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EUROPEAN REGIONAL GROWTH: DO SECTORS MATTER?

Abstract: The recent theoretical and empirical works on economic growth based on Solow's model have generally neglected the role played by the sectoral mix and structural change on aggregate growth. However, as many development economists have remarked, sectors are characterized by enormous differences in terms of technological change, inter-sectoral linkages and the degree of scale economies. In this paper we show that indeed sectors matter in determining aggregate growth across European regions. More specifically, we show that large part of convergence is induced by a structural change process of shifting employment from low to high productive sectors that is relatively faster in the initially less productive southern European regions.

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1. Introduction *

The recent theoretical and empirical works on economic growth have generally neglected the role played by the sectoral mix and structural change on aggregate growth. This shortfall is hardly surprising since most studies are based on Solow's one-sector growth model and on its prediction that initially poorer economies grow faster than richer ones, due to the decreasing return to capital mechanism [Barro and Sala-y-Martin (1991), Mankiw, Romer and Weil (1992)]. Even when a multi-sectors framework is maintained [Uzawa (1961-62)], the assumptions of homothetic preferences, uniform technical change across sectors and factors return values continuously equalised across all integrated sectors keep out any crucial role for sectoral specialisation and structural change.

The neoclassical approach overlooks the main ideas of the development economists that remarked the enormous differences between sectors in terms of technological change, inter-sectoral linkages and degree of scale economies within an economic system, where the values of marginal factor productivity are not equalised across the existing activities [Lewis (1954), Hirschman (1958), Kaldor (1966, 1968)]. In these views the shift of factors across sectors with different characteristics is a key component which can play an important role in determining aggregate growth. There are several reasons for this to happen, ranging from the existence of surplus labour in the backward primary sector, to the growth effect of the sectoral mix emphasised by endogenous growth models with two sectors characterised by different dynamic potentials [Lucas (1988), Grossman and Helpman (1991)].

Considering the congruity of the theoretical assumptions, it may be argued that the neoclassical growth model can be more usefully applied to analyse mature and well integrated economies with very similar economic structure, such as the OECD countries of the European Union. Although at first sight this point seems to be well grounded, it should be stressed that even within the apparently uniform group of the European Union's countries there are huge differences in the structural

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characteristics of the economies. Moreover, these differences are enhanced when we analyse the growth process at the regional level. As we will show in the paper, yet in the 1980s several regions in southern Europe are characterised by the presence of a very large agriculture sector, which is likely to hide a huge amount of surplus labour.

The aim of this paper is to show that indeed the sectoral mix and structural change matter in determining aggregate growth and catching up across European regions.[1] A careful assessment of the impact of sectoral composition is crucial not only to get a better understanding of the observed aggregate convergence, but also to appraise how strong should we expect this process to be in the future, and to assess the role played by national and European sectoral policies at the regional level.

The paper is organised as follows. In Section 2 we describe the structural specialisation of European regions and their sectoral productivity and growth. In Section 3 we evaluate the sectoral sources of growth. In Section 4 the catching up process is analysed, both at aggregate and sectoral levels. Section 5 examines the role of sectoral specialisation and structural change in determining overall convergence. Section 6 concludes. The date base is described in the Appendix.

2. Sectoral specialisation in the European regions

This section presents our data for the 109 European regions over the period 1980-90.[2] We first analyse output and employment shares for the three main sectors - agriculture, industry and services - and their evolution over time; we also provide a spatial description of the sectoral specialisation across the European regions. Secondly, the labour productivity and its growth at the aggregate and sectoral levels are considered.

Table 1 summarises the data on labour and output shares in 1980 and 1990 for the European Community and for the average of the

[1] The role of structural change in the convergence process has been analysed by Paci and Pigliaru (1997) for the case of the Italian regions. See section 2 of that paper for a survey of the different viewpoints of the literature on structural change and growth. Other recent empirical studies relating sectoral mix and its changes with economic growth are Bernard and Jones (1994, 1996) and Garcia-Mila and Marimon (1998).

