,t-1}) + \varepsilon$$

Table 3 – Extended beta convergence: specialisation (1990-2007)°

	[a]	[b]	[c]	[d]	[e]
Aggregate	EU27	EU15	CEEC10	EMU12	EMU12 recent°
n. obs.	27*17	15*17	10*17	12*17	12*17
Explanatory variables:					
Initial specialisation^{+}	-0.19***	-0.24***	-0.14***	0.10**	0.052
Adj. R2	0.210	0.212	0.165	0.044	0.136

Note: Change in KSI: dependent variable. + in logs °(1999-2007). Significance levels: 1%***, 5%**, 10%*; constant and fixed effects not reported.

The results are shown in Table 3. Convergence in sector structures is well established for the entire EU, for old members (EU15) and for the new CEEC members. For the EMU countries a divergence in sector structures seems to emerge for the full period; for a check, we have run the regression for a shorter period (1999-2007), i.e. after the start of EMU: since the coefficient is not significant, we can conclude that within EMU the pattern of structural convergence is unclear.

[49] It has been used in the past by Canova-Marcet (1995),Tondl (1999), Marelli(2004).

4.4 Beta convergence of employment and unemployment rates

Considering the two main indicators of labour market performance, i.e. the employment rate (ER) and the unemployment rate (UR), we illustrate here the results of a beta convergence analysis for different periods and EU aggregates. The equation to be estimated for the first variable is the following[50]:

$$1/n \log (ER_{it} /ER_{i0}) = \alpha + \beta \log (ER_{i0}) + \varepsilon$$

General and highly significant beta convergence dynamics emerge for both indicators, various aggregates and periods (Table 4)[51].

Table 4 – Absolute convergence: ER (1994-2007 and 2000-2007)

	[a]	[b]	[c]	[d]	[e]
Aggregate	EU-27	EU-15	EU-10-East	EU-15	EMU-12
Period	2000-2007	2000-2007	2000-2007	1994-2007	1994-2007
n. obs.	27	15	10	15	12
Initial ER+	-0.036***	-0.035***	-0.074(*)	-0.038***	-0.044***
Adj. R2	0.236	0.482	0.213	0.591	0.552

Note: Change in employment rate: dependent variable. + in logs. Significance levels: 1%***, 5%**, 10%*; constant not reported. (*) Significance level = 10.1%

The equation in the case of the unemployment rate[52] is the following:

$$1/n \log (UR_{it} /UR_{i0}) = \alpha + \beta \log (UR_{i0}) + \varepsilon$$

and the results are in Table 5.

Table 5 – Absolute convergence: UR (1994-2007 and 2000-2007)

	[a]	[b]	[c]	[d]	[e]	[f]
Aggregate	EU-27	EU-15	EU-10-East	EU-10-East	EU-15	EMU-12
Period	1990-2007	1990-2007	1990-2007	2000-2007	2000-2007	2000-2007
n. obs.	27	15	10	10	15	12
Initial UR+	-0.034***	-0.031***	-0.0392**	-0.0963**	-0.062***	-0.066***
Adj. R2	0.567	0.587	0.344	0.489	0.586	0.648

Note: Change in unemployment rate: dependent variable. + in logs. Significance levels: 1%***, 5%**, 10%*; constant not reported.

4.5 Trade integration and its determinants

We have seen in the previous sections that, on one hand, the benefits of the monetary union can be reaped by a group of fully integrated countries; on the other hand, we can detect an inverse link, in particular:

- *trade deepening* is expected to increase with the process of institutional integration and nominal convergence: hence, by EU members more than others; this is all the more true for the reason that since 1992 the Single Market has significantly helped in increasing integration within the EU;
- however, also candidate countries normally increase trade relationships with the EU even before the formal admission;
- furthermore, trade links are enhanced by stable exchange-rates, thus also ERM membership should be relevant;
- and, lastly, full EMU membership (i.e. euro adoption) should lead to the strongest increase in trade relations (see the studies surveyed in section 2).

[50] In specifications without logarithms and/or the division by n of the dependent variable, we obtain almost identical results.
[51] The only partial exception regards the EU-10-East aggregate for which the beta convergence in ER is almost significant.
[52] As for UR, we have used CE data for the 1990-99 period and Eurostat data for the 2000-2007 period.

A simple way to investigate the effect of institutional and nominal convergence on trade is to regress trade flows with the EU on the integration index (I). However, to increase the significance of the relation, it is advisable to add the most relevant economic variables explaining trade flows, such as the GDP in the individual countries and aggregate EU's GDP. This resembles "gravity models", although we do not consider here bilateral trade flows between country i and country j, but rather trade flows between country i and the aggregate EU27.[53]
We can estimate an equation of the following type:

$$T_{iUt} = \alpha + \beta Y_{it-1} + \gamma Y_{Ut-1} + \delta I_{it-1} + \varepsilon$$

where T_{iUt} are total trade flows (imports plus exports) between individual countries (i) and EU27 (U). As specified in section 4.1, Eurostat's data are available for the period 1999-2007 at current prices. So, also GDP of individual countries (Y_{it}) and EU's GDP (Y_{Ut}) are at current prices. The estimation is a pool with fixed effects. In order to tackle the possible endogeneity problems, we have preferred to specify the explanatory variables with a 1-year lag. The results are in Table 4.

In the case of the full sample (EU27), not only are the coefficients of Y_{it} and Y_{Ut} positive and significant as expected, but also the integration index is positive and significant (eq. [6a]). This means that the process of institutional integration and nominal convergence (EU membership, ERM joining, euro adoption, etc.) had indeed positive effects on trade integration within the EU. A further check is that even leaving the integration index as the sole explanatory variable (in addition to fixed effects), it remains positive and significant (eq. [6b]).[54]

Table 6 – Trade integration (1999-2007)

	[a]	[b]	[c]	[d]	[e]	[f]	[g]
Depend.var.	Trade values (current prices)				Export volumes		Trade/GDP ratio
Aggregate	EU27	EU27	EU15	CEEC10	EU27	EU27	EU27
n. obs.	27*8	27*8	15*8	10*8	27*8	27*8	27*8
Explanatory variables:							
Country's GDP°	0.78***		0.02	0.71***	0.38**		-2.72***
EU27's GDP°	0.46***		1.22***	1.40***	1.71***		
Integr.index°	0.52***	1.49***	-1.00	0.21**	0.54***	1.04***	0.26***
Adj. R2	0.997	0.993	0.996	0.993	0.998	0.997	0.980

Note: + in logs and lagged values. °country's GDP share in eq. [g]
Significance levels: 1%***, 5%**, 10%*; constant and fixed effects not reported.

Since the previous result might be distorted because of the consideration of Trade and GDP at current prices, we have tried a different specification by considering real Exports (just exports and not total trade: E_{iUt} in the previous equation in the place of T_{iUt}), deflated according to the method already specified (see section 4.1). In this case, of course, also GDP data are at constant prices (precisely they are value added data).

Well, the estimated coefficients of eq. [6e] (and similarly of eq. [6f]) confirm the significance of all variables, especially of the integration index.[55] So, the positive link between institutional/nominal convergence and trade integration seems robust.

[53] Distance is not considered in our case, but if we estimate a panel with fixed effects (FE), we can assume that distance is indirectly captured by such effects. Peripheral countries probably will have negative FE, although the distance effect could be compensated by many other idiosyncratic elements.

[54] The integration proxy is positive and significant also for the group of CEEC10, while it seems negative in the case of EU15 countries (equations [6d] and [6c] respectively).

[55] Notice that the coefficient of Y_{Ut-1}, the variable that captures the attraction of export flows, is higher than in eq. [16] (where we had exports+imports): this is in accordance with economic theory, since exports depend mainly on income in the destination country.

An alternative procedure could be to estimate a relation between trade shares on GDP for each country (a proxy of the intensity of trade with the EU), i.e. T_{iUt}/Y_{it}, and the GDP weight of the country, Y_{it}/Y_{Ut}; plus, as usual, the integration index. Notice that the ratios T_{iUt}/Y_{it} capture both an aspect of trade intensity (i.e. the openness of the countries) and an element of trade re-orientation toward the EU27 (i.e. stronger trade integration within the EU). The equation to be estimated is the following:

$$T_{iUt}/Y_{it} = \alpha + \beta\, Y_{it}/Y_{Ut} + \delta\, I_{it} + \varepsilon$$

If we look at eq. [6g] we can see that the integration index is once more positive and significant in the case of the EU27 group of countries. On the other hand, the coefficient of Y_{it}/Y_{Ut} is negative and significant because the bigger countries are normally less "open" to international trade.

4.6 Output correlations

A final aspect of real convergence refers to the business cycle performance of the different countries, in order to see whether the cycles of individual countries are correlated with a "European" cycle. Even without adopting complex econometric procedures (e.g. VAR methods), we can start with the computation of correlation coefficients between real output (in our case *value added*) of individual countries and EU27's output (total value added for the EU27 countries at constant prices).

In some empirical studies, the reference country or area is sometimes Germany or, more often, EMU. We prefer to consider EU27 to identify an "average" cycle for all EU.[56] Table 6 shows, in the left column, the correlation coefficients computed on the *output levels*; the countries are shown in a descending order. The highest correlations can be found in the "old" European countries, with some exceptions[57] (all the coefficients are statistically significant, but Romania and Bulgaria).

From a business cycle perspective is more useful to compute correlation coefficients on *output differences* over time. The right column of Table 6 shows a rather different pattern (also the statistical significance is achieved for a smaller number of countries). The first ten countries comprehend not only "old" European countries (with Germany leading the group), but nine out of ten are EMU's countries (the only exception being Sweden). The last ten countries in the table include mostly the "new" members, plus Denmark and the United Kingdom, two countries not yet adopting the euro (and the UK business cycle is traditionally considered rather asymmetric); the real exception is however Luxembourg.[58]

We can perhaps conclude by saying that the EMU has actually been launched including a group of rather "integrated" countries, paying full respect – from this point of view – to OCA's criteria: real convergence has thus justified the subsequent steps toward nominal convergence (euro adoption and the related criteria). A different explanation, more in accordance with OCA's endogeneity theories, is that nominal convergence – euro adoption and the satisfaction of Maastricht's criteria – has led to a better real integration of EU countries, which reaches the highest values (e.g. in terms of output correlations) in the EMU's group. We think that both explanations are relevant to understand economic performances and evolutions in the EU over the two last decades.

[56] Moreover, the difference between EU27's GDP and EU15's GDP (another aggregate sometimes used as a reference area) is just about 10% in terms of levels (probably insignificant in terms of changes over time).
[57] Slovenia and Cyprus are in the first group; Italy, France and the Netherlands are rather low in the ranking.
[58] The tiny size of its GDP perhaps amplifies changes over time and possible measurement errors.

Tab. 6 – Output correlations

Correlations on real value added *levels* (1992-2007)		Correlations on real value added *changes* (1993-2007)	
	Correl. coeff. (and sign. level)		*Correl. coeff. (and sign. level)*
Belgium	0.998634***	Germany	0.966017***
Germany	0.997486***	Belgium	0.910347***
Sweden	0.997103***	France	0.871988***
Spain	0.996558***	Sweden	0.870159***
Ireland	0.996313***	Spain	0.838866***
Slovenia	0.995633***	Italy	0.830866***
Cyprus	0.995269***	Austria	0.788153***
United Kingdom	0.994871***	Portugal	0.763854***
Finland	0.994474***	Finland	0.758146***
Luxembourg	0.993945***	Greece	0.731194***
Denmark	0.992891***	Bulgaria	0.716843***
Austria	0.992609***	Netherlands	0.711544***
Hungary	0.991795***	Hungary	0.693873***
Italy	0.991086***	Slovenia	0.679699***
France	0.985734***	Ireland	0.656603***
Greece	0.984819***	Malta	0.592743**
Netherlands	0.982732***	Cyprus	0.502705*
Portugal	0.979127***	Latvia	0.493134*
Poland	0.978168***	Denmark	0.482378*
Slovakia	0.977203***	Lithuania	0.386387
Estonia	0.976623***	United Kingdom	0.365782
Lithuania	0.975838***	Czech Republic	0.236564
Latvia	0.975049***	Poland	-0.08836
Czech Republic	0.951609***	Slovakia	-0.09452
Malta	0.920593***	Estonia	-0.15134
Romania	0.416466	Romania	-0.28936
Bulgaria	-0.41894	Luxembourg	-0.29896

Note: Significance levels: 1%***, 5%**, 10%*. Source: elaboration on CE database.