[2] See Paci (1997) for a detailed description of the data base. In our data, Industry includes the Manufacturing, Constructions and Mining sectors; Services includes Private services and Public Administration.

northern and southern regions.[3] We have also reported for each sector the lowest and the highest share, in order to highlight the tremendous variation in sectoral specialisation that exists across regions.[4] The agriculture sector shows the largest dispersion: labour shares span from less than 1% (Ile de France which includes Paris) to a maximum of 50% (Kriti in Greece). The European average is decreasing (6.5% in 1990), although the coefficient of variation signals an increase in the differences across regions. As expected, the southern regions are characterised by a much higher agricultural labour shares. They are declining over time, but still in 1990 the average share in the south is almost four times larger than in the north. It is worth remarking that the dispersion in the south is increasing and it means that the structural change process in the southern regions is proceeding with different speeds. A similar pattern, but with lower shares, is detected if we observe the value added data.

The industrial sector represents more than 30% of the entire economy for both labour and output. It also shows remarkable variations; for example, in 1980 the industrial labour shares range from 17% (Ionia Nisia in Greece) to 49% (Baden Wuerttemberg in Germany). The dispersion tends to increase, especially for output shares. Although the northern regions are more specialised in the industrial activities the differences between north and south are diminishing.

Finally, services are the most relevant sector in the economy; its size is still growing and in 1990 it reaches an average of 62% and 63%, respectively in terms of labour and output shares. Interestingly, the dispersion in this sector is the lowest in the economy and it is also decreasing over time. However the differences across regions are still large, ranging from 36% (Dytiki Makedonia in Greece) to 75% (West Nederland) in terms of employment shares.

Looking at the coefficients of variation, we can see that the dispersion in the sectoral composition of the economy is considerably larger in the south, except for agriculture where regional disparities within the northern regions are bigger. Agriculture shows in all areas a cross-regional dispersion that is enormously higher than in the rest of the economy.

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[3] The southern regions group includes Greece, Spain, Portugal and the 8 Mezzogiorno's regions in Italy.

[4] The ranking does not include Brussels, because of its complete specialisation in the services sector.

Although the period considered is limited, it is possible to document a clear process of structural change taking place in the European regions. On average, there is a shift away from agriculture and industry toward services in terms of both labour and output shares. This process is stronger among the southern regions, which at the beginning of the period still showed a strong specialisation in agriculture.

Figure 1 shows a spatial representation of the sectoral specialisation across the European regions in 1990, based on the index of comparative advantage of labour shares computed for each region and sector.[5] Each region has been assigned to a specialisation sector if its index for this sector exceeds 1.1.[6] We obtain the following portrait.

1) *High specialisation in agriculture*. All Portuguese and all but one Greek regions, most Spanish and Italian regions; most western regions in France; Ireland.

2) *High specialisation in industry*. A cluster of regions in the north-east of Spain and in the north of Italy, most German Lander, six French northern regions.

3) *High specialisation in services*. In this group are included most of the regions that host the national capital and important city (Ile de France, Lazio, Attiki, Bruxelles, Madrid, South East of UK, Berlin, Hamburg), a group of region with strong tourism sector (Baleares, Canarias, Liguria, Provence, Languedoc) and with autonomous local government (Scotland, Corse).

4) *Homogeneous sectoral distribution*. In this cluster we have regions, all in the north of Europe, that are characterised by a sectoral composition of the economy very similar to the average of the European Union. These regions do not show any specific specialisation pattern.

In summary, the picture of the sectoral specialisation across the European regions in 1990 shows a quite well defined pattern. Agriculture is still prevailing in the south, while industry tends to concentrate in contiguous clusters due to the presence of local strategic complementarities [Krugman (1991)].[7]

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[5] The specialisation index is calculated as: $SPE_{ij} = (L_{ij} / S_j L_{ij}) / (S_i L_{ij} / S_i S_j L_{ij})$, where L are units of labour in region i and sector j. The index is higher than one when the region has a relative specialisation in that sector and it is less than one when it has a disadvantage.