5. Conclusions

In the review section of this paper, we have seen how complex are the relations between nominal and real convergence, and how many issues they involve. Afterwards, in the empirical part of the paper, we have illustrated and discussed the two sorts of convergence in the case of EU, initially in separate sections; then, in the econometric estimates, they have been connected to each other by means of indirect methods, in particular thanks to the inclusion in the real convergence analysis of an "integration index", originally proposed and applied in this paper.

A satisfactory degree of *nominal convergence* has been achieved in the EU, at least in the last fifteen years. In particular, the *deficit/GDP* ratio has improved in the EMU countries in the second part of the 1990s, followed by a significant worsening in the first three years of the new century and by a new reduction in the subsequent years; higher levels of the ratio are exhibited by the New Members, although significant reductions occurred since 2003 and especially in 2007. Similar tendencies are shown by the *debt/GDP* ratio: in this case, we should mention the much lower levels in the New Members, although a gradual reduction of the remarkable distance with "old-EU members" was interrupted in more recent years. The *inflation rate* remained quite stable (around 2%) in both the EMU-12 and EU-15 aggregates; as to the NMS, the significant decline of the 1990s was followed by a stabilisation (around 3-4%) in the new century (but still in 2007 seven countries out of ten did not respect the Maastricht parameter). Concerning the long-term *interest rate*, the Euro-area aggregate declined from a value higher than 9% in 1992 to a level close to 3% in 2006, with a strong reduction in the immediate period before EMU's birth. As to the *exchange rate*

condition, the three Baltic states (in addition to Denmark) adhere at present to the ERM-II agreements, as did Slovenia, Slovakia, Cyprus and Malta before adopting the euro. The inter-country *dispersion* of the nominal variables has generally decreased, save for the ambiguous trends in public finance parameters.

Turning now to *real convergence*, the analysis of sigma convergence/divergence showed for the EMU-12 and EU-15 aggregates: (i) a weak sigma divergence in national per capita GDP (although not constant over time), (ii) low but persisting disparities in productivity and industrial specialisation, (iii) significant sigma convergence in both employment and unemployment rates (but only after 1999 in the latter case). This contrasts, in some way, with the tendencies in the New Members: (i) significant sigma convergence in both per capita GDP and productivity, (ii) remarkable increases in the disparities in the specialisation index, (iii) persistent disparities in employment and unemployment rates (although sigma convergence prevails in more recent years in the latter case). The analysis of lowess-beta convergence/divergence has allowed to derive more specific results, depending on the period considered and on the aggregate of countries, but the EU-27 aggregate showed a convergence in all the considered variables. As for the other aggregates: (i) the (lowess) beta convergence in per capita GDP was stronger in the EU-8-east aggregate and a clear beta convergence in productivity emerged only within the same aggregate; (ii) a beta convergence in unemployment rate emerged for all the aggregates, not affected by the choice of the initial year; (iii) concerning the employment rate variable, a strong beta convergence emerged only for the EMU and EU-15 aggregates. Considering the two labour market performance variables (UR and ER), kernel densities permitted to better highlight the significant improvements occurred and the shape of concentration/convergence dynamics.

The results of *regression analysis* exhibit a beta-convergence in productivity across the EU-27 countries: this refers both to absolute and conditional (e.g. controlling for education) convergence; convergence in productivity is confirmed considering an "extended beta-convergence" approach (making use of annual observations for the recent period), in which case our "*integration index*" turns out to be positive and significant as well. The same approach has been applied to convergence in industrial specialisation, which seems verified in the EU-27 aggregate (less clear is the result in the case of EMU countries): remember that this type of convergence is important for the probability of occurrence of (a)symmetric shocks. Robust results are obtained for absolute convergence of labour market indicators (employment and unemployment rates).

The trade flows, which have been estimated in panel regressions with fixed effects (in specifications resembling gravity equations), are positively linked not only to the level of activity (EU-27's GDP and country's GDP) but also to the integration index. Finally, the analysis of output correlations – especially those referred to valued added changes – show that in a rank of countries according to the size of correlations, on one side the first ten countries (whose correlation coefficients are all statistically significant) comprehend exclusively "old" European countries (with Germany leading the group) and nine of them are EMU's countries (the additional country being Sweden); on the other side, the last ten countries include the "new" members as well as Denmark and the United Kingdom, two countries not adopting the euro.

We can conclude by recognizing that EMU has been launched in a group of rather integrated countries (at least in comparison with other European countries), as shown by output correlations, trade links, convergence in productivity and labour market performance. We could add that integration itself has probably been enhanced by convergence to EMU and the ensuing euro's adoption (as maintained by OCA's endogeneity theories). In old members, and particularly in EMU countries, only the pattern of convergence in economic structures and in per capita GDP is not so clear. So some risks could persist in the future, particularly if the (more or less) continuous respect of nominal conditions (Maastricht's and Stability Pact's parameters) will not be accompanied by the realization of structural reforms, the execution of all reforms launched by the Single Market and new progresses in the implementation of the Lisbon's strategy.

Concerning the New Members, they generally had more difficulties in respecting nominal conditions, but have shown a widespread catching-up – in terms of productivity and per-capita GDP – toward the average EU levels; they are also well integrated, in terms of trade links, with Western Europe. The major problems they experience refer not only to the persisting disparities in labour market indicators, to the still different specialisation and consequently low output correlations; but also to the conflicts emerging by the attempts to simultaneously satisfy the nominal conditions (we have discussed in the review section the trade-off between inflation and exchange-rate Maastricht's criteria). Although all these countries will probably benefit from entering EMU in the long run, the real question for some of them is *when* and *how* to proceed toward this final step of integration. More immediate policy measures refer to the need to tackle the persisting labour market problems and unemployment levels, which are unfortunately bound to increase because of the present recession. But the current economic crisis is a widespread challenge which is distressing nominal and real convergence of all European countries (new and old) as well as of most countries of the world.

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Appendix

Table A1 - Deficit/GDP

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Belgium	-8.4	-7.5	-5	-4.5	-3.9	-2.2	-0.9	-0.6	0	0.5	0	-0.1	-0.2	-2.6	0.3	-0.3
Bulgaria											-0.8	-0.3	1.6	1.9	3	0.1
Czech Republic				-13.4	-3.3	-3.8	-5	-3.7	-3.7	-5.7	-6.8	-6.6	-3	-3.6	-2.7	-1
Denmark	-2.6	-3.8	-3.3	-2.9	-1.9	-0.5	0.1	1.5	2.4	1.5	0.3	0.1	2	5.2	5.1	4.9
Germany	-2.5	-3	-2.3		-3.3	-2.6	-2.2	-1.5	1.3	-2.8	-3.7	-4	-3.8	-3.3	-1.5	-0.2
Estonia				1.1	-0.4	2.2	-0.7	-3.5	-0.2	-0.1	0.3	1.7	1.7	1.5	2.9	2.7
Ireland	-2.9	-2.8	-2	-2.1	-0.1	1.1	2.4	2.7	4.7	0.9	-0.4	0.4	1.4	1.7	3	0.2
Greece									-3.7	-4.5	-4.7	-5.7	-7.5	-5.1	-2.8	-3.5
Spain				-6.5	-4.8	-3.4	-3.2	-1.4	-1	-0.6	-0.5	-0.2	-0.3	1	2	2.2
France	-4.6	-6	-5.5	-5.5	-4	-3.3	-2.6	-1.8	-1.5	-1.5	-3.1	-4.1	-3.6	-2.9	-2.4	-2.7
Italy	-8.6	-9.5	-9	-7.4	-7	-2.7	-2.8	-1.7	-0.8	-3.1	-2.9	-3.5	-3.5	-4.3	-3.4	-1.6
Cyprus							-4.1	-4.3	-2.3	-2.2	-4.4	-6.5	-4.1	-2.4	-1.2	3.5
Latvia	-0.5	2.2	-1.3	-1.6	-0.4	1.2	0	-3.9	-2.8	-2.1	-2.3	-1.6	-1	-0.4	-0.2	0.1
Lithuania				-1.6	-3.3	-11.9	-3.1	-2.8	-3.2	-3.6	-1.9	-1.3	-1.5	-0.5	-0.4	-1.2
Luxembourg	-0.2	1.7	2.8	2.4	1.2	3.7	3.4	3.4	6	6.1	2.1	0.5	-1.2	-0.1	1.3	3.2
Hungary				0	-4.7	-6.2	-8.2	-5.5	-2.9	-4	-8.9	-7.2	-6.4	-7.8	-9.3	-5
Malta				-4.2	-8	-7.7	-9.9	-7.7	-6.2	-6.4	-5.5	-9.9	-4.7	-2.8	-2.3	-1.8
Netherlands	-4.3	-2.8	-3.4	:	-1.9	-1.2	-0.9	0.4	2	-0.2	-2.1	-3.1	-1.7	-0.3	0.6	0.3
Austria	-2	-4.1	-4.8	-5.8	-4	-1.8	-2.4	-2.3	-1.7	0	-0.7	-1.4	-4.4	-1.5	-1.5	-0.4
Poland				-4.4	-4.9	-4.6	-4.3	-2.3	-3	-5.1	-5	-6.3	-5.7	-4.3	-3.8	-2
Portugal	-4.1	-7.6	-7.6	-5	-4.5	-3.5	-3.4	-2.8	-2.9	-4.3	-2.8	-2.9	-3.4	-6.1	-3.9	-2.6
Romania				-2.1	-3.7	-4.5	-3.2	-4.5	-4.4	-3.5	-2	-1.5	-1.2	-1.2	-2.2	-2.6
Slovenia				-8.6	-1.2	-2.4	-2.5	-3.1	-3.7	-4	-2.5	-2.7	-2.2	-1.4	-1.2	0.5
Slovakia		-31.2	-6.1	-3.4	-9.9	-6.3	-5.3	-7.4	-12.3	-6.5	-8.2	-2.7	-2.3	-2.8	-3.5	-1.9
Finland	-5.3	-9.3	-7	-6.2	-3.5	-1.2	1.7	1.6	6.9	5	4.1	2.6	2.4	2.9	4.1	5.3
Sweden			-9.2	-7.4	-3.2	-1.5	1.1	1.3	3.7	1.6	-1.2	-0.9	0.8	2.4	2.3	3.6
United Kingdom	-6.4	-7.9	-6.8	-5.9	-4.3	-2.2	-0.1	0.9	3.6	0.5	-2	-3.3	-3.4	-3.4	-2.7	-2.8
Aggregates																
EU-27						-2.6	-1.9	-1	0.6	-1.4	-2.5	-3.1	-2.9	-2.4	-1.4	-0.9
EU-25				-5.1	-4.2	-2.6	-1.9	-0.9	0.6	-1.4	-2.5	-3.1	-2.9	-2.5	-1.4	-0.8
EU-15-old				-5.1	-4.2	-2.6	-1.8	-0.8	0.8	-1.2	-2.3	-3	-2.8	-2.4	-1.3	-0.8
NMS-10				-5.3	-4.5	-4.7	-4.8	-3.5	-3.7	-4.8	-5.7	-5.7	-4.4	-4.1	-3.8	-1.8
Euro area				-4.9	-4.2	-2.6	-2.2	-1.3	0.1	-1.8	-2.5	-3	-2.9	-2.5	-1.3	-0.6
Euro area-15				-5	-4.2	-2.7	-2.3	-1.4	0	-1.8	-2.5	-3.1	-2.9	-2.5	-1.3	-0.6
Euro area-13				-5	-4.2	-2.7	-2.3	-1.4	0	-1.8	-2.5	-3.1	-2.9	-2.5	-1.3	-0.6
Euro area-12				-5	-4.2	-2.7	-2.3	-1.4	0	-1.8	-2.5	-3.1	-2.9	-2.5	-1.3	-0.6

Source: Eurostat database. Net lending (+) minus Net borrowing (-) under the EDP (Excessive Deficit Procedure) as percent of GDP

Table A2 - Debt/GDP

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Belgium	132.2	137.9	135.9	129.8	127	122.3	117.1	113.6	107.8	106.5	103.5	98.7	94.3	92.1	87.8	83.9
Bulgaria						105.1	79.6	79.3	74.3	67.3	53.6	45.9	37.9	29.2	22.7	18.2
Czech Republic				14.6	12.5	13.1	15	16.4	18.5	25.1	28.5	30.1	30.4	29.8	29.6	28.9
Denmark	69.4	81.1	77.4	72.5	69.2	65.2	60.8	57.4	51.5	48.7	48.3	45.8	43.8	36.4	30.5	26.2
Germany	42.9	46.9	49.3	55.6	58.4	59.7	60.3	60.9	59.7	58.8	60.3	63.8	65.6	67.8	67.6	65.1
Estonia				9	7.4	6.2	5.5	6	5.2	4.8	5.7	5.6	5	4.5	4.3	3.5
Ireland	92.5	95.1	89.6	82.1	73.5	64.3	53.6	48.5	37.8	35.5	32.2	31.1	29.4	27.3	24.7	24.8
Greece	87.8	110.1	107.9	108.7	111.3	108.2	105.8	105.2	103.2	103.6	100.6	97.9	98.6	98.8	95.9	94.8
Spain	46.8	58.4	61.1	63.3	67.4	66.1	64.1	62.3	59.3	55.5	52.5	48.7	46.2	43	39.6	36.2
France	39.6	45.3	48.4	55.5	58	59.2	59.4	58.9	57.3	56.9	58.8	62.9	64.9	66.4	63.6	63.9
Italy	108.1	118.7	124.8	121.5	120.9	118.1	114.9	113.7	109.2	108.8	105.7	104.4	103.8	105.9	106.9	104.1
Cyprus							58.6	58.9	58.8	60.7	64.7	68.9	70.2	69.1	64.6	59.5
Latvia				15.1	13.9	11.1	9.6	12.5	12.3	14	13.5	14.6	14.9	12.4	10.7	9.5
Lithuania				11.9	14.3	15.6	16.6	22.8	23.7	23.1	22.3	21.1	19.4	18.4	18	17
Luxembourg	5.5	6.8	6.3	7.4	7.4	7.4	7.1	6.4	6.2	6.3	6.3	6.1	6.3	6.1	6.6	7
Hungary				87.4	73.7	64	62	61.1	54.3	52.1	55.7	58	59.4	61.7	65.6	65.8
Malta				35.3	40.1	48.4	53.4	57.1	55.9	62.1	60.1	69.3	72.1	69.9	63.8	62.2
Netherlands	77.9	79.3	76.4	76.1	74.1	68.2	65.7	61.1	53.8	50.7	50.5	52	52.4	51.8	47.4	45.7
Austria	55.8	60.5	63.4	68.3	68.3	64.4	64.8	67.2	66.5	67.1	66.5	65.5	64.8	63.7	62	59.5
Poland				49	43.4	42.9	38.9	39.6	36.8	37.6	42.2	47.1	45.7	47.1	47.7	44.9
Portugal	54.4	59.1	62.1	61	59.9	56.1	52.1	51.4	50.5	52.9	55.6	56.9	58.3	63.6	64.7	63.6
Romania				7	11.1	15.2	16.6	21.9	22.6	26	25	21.5	18.8	15.8	12.4	12.9
Slovenia										26.8	28	27.5	27.2	27	26.7	23.4
Slovakia				22.1	31.1	33.8	34.5	47.8	50.3	48.9	43.4	42.4	41.4	34.2	30.4	29.4
Finland	40.5	55.9	58	56.7	56.9	53.8	48.2	45.5	43.8	42.3	41.3	44.3	44.1	41.3	39.2	35.1
Sweden			73.9	72.2	73	71	69.1	64.8	53.6	54.4	52.6	52.3	51.2	50.9	45.9	40.4
United Kingdom	39.2	45.4	48.6			49.8	46.7	43.7	41	37.7	37.5	38.7	40.6	42.3	43.4	44.2
Aggregates																
EU-27						68.5	66.5	65.9	61.9	61	60.3	61.8	62.2	62.7	61.3	58.7
EU-25						68.6	66.8	66.1	62	61.1	60.5	62	62.4	63.1	61.8	59.3
EU-15-old			66.4			69.9	68.1	67.2	63.2	62.2	61.6	63	63.2	64.1	62.8	60.4
NMS-10				41.6	37	36.3	34.6	38.2	36.6	38.5	39.4	41	44.9	43.3	43.4	41.4
Euro area				72.1	73.6	73.1	72.8	71.5	68.7	68.4	68.2	69.3	69.7	70.3	68.6	66.6
Euro area-15				72.5	74.1	73.6	73.2	71.9	69.3	68.2	68	69.2	69.6	70.2	68.5	66.3
Euro area-13				72.5	74.2	73.6	73.2	72	69.3	68.3	68.1	69.2	69.6	70.2	68.5	66.3
Euro area-12	60.3	66.2	68.9	72.6	74.3	73.8	73.4	72.1	69.4	68.4	68.2	69.3	69.7	70.3	68.6	66.5

Source: Eurostat database. Legend: Government consolidated gross debt - General government - Percentage of GDP

Table A3 - Inflation rates

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Belgium	1.5	0.9	1.1	2.7	2.4	1.6	1.5	1.9	2.5	2.3	1.8
Bulgaria		18.7	2.6	10.3	7.4	5.8	2.3	6.1	6	7.4	7.6
Czech Republic	8	9.7	1.8	3.9	4.5	1.4	-0.1	2.6	1.6	2.1	3
Denmark	2	1.3	2.1	2.7	2.3	2.4	2	0.9	1.7	1.9	1.7
Germany	1.5	0.6	0.6	1.4	1.9	1.4	1	1.8	1.9	1.8	2.3
Estonia	9.3	8.8	3.1	3.9	5.6	3.6	1.4	3	4.1	4.4	6.7
Ireland	1.3	2.1	2.5	5.3	4	4.7	4	2.3	2.2	2.7	2.9
Greece	5.4	4.5	2.1	2.9	3.7	3.9	3.4	3	3.5	3.3	3
Spain	1.9	1.8	2.2	3.5	2.8	3.6	3.1	3.1	3.4	3.6	2.8
France	1.3	0.7	0.6	1.8	1.8	1.9	2.2	2.3	1.9	1.9	1.6
Italy	1.9	2	1.7	2.6	2.3	2.6	2.8	2.3	2.2	2.2	2
Cyprus	3.3	2.3	1.1	4.9	2	2.8	4	1.9	2	2.2	2.2
Latvia	8.1	4.3	2.1	2.6	2.5	2	2.9	6.2	6.9	6.6	10.1
Lithuania	10.3	5.4	1.5	1.1	1.6	0.3	-1.1	1.2	2.7	3.8	5.8
Luxembourg	1.4	1	1	3.8	2.4	2.1	2.5	3.2	3.8	3	2.7
Hungary	18.5	14.2	10.0	10.0	9.1	5.2	4.7	6.8	3.5	4	7.9
Malta	3.9	3.7	2.3	3	2.5	2.6	1.9	2.7	2.5	2.6	0.7
Netherlands	1.9	1.8	2	2.3	5.1	3.9	2.2	1.4	1.5	1.7	1.6
Austria	1.2	0.8	0.5	2	2.3	1.7	1.3	2	2.1	1.7	2.2
Poland	15.0	11.8	7.2	10.1	5.3	1.9	0.7	3.6	2.2	1.3	2.6
Portugal	1.9	2.2	2.2	2.8	4.4	3.7	3.3	2.5	2.1	3	2.4
Romania	154.8	59.1	45.8	45.7	34.5	22.5	15.3	11.9	9.1	6.6	4.9
Slovenia	8.3	7.9	6.1	8.9	8.6	7.5	5.7	3.7	2.5	2.5	3.8
Slovakia	6	6.7	10.4	12.2	7.2	3.5	8.4	7.5	2.8	4.3	1.9
Finland	1.2	1.3	1.3	2.9	2.7	2	1.3	0.1	0.8	1.3	1.6
Sweden	1.8	1	0.5	1.3	2.7	1.9	2.3	1	0.8	1.5	1.7
United Kingdom	1.8	1.6	1.3	0.8	1.2	1.3	1.4	1.3	2.1	2.3	2.3
Aggregates											
EU-27	7.3	4.6	3	3.5	3.2	2.5	2.1	2.3	2.3	2.3	2.4
EU-25	2.6	2.1	1.6	2.4	2.5	2.1	1.9	2.1	2.2	2.2	2.3
EU-15	1.7	1.3	1.2	1.9	2.2	2.1	2	2	2.1	2.2	
Euro area	1.6	1.1	1.1	2.1	2.3	2.2	2.1	2.1	2.2	2.2	2.1
Euro area-15	1.7	1.2	1.1	2.2	2.4	2.3	2.1	2.1	2.2	2.2	2.1
Euro area-13	1.7	1.2	1.1	2.1	2.4	2.3	2.1	2.1	2.2	2.2	2.1
Euro area-12	1.7	1.2	1.1	2.1	2.4	2.3	2.1	2.1	2.2	2.2	2.1
NMS-10	9.1	7.5	4.6	6.1	4.9	3.1	2.9	3.9	3.1	3.4	4.5

Source: Eurostat database. Legend: Inflation rate - Annual average rate of change in Harmonized Indices of Consumer Prices (HICPs)