[6] Few regions show a specialisation index higher than 1.1 in two sectors. In such a case the region has been included in the sector that exhibits the highest index.

[7] The potential role of these local industrial cluster is strengthen by the high degree of spatial concentration of the technological activity that prevails across the European regions. See Verspagen (1998) and Paci and Usai (1997).

Let now turn to the analysis of labour productivity. In Table 2 the levels of labour productivity are calculated relatively to the overall productivity of the European average in order to account for sectoral and regional differences. Considering the sectoral averages in 1990, the most productive sector is industry (relative index = 106) closely followed by services (102). Labour productivity in agriculture is less than half of the aggregate level (48).

As regards the differences across regions, our results show a large degree of disparities. For example, considering the whole economy in 1990, the most productive region (Ile de France, relative index = 148)) is four times more efficient than the least productive region (Ipeiros in Greece, 37). In 1990 the gap between north and south is still relevant (the indices are, respectively, 104 and 84) although it shows a tendency to decline. The regional disparities are tremendous in agriculture, where the productivity level of Champagne (France) is fourteen times higher than in Norte (Portugal). On average northern regions display an agriculture productivity level two times higher than the southern regions. The range between the most and least productive regions is also broad in industry, while it is less remarked in the service sector. The pattern of productivity differentials over time shows that the degree of disparities is slightly decreasing at the aggregate level and in the industry and service sectors, while it is considerably increasing in agriculture.

The last columns of Table 2 document the average growth rate of labour productivity over the period 1980-90. The most remarkable result is an enormous variation across sectors and regions. At the aggregate level, the European regions are growing at an average rate of 2.3%, ranging from a -1.1% in Noord Nederland to 7% in Algarve (Portugal). Southern regions exhibit an average growth (2.6%) higher than the northern ones (2.2%). Since they started with a lower productivity levels, it indicates that a process of aggregate catching up is occurring across the European regions.

Agriculture displays the highest rate of productivity growth (2.8%), followed by industry (2.3%) and services (1.9%). As we have already noted, the larger intra-sector difference in growth rates is detected in agriculture, where some regions had highly improved their productivity due to the expulsion of non-efficient labour. For example, the fastest productivity growth in agriculture is showed by the Greek region of Notio Aigaio (22.5% per year) that, over the entire period, has decreased its agriculture labour share by 12 percentage points. On average,

however, the growth rate of agriculture productivity in northern regions (3.7%) is higher than in the south (1.2%). It seems thus while the labour migration out of agriculture has been higher in the southern regions that started with an higher shares, this process has not automatically led to an increase in the productivity. A possible explanation of this outcome is that in many southern regions a dualistic economic structure is still prevailing and the agriculture sector is characterised by surplus labour.

Finally, it is very interesting to remark that in the south the aggregate productivity growth rate is higher than those detected at the sectoral level. This result implies that an important part of the aggregate gains enjoyed by the southern regions comes from a process of structural change across sectors. The important issue of convergence and structural change will be analysed in details in sections 5 and 6.

In conclusion, the results reported in this section highlight the enormous differences in employment and output shares, productivity levels and growth rates across sectors and regions. All these differences appear to be magnified in agriculture.

3. Sectoral sources of aggregate growth

Is there some sort of relationship between sectoral specialisation and growth? What are the sectoral sources of aggregate productivity growth? These are old questions often addressed by the development literature, which has emphasised how the differences across sectors (in terms of technological change, inter-sectoral linkages and spillovers) affect their contribution to the overall growth.

A well known attempt to investigate the relationship between sectoral and aggregate growth is represented by Kaldor's "third law" (KTL). It states that the growth of overall labour productivity is positively correlated with the growth of manufacturing output. Interestingly, such correlation is consistent with various models. In Lewis's model the shift of labour from low- to high-productivity sectors is a key component of the overall growth rate of productivity. Moreover several endogenous growth models generate KTL. For example in Lucas's learning by doing model, the larger the size of manufacturing, the higher the growth rate of overall productivity [Lucas (1988)]. The same result is obtained allowing for the possibility of intersectoral spillovers [Murat and Pigliaru (1998)].

The precise functional form of KTL has been largely discussed in the literature. Kaldor (1975) estimates a regression where the growth rate

of aggregate labour productivity is a function of growth rates of industrial output (with an expected positive sign) and non-industrial employment (negative effect). However McCombie (1981) has shown that there is an underlying identity in this KTL equation and thus it impairs any attempt to interpret it as causal relationships. Therefore to get some hints on the relationship between sectoral output growth and overall productivity growth we have estimated, for a cross-section of our 109 regions, the following specification of KTL:

$$(1) \qquad \dot{y}_i / y_i = a + b\, \dot{Y}_i^A / Y_i^A + c\, \dot{Y}_i^I / Y_i^I + d\, \dot{Y}_i^S / Y_i^S$$

where, for each region i, $\dot{x}$ indicates the annual average growth rates of x between the initial year t and final year $t+T$, Y is value added for the three sectors agriculture (A), industry (I) and services (S) and y is the overall labour productivity defined as $y_i = \Sigma_j Y_{ij} / \Sigma_j L_{ij}$.

The results are reported in Table 3. Our findings give support to KTL: in regr. 1 the growth of industrial output is indeed positively correlated to the growth of labour productivity in the entire economy. However, the services sector also shows a positive impact and its influence appears to be even larger. On the other hand, agriculture output growth does not show any significant effect on aggregate labour productivity. The explanatory power of the regression is quite good for a cross-section estimate, output growth in the three sectors explains 33% of aggregate productivity changes. The regression exhibits serial correlation of residuals. In regional studies this is often a signal for the presence of spatial correlations, since regional observations are usually grouped by state. In other words, the regional growth process of the European regions seems to have followed a pattern characterised by idiosyncratic national elements. To take into account these country-specific omitted variables, we have simply included some national dummies in our equation (see regr. 2).[8] The coefficients for industry and services output growth do not change, while the coefficient of agriculture becomes positive, although it still remains not significant. The explanatory power of the regression is now very high (R^2 adj = 0.71) and the serial correlation has disappeared.

Our analysis has shown that industrial output growth induces positive effect on overall productivity growth. However it must be

[8] A recent analysis of the effects of spatial elements on Kaldor's laws is presented by Bernat (1996) for the states of the United States.

remarked that, in the modern economies, an increasingly important role is played by the services sector and specifically by its advanced activities like finance, communications, software and banking. Moreover, as we have already pointed out, there are several shortcomings in the use of KTL as a behavioural equation. Therefore to assess the effect of sectoral specialisation on aggregate growth it may be more appropriate to use accurate accounting approaches.

Several methods to estimate the sectoral sources of overall growth has been proposed in the literature [McCombie (1980), Paci and Pigliaru (1997), Bernard and Jones (1996)]. Here, following the latter authors, we decompose the growth rate of aggregate labour productivity in each region into within- and between-sector components as follows:

$$(2) \qquad \hat{y}_i = \underbrace{\sum_j \hat{y}_{ij} \left(\frac{y_{ijt}}{y_{it}} \right) \overline{w}_{ij}}_{Within\ \ Sector\ \ Effect\ \ (WSE)} + \underbrace{\sum_j (w_{ij,\,t+T} - w_{ijt}) \left(\frac{\overline{y}_{ij}}{y_{it}} \right)}_{Structural\ \ Change\ \ Effect\ \ (SCE)}$$

where, for each region *i*, the labour shares, $w_{jt} = L_j \Big/ \sum_j L_j$, $\bar{x}$ represents the average value of *x* over the period and the annual average growth rate are expressed in percentage values.