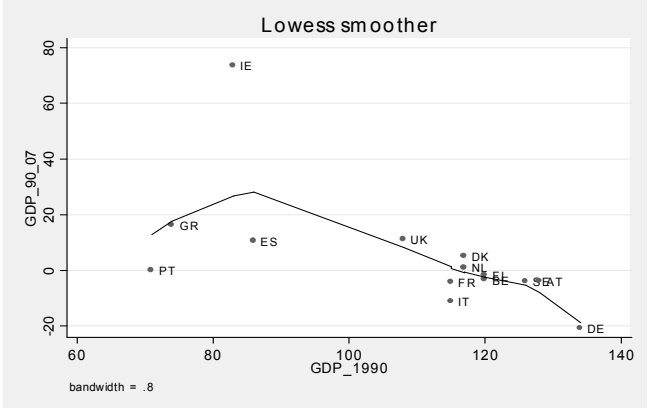
Table A4 - Long term interest rates

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Belgium	8.7	7.2	7.8	7.5	6.5	5.8	4.8	4.8	5.6	5.1	5.0	4.2	4.2	3.4	3.8	4.1
Bulgaria											8.3	6.4	5.3	3.8	4.0	4.4
Czech Republic									6.9	6.3	4.9					
Denmark	9.0	7.3	7.8	8.3	7.2	6.3	4.9	4.9	5.6	5.1	5.1	4.3	4.3	3.4	3.8	4.0
Germany	7.9	6.5	6.9	6.9	6.2	5.6	4.6	4.5	5.3	4.8	4.8	4.1	4.0	3.4	3.8	4.0
Estonia																
Ireland	9.1	7.7	7.9	8.3	7.3	6.3	4.8	4.7	5.5	5.0	5.0	4.1	4.1	3.3	3.7	4.0
Greece	24.0	23.4	20.9	17.3	14.6	10.2	8.5	6.3	6.1	5.3	5.1	4.3	4.3	3.6	4.1	4.3
Spain	11.7	10.2	10.0	11.3	8.7	6.4	4.8	4.7	5.5	5.1	5.0	4.1	4.1	3.4	3.8	4.1
France	8.6	6.8	7.2	7.5	6.3	5.6	4.6	4.6	5.4	4.9	4.9	4.1	4.1	3.4	3.8	4.1
Italy	13.3	11.2	10.5	12.2	9.4	6.9	4.9	4.7	5.6	5.2	5.0	4.3	4.3	3.6	4.1	4.3
Cyprus						6.9	6.7	7.4	7.6	7.7	5.4	4.7	6.1	5.2	4.1	4.5
Latvia													4.9	3.5	4.2	5.6
Lithuania											6.0	5.2	4.4	3.7	4.0	:
Hungary								9.9	8.6	7.9	7.1	6.8	8.2	6.6	7.1	6.7
Malta									5.8	6.1	5.7	5.0	4.7	4.6	4.3	4.7
Netherlands	8.1	6.4	6.9	6.9	6.2	5.6	4.6	4.6	5.4	5.0	4.9	4.1	4.1	3.4	3.8	4.1
Austria	8.2	6.7	7.0	7.1	6.3	5.7	4.7	4.7	5.6	5.1	5.0	4.2	4.2	3.4	3.8	4.1
Poland								9.5	11.8	10.7	7.3	5.8	6.9	5.2	5.3	5.5
Portugal	13.8	11.2	10.5	11.5	8.6	6.4	4.9	4.8	5.6	5.2	5.0	4.2	4.1	3.4	3.9	4.2
Slovenia													2.5	3.8	3.9	4.5
Slovakia									8.3	8.1	6.9	5.0	5.0	3.5	4.4	4.5
Finland	12.0	8.8	9.0	8.8	7.1	6.0	4.8	4.7	5.5	5.0	5.0	4.1	4.1	3.4	3.8	4.1
Sweden	10.0	8.6	9.7	10.2	8.0	6.6	5.0	5.0	5.4	5.1	5.3	4.6	4.4	3.4	3.7	3.9
United Kingdom	9.1	7.6	8.2	8.3	7.9	7.1	5.6	5.0	5.3	5.0	4.9	4.6	4.9	4.5	4.4	4.9
Aggregates																
Euro area	9.8	8.1	8.2	8.7	7.2	6.0	4.7	4.7	5.4	5.0	4.9	4.1	4.1	3.4	3.8	
Euro area-12							4.7	4.7	5.4	5.0	4.9	4.1	4.1	3.4	3.8	

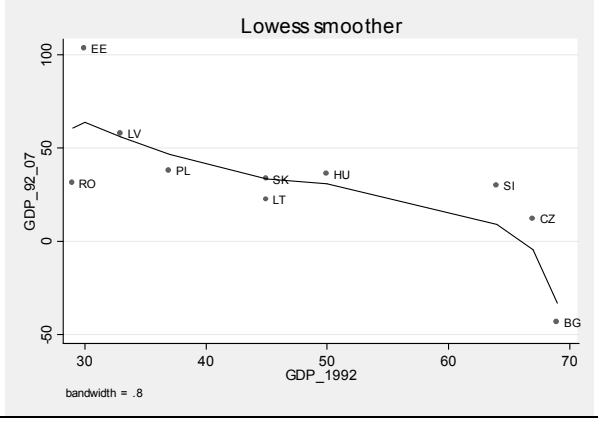
Source: Eurostat database. Legend: the indicators are long-term interest rates.

Graph A1 - Per capita GDP: Lowess beta

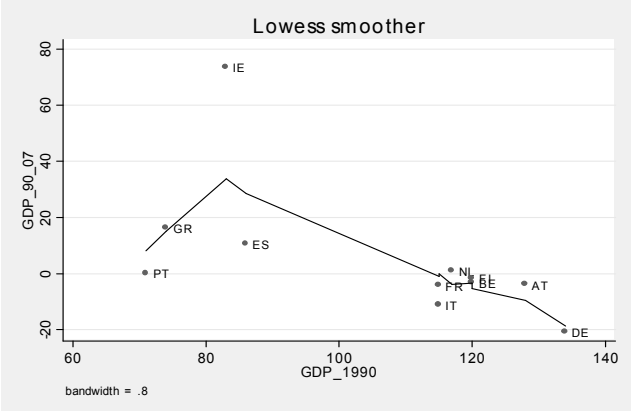
[a] EU-15 (Lux. escluded): 1990 - 2007



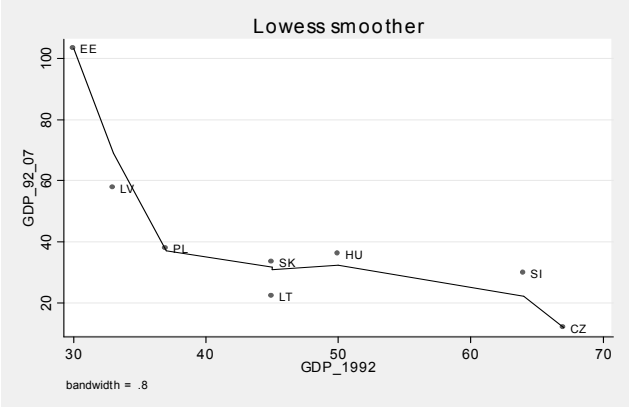
[b] 10-NMS-EAST: 1992-2007



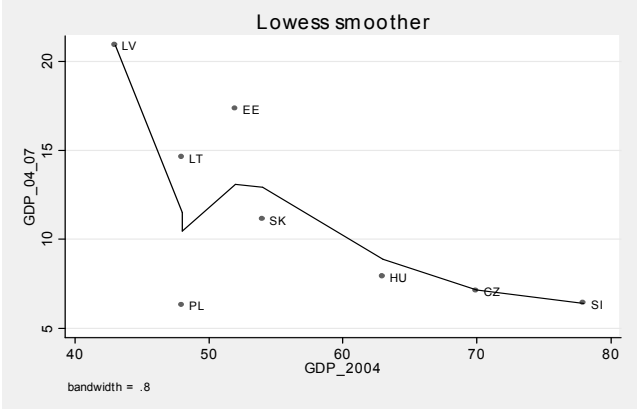
[c] EMU-12 (Lux. escluded): 1990 - 2007



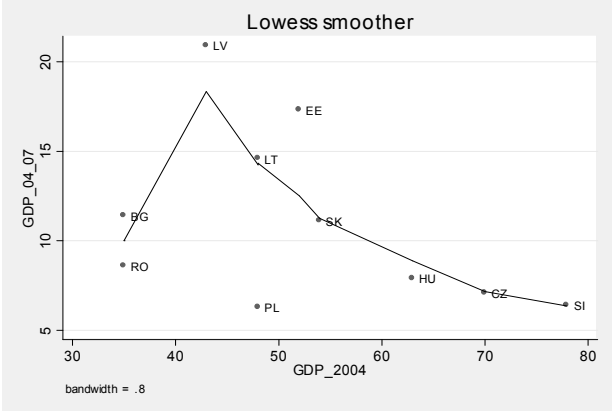
[d] 8-NMS(2004)-EAST: 1992-2007



[e] 8-NMS(2004)-EAST: 2004-2007



[f] NMS-EAST: 2004-2007

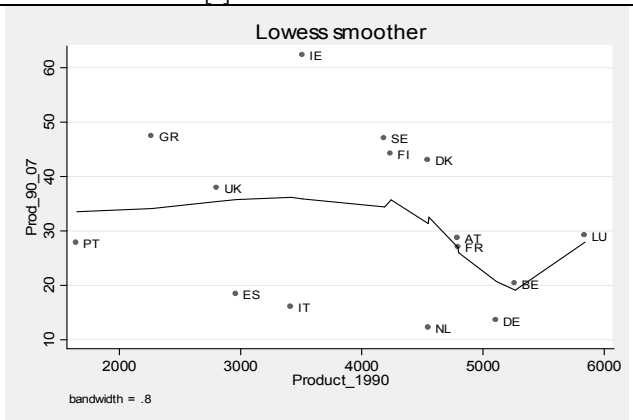


Source: our elaboration on CE database.

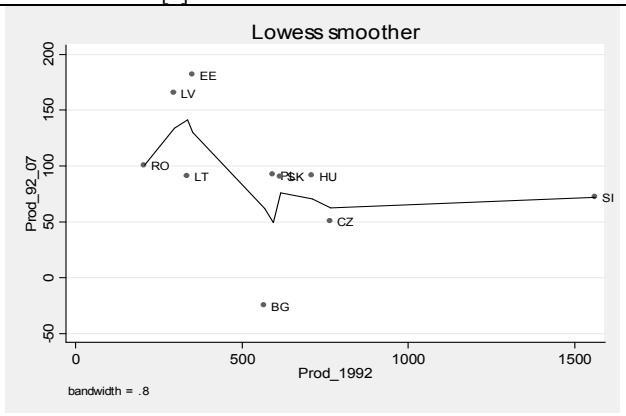
Graph A2 - Productivity: Lowess beta (elaboration on CE and Eurostat database)