The first component represents the contribution of within-sector labour productivity growth and it is computed using the average employment shares over the period as weights. The second term captures the effect of structural change in each sector on total productivity growth and this effect turns to be negative in sectors with declining labour shares.

Table 4 reports the sources of productivity growth for the average European case and for some specific group of regions. The most relevant sectoral source of the average annual growth rate of labour productivity is the service sector that shows a positive growth effect (52% of total change in aggregate productivity) together with a strong positive structural change effect (40%). As we have stressed before, services labour shares have remarkably increased in Europe over the 1980s. In total, the services sector accounts for 92% of aggregate productivity growth. A total positive effect is also shown by industry (10%). This weak effect is the net result of two opposite processes: the positive within-sector productivity growth (36%) is partially offset by the negative share effect (-26%). A similar pattern is shown by agriculture:

the positive growth effect (5%) is accompanied by a negative and stronger structural change effect (-7%) that gives rise to a total negative result on aggregate productivity growth.

An important issue to be addressed is whether these results for the European average are similar across different areas. Indeed, as we have stressed in the previous section, the sectoral specialisation changes dramatically across regions and thus we expect some degree of variation. In Table 4 we have decomposed the sources of aggregate growth for the northern and southern European regions. The most relevant difference is that in the south the positive effect of structural change is much higher and it accounts for 23% of the overall growth. At the sectoral level it is worth noticing the higher negative impact of agriculture in the south (-8%) due to a wider decrease in the labour shares. Moreover the industrial sector in the southern regions represents a more important source of growth (15% compare to 9% in the north). Interestingly, this effect is the combined results of the two following contrasting elements. First, in the north the within-sector productivity growth is much higher than in the South (39% vs. 26%) probably due to the advantage of local agglomeration economies. Second, in the northern regions the growth gains are in large part offset by the huge decline of their industry shares; the negative growth impact of structural change is indeed -30% in the north and only -11% in the south.

In this section we have accounted for the sources of overall growth at the sectoral level, breaking the effects of intra-sectors productivity growth and structural change. We have also documented how this growth account varies considerably across different groups of regions.

4. Aggregate and sectoral catching up

Let now turn to the analysis of the convergence process across the regions of the European Union. In this section we test a simple catching up model where, for each region, the labour productivity growth gap is a function of the productivity difference in the initial year. The gap is calculated as the distance between each region and the average for the whole European Union. We have chosen this procedure due to the absence of a clear and constant leader region over the entire period considered. Moreover using the European average, the catching up process is not affected by specific shocks that may have hit the leader region over the period. We have thus estimated the following regression:

(3) $$y_i/y_i - y_E/y_E = a + b\left[\log(y_{it}) - \log(y_{Et})\right]$$

where the subscript *E* indicates the European average.[9]

A negative and significant coefficient for the initial productivity differential would signal that regions with a higher gap at the beginning of the period have grown faster, so that they have caught up the richer regions. This equation, however, does not allow to assess what is the economic mechanism supporting the convergence process. This functional form is indeed compatible with both the diminishing return to capital effect of the neoclassical growth model and with a technological diffusion model [Sala-i-Martin (1996a)]. Moreover the aggregate convergence equation does not allow to consider explicitly the role of the structural change process in generating convergence. This last issue will be directly addressed in section 5 below.