CE database

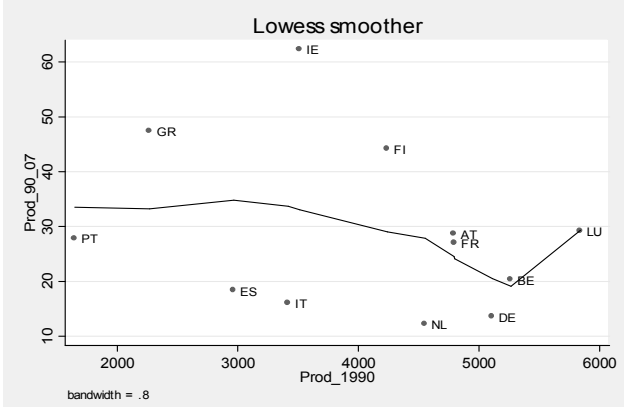
[a] EU-15: 1990 - 2007



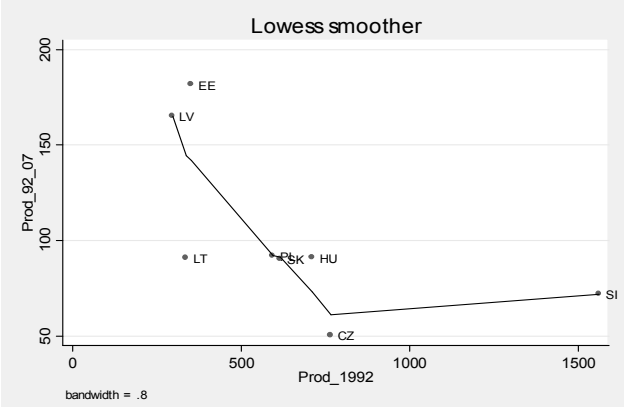
[b] 10-NMS-EAST: 1992-2007



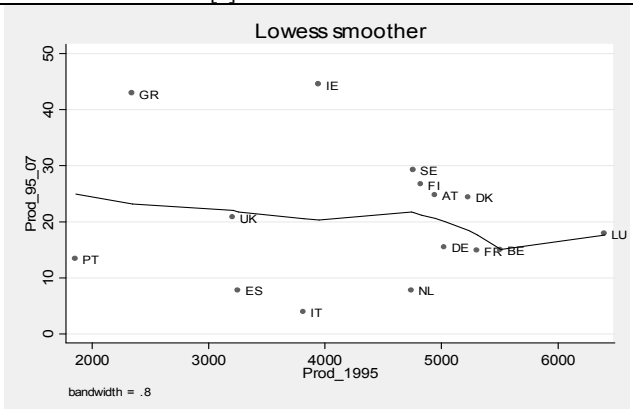
[c] EMU-12: 1990 - 2007



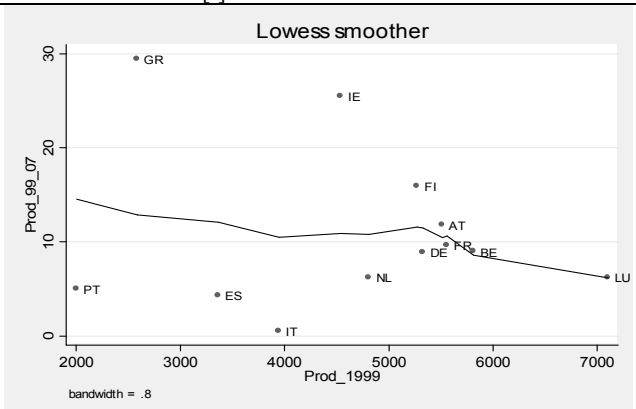
[d] 8-NMS(2004)-EAST: 1992-2007



[e] UE-15: 1995-2007

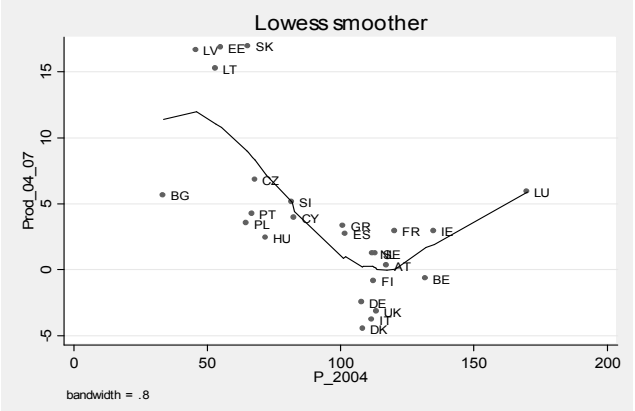


[f] EMU-12: 1999-2007

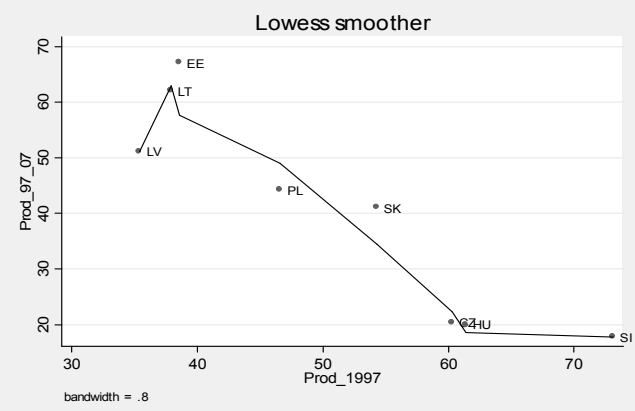


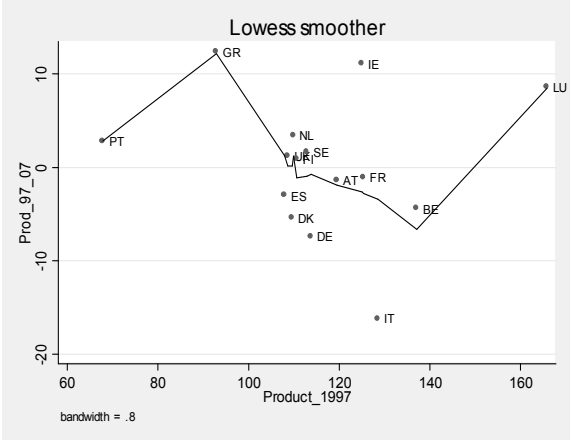
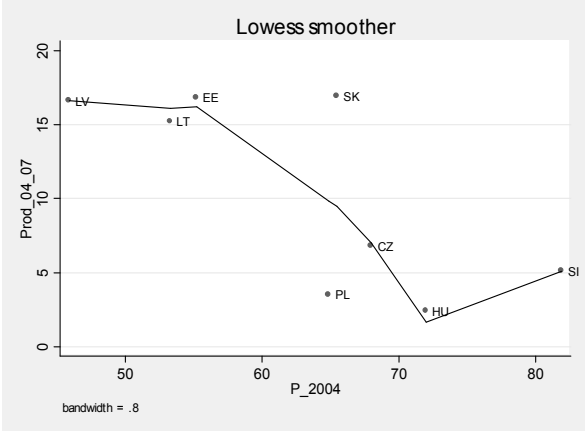
Eurostat database

[g] EU-25*: 2004-2007 * EU-27 minus Romania and Malta

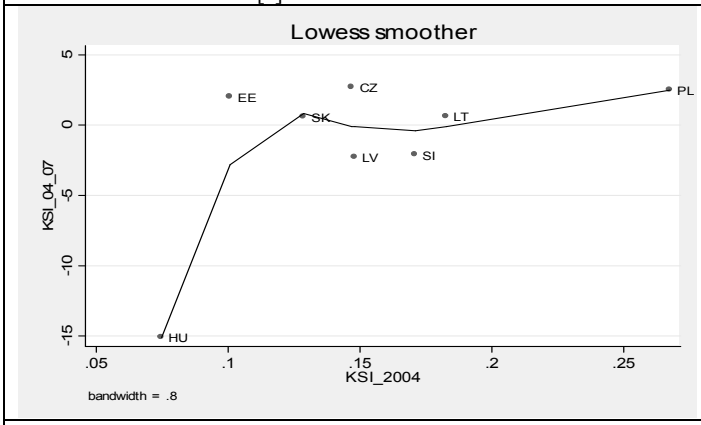
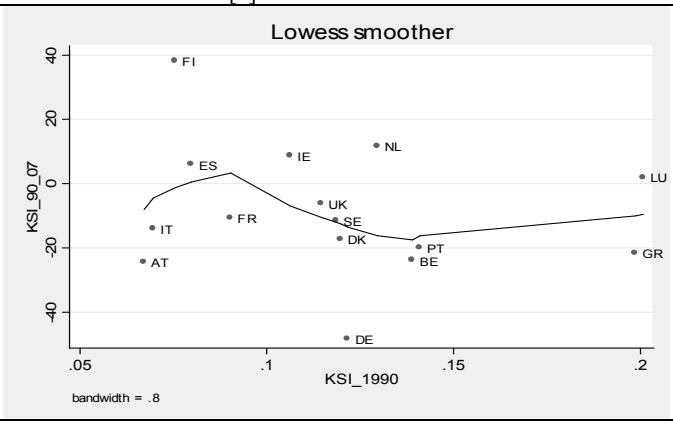
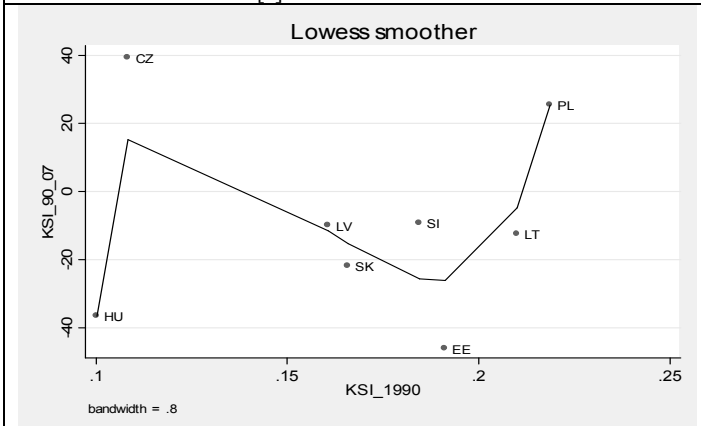
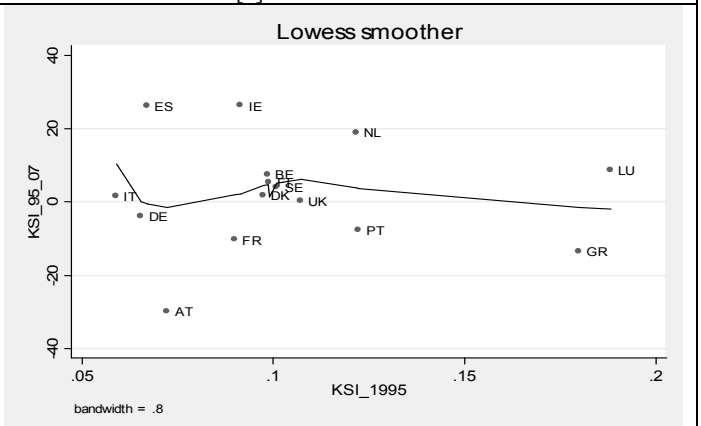
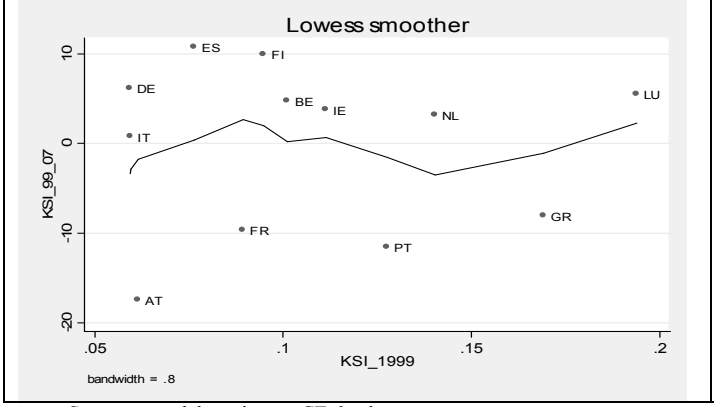
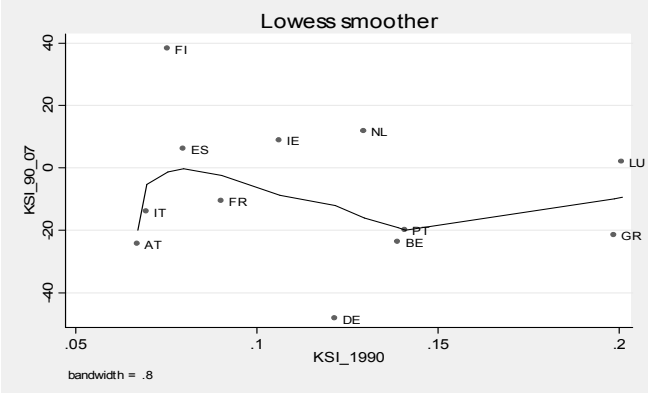


[h] EU-8: 1997-2007



[i] EU-15. 1997-2007)	[l] EU-8. 2004-2007
	

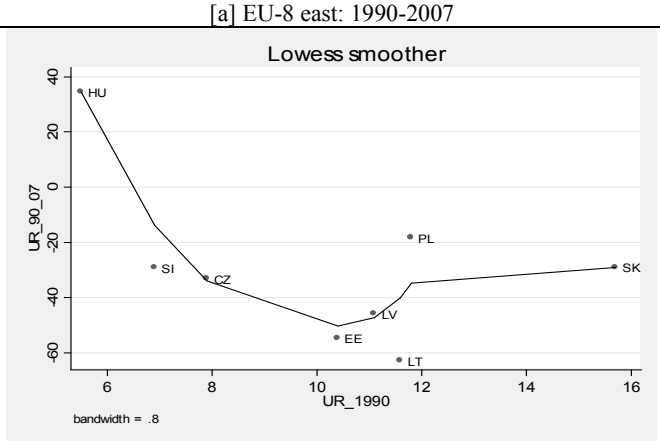
Graph A3 - KSI: Lowess beta

[a] EU-8: 2004-2007	[b] EU-15: 1990-2007
	
[c] EU-8: 1990-2007	[d] EU-15: 1995-2007
	
[e] EMU-12: 1999-2007	[f] EMU-12: 1990-2007
	

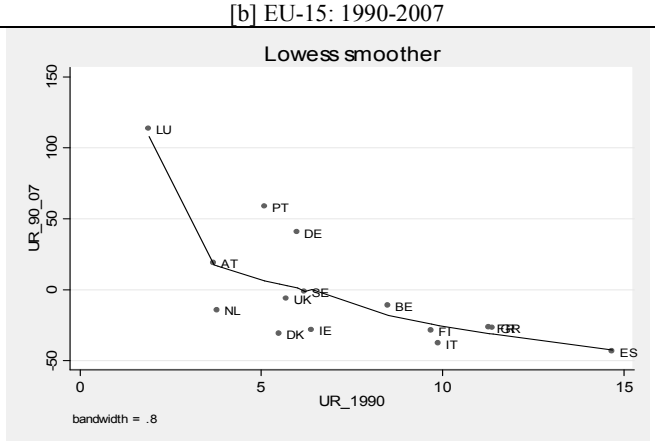
Source: our elaboration on CE database.

Graph A4 - Unemployment rate: Lowess beta (elaboration on CE and Eurostat database)

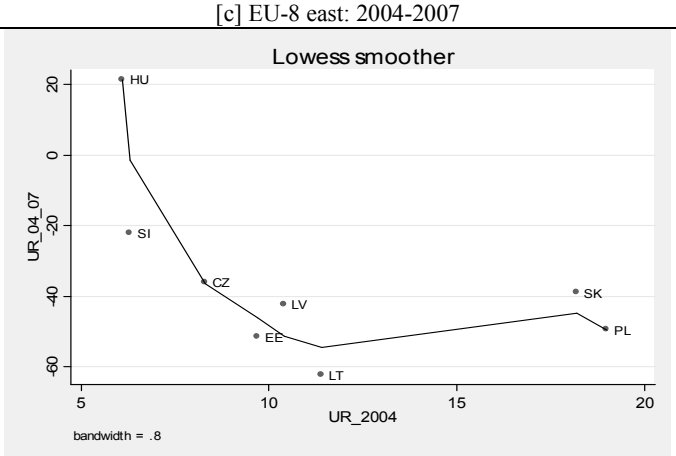
[a] EU-8 east: 1990-2007



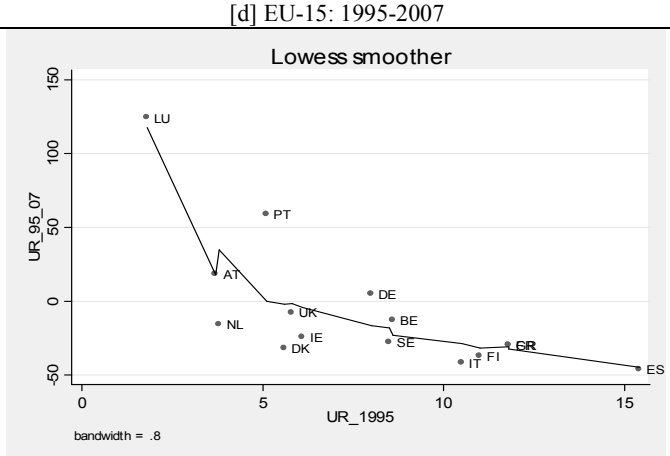
[b] EU-15: 1990-2007



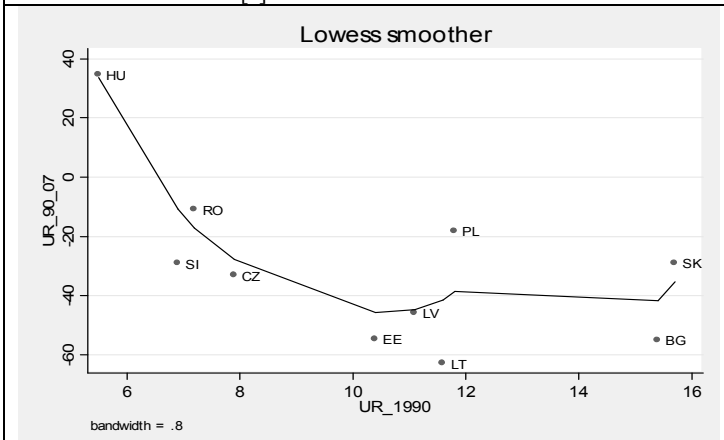
[c] EU-8 east: 2004-2007



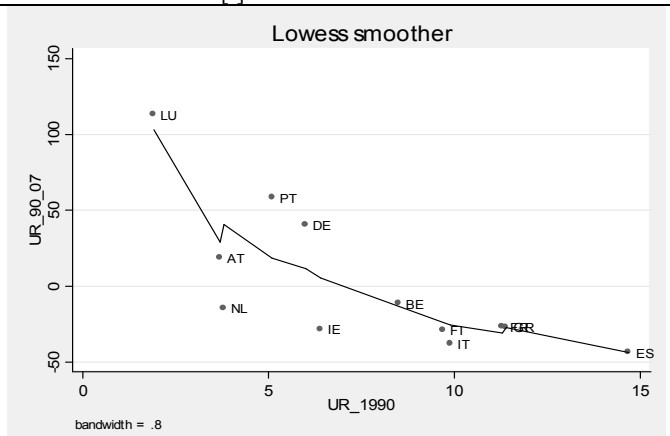
[d] EU-15: 1995-2007



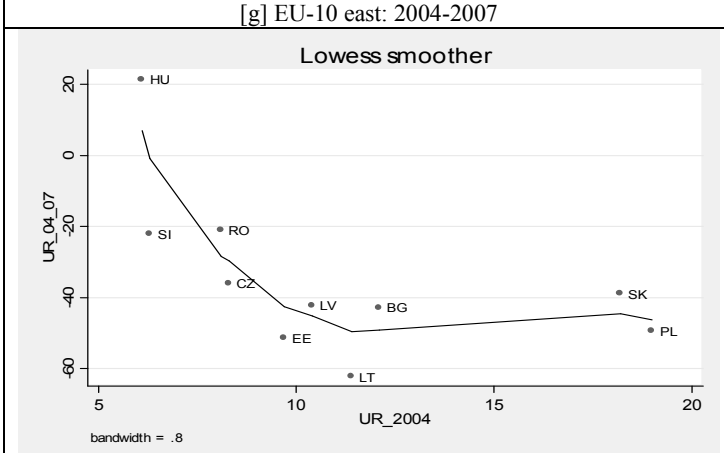
[e] EU-10 east: 1990-2007



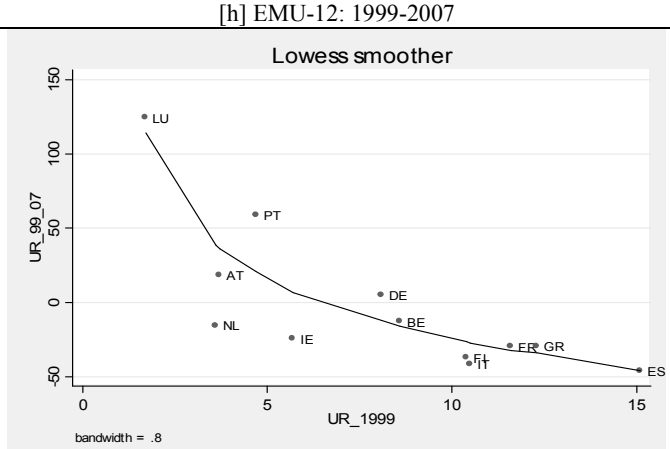
[f] EMU-12: 1990-2007



[g] EU-10 east: 2004-2007

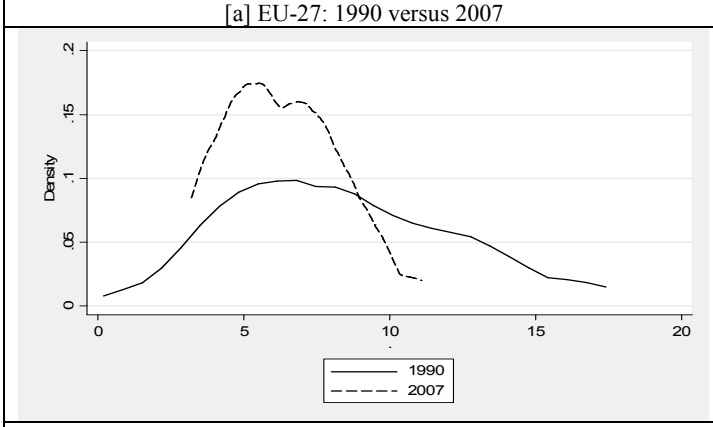


[h] EMU-12: 1999-2007

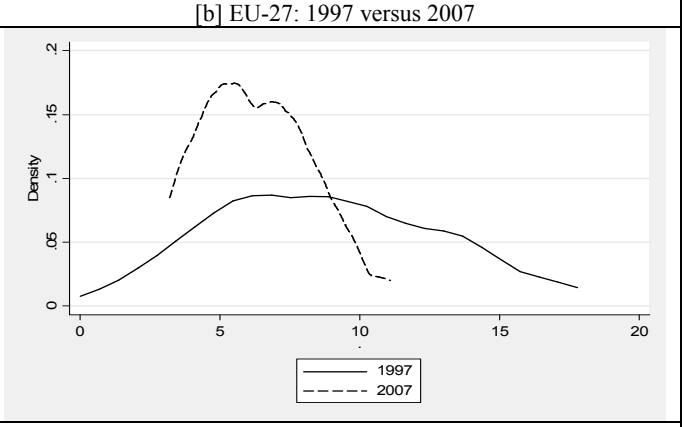


Graph A5 - Unemployment rate: Kernel density (elaboration on CE and Eurostat database)

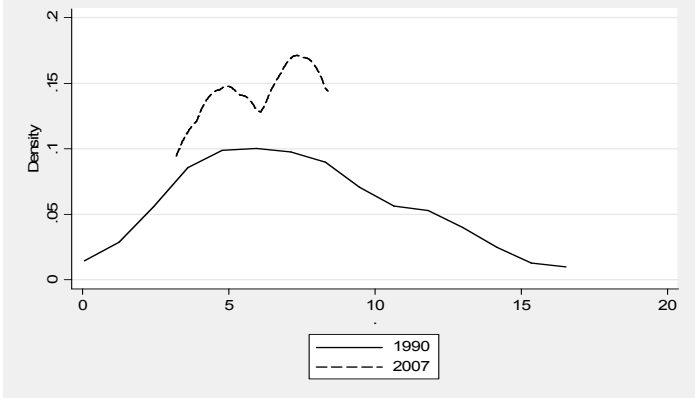
[a] EU-27: 1990 versus 2007



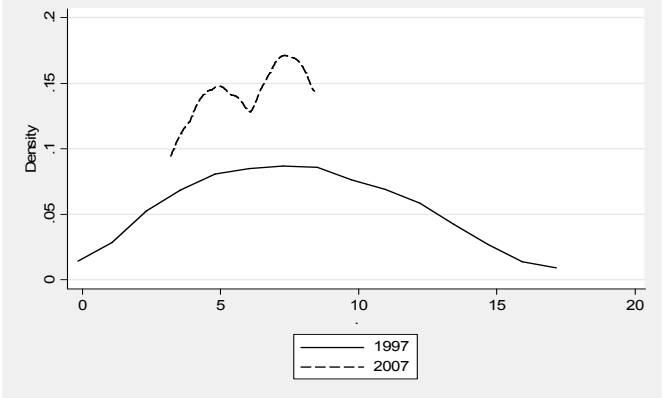
[b] EU-27: 1997 versus 2007



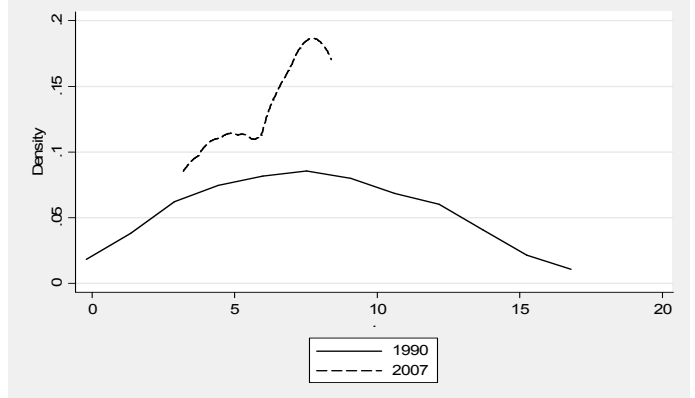
[c] EU-15: 1990 versus 2007



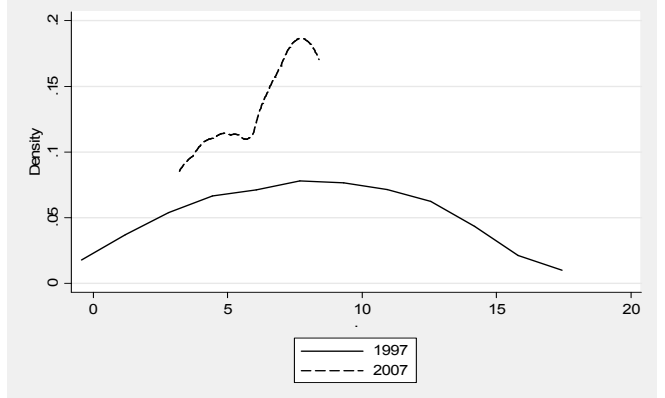
[d] EU-15: 1997 versus 2007



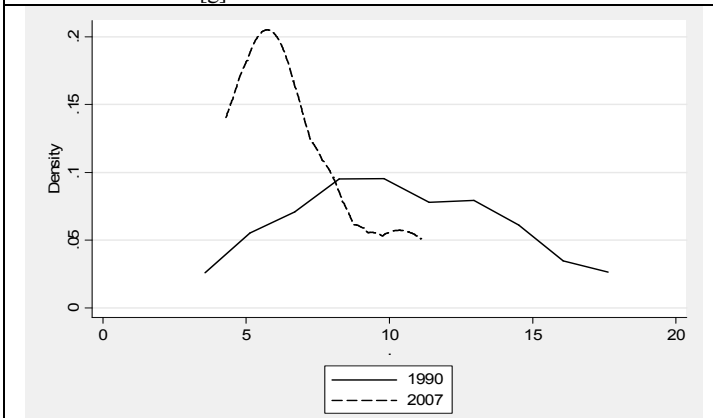
[e] EMU-12: 1990 versus 2007



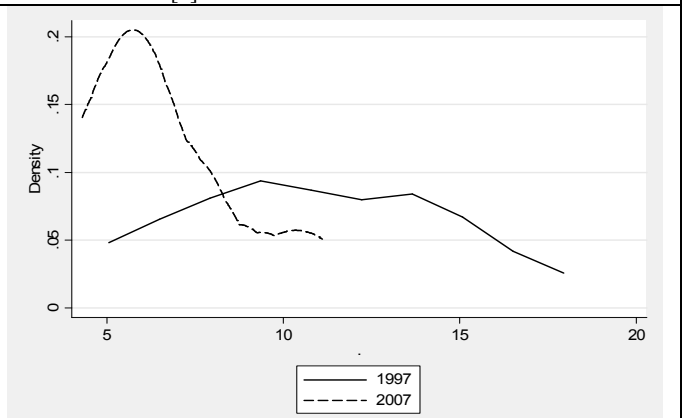
[f] EMU-12: 1997 versus 2007



[g] 10-EU-East: 1990 versus 2007

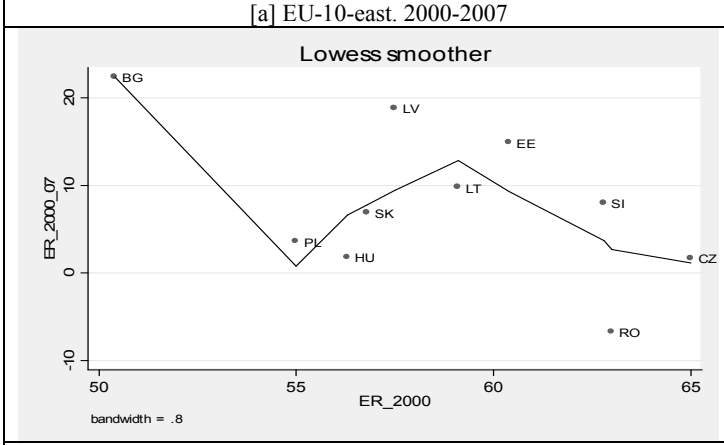


[h] 10-EU-East: 1997 versus 2007

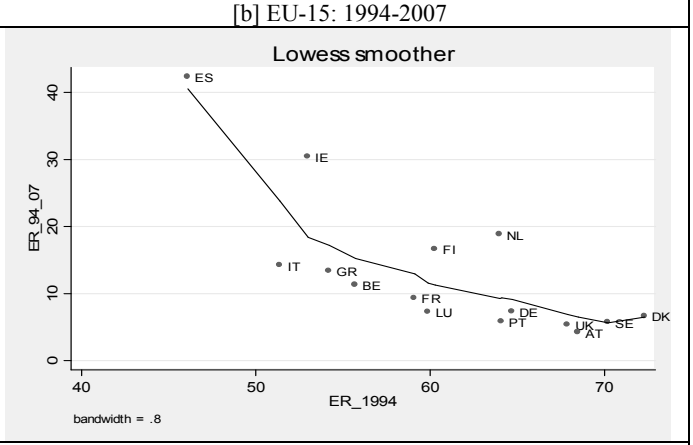


Graph A6 - Total Employment rate: Lowess beta (elaboration on Eurostat database)

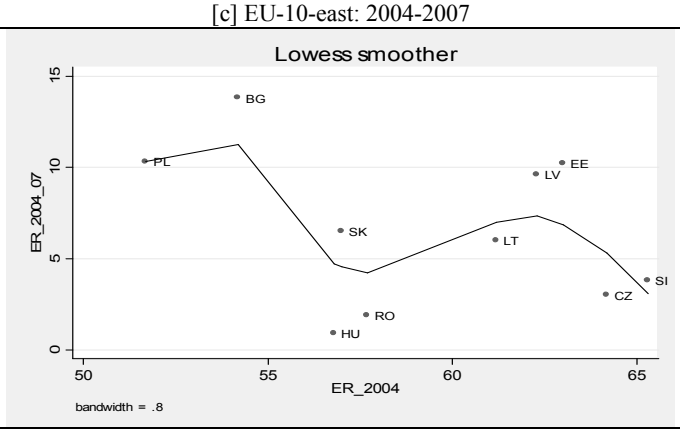
[a] EU-10-east. 2000-2007



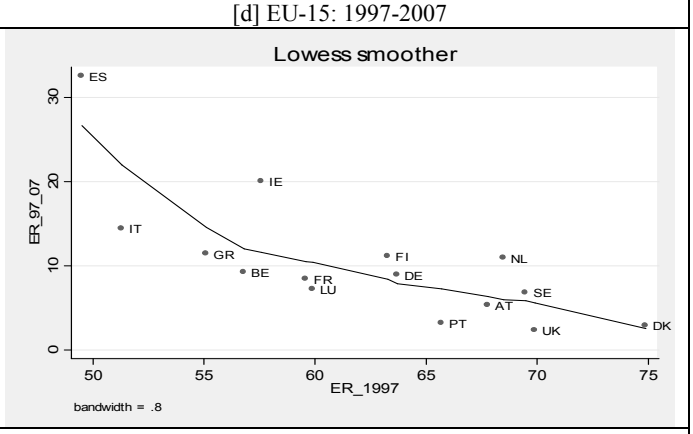
[b] EU-15: 1994-2007



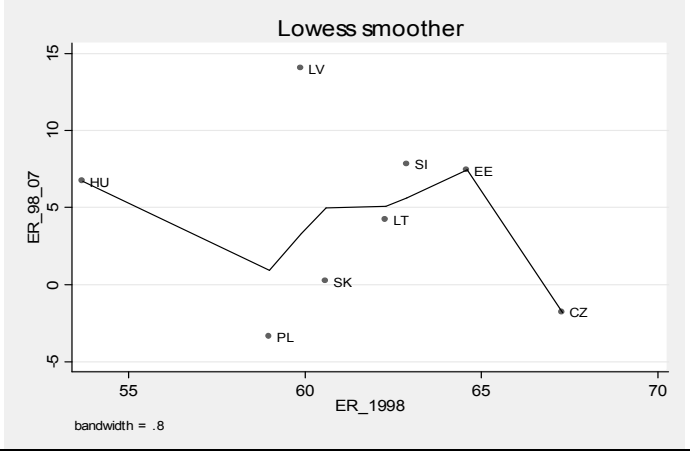
[c] EU-10-east: 2004-2007



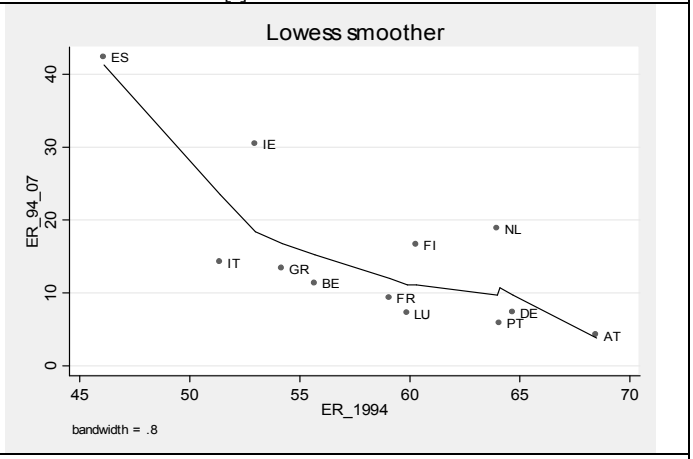
[d] EU-15: 1997-2007



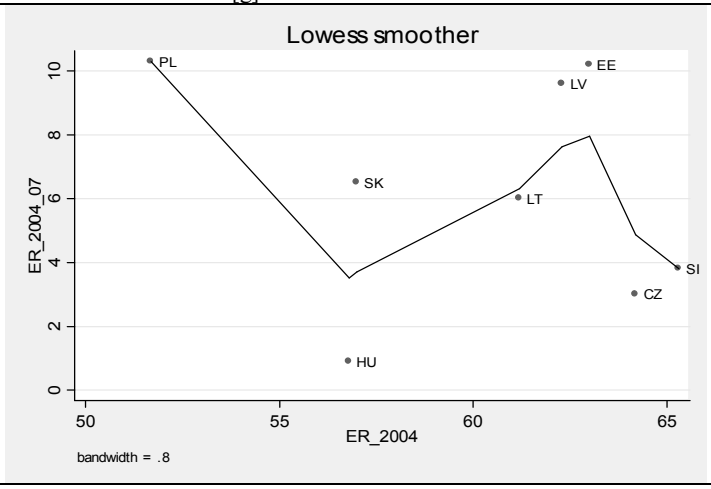
[e] EU-8-east: 1998-2007



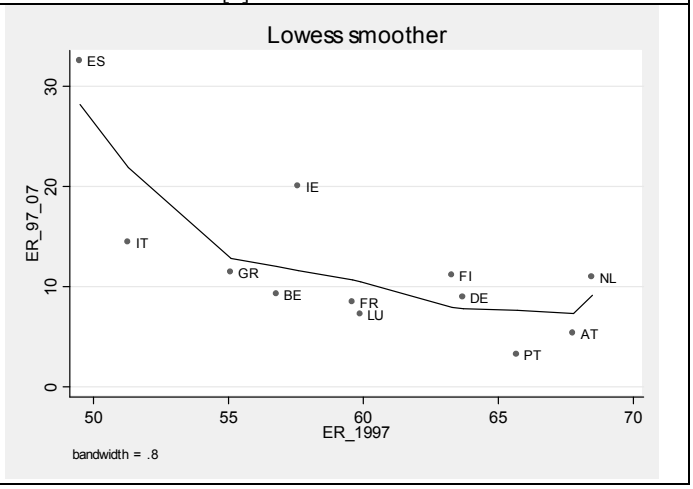
[f] EMU-12: 1994-2007



[g] EU-8-east. 2004-2007

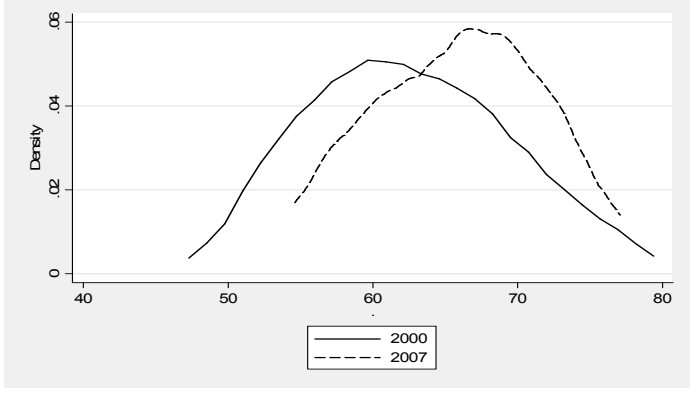


[h] EMU-12: 1997-2007

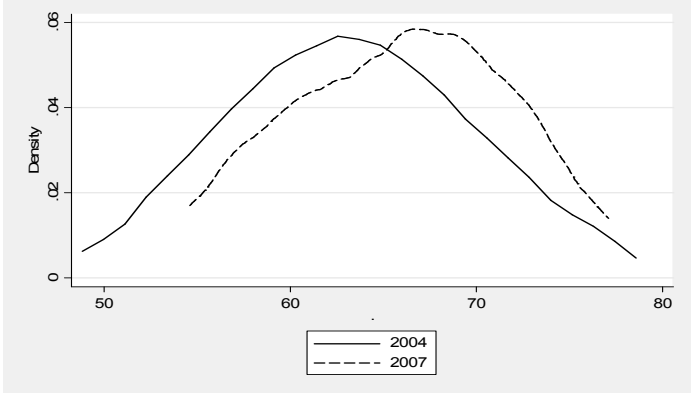


Graph A7 - Employment rate: Kernel density (elaboration on Eurostat database)

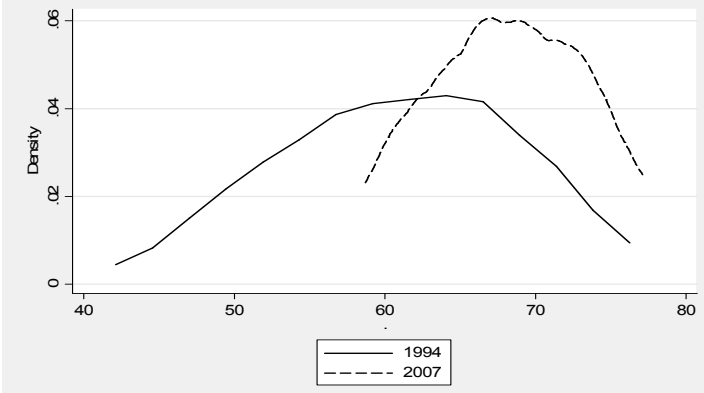
[a] EU-27: 2000 versus 2007



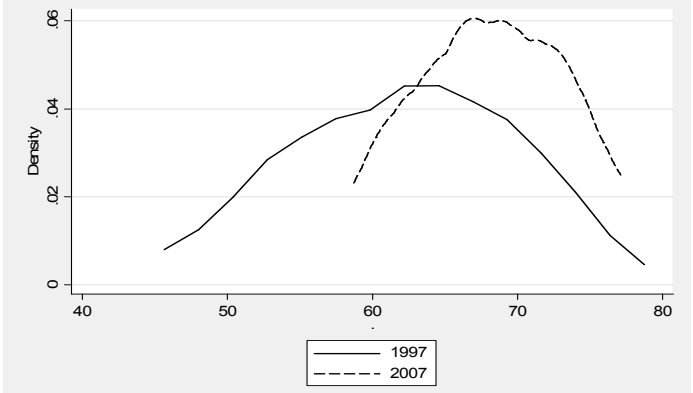
[b] EU-27: 2004 versus 2007



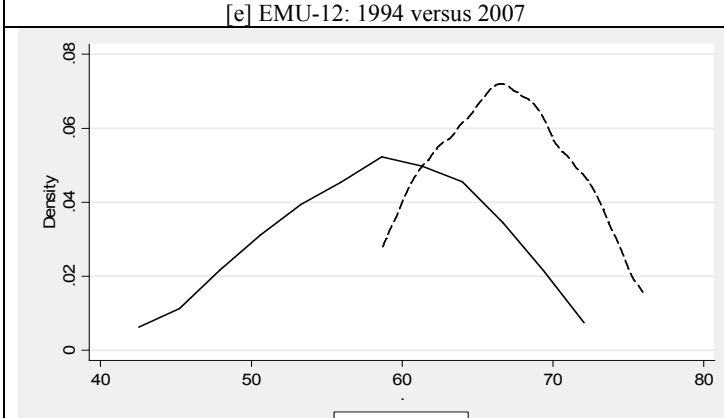
[c] EU-15: 1994 versus 2007



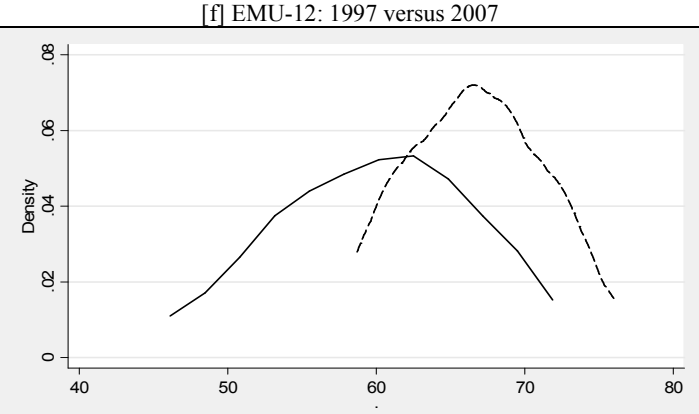
[d] EU-15: 1997 versus 2007



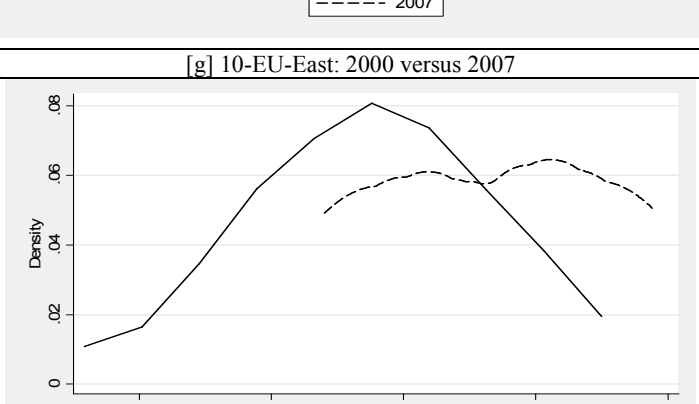
[e] EMU-12: 1994 versus 2007



[f] EMU-12: 1997 versus 2007



[g] 10-EU-East: 2000 versus 2007



[h] 10-EU-East: 2004 versus 2007

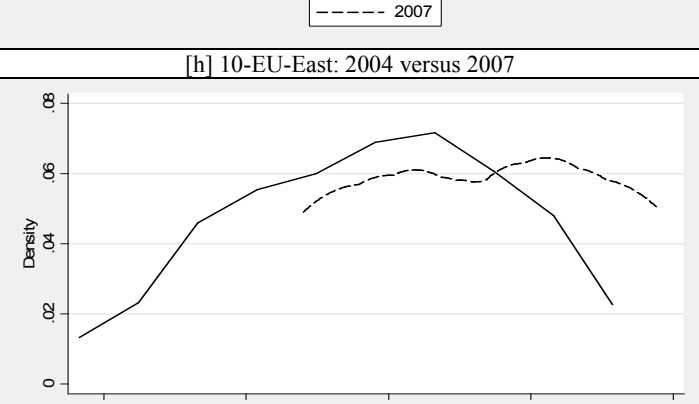


Table A5 - Institutional Integration Index

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Austria	0.25	0.3	0.35	0.4	0.45	0.75	0.82	0.88	0.94	1	1	1	1	1	1	1	1	1
Belgium	0.75	0.75	0.75	0.79	0.82	0.86	0.89	0.93	0.96	1	1	1	1	1	1	1	1	1
Bulgaria	0	0	0	0	0	0	0	0	0	0	0.25	0.29	0.32	0.36	0.4	0.44	0.47	0.5
Cyprus	0	0	0	0	0	0	0	0	0.25	0.29	0.33	0.37	0.41	0.46	0.5	0.75	0.83	0.92
Czech Republic	0	0	0	0	0	0	0	0	0.25	0.29	0.33	0.37	0.41	0.46	0.5	0.5	0.5	0.5
Germany	0.75	0.75	0.75	0.79	0.82	0.86	0.89	0.93	0.97	1	1	1	1	1	1	1	1	1
Denmark	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
Estonia	0	0	0	0	0	0	0	0	0.25	0.29	0.33	0.37	0.41	0.46	0.75	0.75	0.75	0.75
Spain	0.75	0.75	0.75	0.79	0.82	0.86	0.89	0.93	0.97	1	1	1	1	1	1	1	1	1
Finland	0.25	0.3	0.35	0.4	0.45	0.5	0.5	0.75	0.88	1	1	1	1	1	1	1	1	1
France	0.75	0.75	0.75	0.79	0.82	0.86	0.89	0.93	0.97	1	1	1	1	1	1	1	1	1
Greece	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.75	0.83	0.92	1	1	1	1	1	1	1
Hungary	0	0	0	0	0	0	0	0	0.25	0.29	0.33	0.37	0.41	0.46	0.5	0.5	0.5	0.5
Ireland	0.75	0.75	0.75	0.79	0.82	0.86	0.89	0.93	0.97	1	1	1	1	1	1	1	1	1
Italy	0.75	0.75	0.75	0.5	0.5	0.5	0.5	0.75	0.88	1	1	1	1	1	1	1	1	1
Lithuania	0	0	0	0	0	0	0	0	0	0	0.25	0.31	0.37	0.44	0.75	0.75	0.75	0.75
Luxembourg	0.75	0.75	0.75	0.79	0.82	0.86	0.89	0.93	0.97	1	1	1	1	1	1	1	1	1
Latvia	0	0	0	0	0	0	0	0	0	0	0.25	0.31	0.37	0.44	0.5	0.75	0.75	0.75
Malta	0	0	0	0	0	0	0	0	0	0	0.25	0.31	0.37	0.44	0.5	0.75	0.83	0.92
Netherlands	0.75	0.75	0.75	0.79	0.82	0.86	0.89	0.93	0.97	1	1	1	1	1	1	1	1	1
Poland	0	0	0	0	0	0	0	0	0.25	0.29	0.33	0.37	0.41	0.46	0.5	0.5	0.5	0.5
Portugal	0.75	0.75	0.75	0.79	0.82	0.86	0.89	0.93	0.97	1	1	1	1	1	1	1	1	1
Romania	0	0	0	0	0	0	0	0	0	0	0.25	0.29	0.32	0.36	0.4	0.44	0.47	0.5
Sweden	0.25	0.3	0.35	0.4	0.45	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Slovenia	0	0	0	0	0	0	0	0	0.25	0.29	0.33	0.37	0.41	0.46	0.75	0.83	0.92	1
Slovakia	0	0	0	0	0	0	0	0	0	0	0.25	0.31	0.37	0.44	0.5	0.5	0.75	0.82
United Kingdom	0.75	0.75	0.75	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5

Note: "*Institutional Integration Index*" is an index whose numerical values are between 0 and 1; we first computed the values as follows: (i) I = 0 for non-EU members; (ii) I = 0.25 for non-EU members formally recognized as "candidate" countries; (iii) I = 0.5 for EU members; (iv) I = 0.75 for EU members belonging the ERM (or ERM-II) agreements; (v) I = 1 for Eurozone members. Starting from the above values, some linear interpolations have been considered, in particular between 0.25 and 0.5 (a candidate country must show progresses toward full membership) and between 0.75 and 1 (the ERM members progressively satisfy the Maastricht's criteria to adhere to EMU).