The results of the convergence equation at the aggregate are reported in Table 5. Our findings show that a process of a catching up has taken place across the European regions over the 1980s.[10] However the initial productivity gap explains only a small fraction of the growth process (R^2 adj. = 0.13) and the speed of convergence in not very fast (1.2% per year). In regr. 2 we have included a dummy for the southern regions to control for differences across regions that are not fully explained by the initial productivity gap. However this hypothesis is not confirmed by the data and the dummy south is not significant. The existence of country-specific factors is tested in regr. 3 where a set of national dummies has been included. The explanatory power of the conditional convergence equation is much higher (0.64) meaning that the national dummies are capturing crucial country-specific elements, omitted in the absolute convergence model, which affect the regional growth process. The coefficient of the initial productivity gap is still negative and significant and the speed of convergence has now increased to 1.98%. In the remaining two regression we have split our sample in two groups, northern and southern regions, to assess whether there are differences in the catching up process. Interestingly, the observed overall convergence comes mainly from the northern regions that show a strong and significant catching up process (the convergence speed in this group

[9] The annual average growth rates are now computed as log differences between final and initial years, divided by the number of years.

[10] The process of convergence across the European regions has been analysed by Barro and Sala-i-Martin (1991), Neven and Gouyette (1995), Fagerberg and Verspagen (1996), Quah (1996) and Sala-i-Martin (1996b). Most of these studies are based on per capita income growth. For a critique to the use of this variable in the convergence studies see Paci (1997) which shows how the convergence results are highly affected by the choice of the dependent variable.

is 3.42%). On the other hand, the productivity growth in the southern regions seems not affected by the initial magnitude of the gap.

As regards the convergence process at the sectoral level (Table 6), in agriculture there is no evidence of absolute convergence; however the coefficient of the initial productivity gap becomes significant in the estimates with the south and national dummies and for the sub-samples of northern regions. The industrial and services sectors display a similar behaviour: there is absolute catching up across the European regions together with the presence of local convergence clubs. Moreover in these sectors, the catching up process appears to be mainly driven by the northern regions. Finally, it is worth remarking the high speed of convergence that has occurred among the northern regions in the industrial sector (5.45%).

Summing up, the aggregate catching up process comes mainly from the industrial and services sectors and from the northern European regions, while in the agriculture and in the southern regions there is not a clear tendency to converge to the European average.

5. The sources of convergence

Using the accounting framework of eq. 2, it is interesting to calculate the contribution of each sector to overall convergence. More precisely, following again Bernard and Jones (1996), the growth gap of each region relative to the European average is decomposed into within-sector productivity growth and structural change effects as follows:

(4) $$\frac{y_i}{y_i} - \frac{y_E}{y_E} = \underbrace{\sum_j \left[WSE_{ij} - WSE_{Ej}\right]}_{Within\ \ Sector\ \ Effect} + \underbrace{\sum_j \left[SCE_{ij} - SCE_{Ej}\right]}_{Structural\ \ Change\ \ Effect}$$

The average results for the whole sample of 109 regions are reported in Table 7. The most interesting outcome is that the structural change effect now dominates over the within-sector growth. The catching up process, although quite small in absolute term, is mainly induced by a mechanism of shifting employment across sectors. More specifically there is a migration from low to high productivity sectors that in the initially less efficient regions is relatively faster than in the high efficient regions. Consequently the total effect of structural change on aggregate convergence appears to be very important.

As regards the sectoral contribution, the services sector play the most relevant role, as we have already remarked in the productivity growth accounts. Almost 4/5 of the total convergence comes from the

positive structural change effect of services. Also the industrial sector shows a strong positive structural change effect, while the contrary happens for agriculture. These results mean that the initially less productive regions shift out of agriculture into manufacturing and services more rapidly than the average. Agriculture is the only sector that shows a positive within-sector growth effect on the catching up process (74%), signalling that poorer regions have enjoyed higher growth rate of productivity in this sector. Interestingly, the contribution of productivity growth in industry is large and negative (-46%). This negative within-sector effect represents the fact that high efficient regions had relatively higher growth in this sector and therefore it has implied a negative contribution to convergence.[11] However, as we have already pointed out, the net effect of industry is positive, due to a huge employment migration into this high productive sector in the poorer regions.

The total net effect of each sector on convergence turns out to be positive in the industrial and services sectors while it appears negative for agriculture. This outcome is compatible with the sectoral estimates of the catching up equation presented before, where we found a convergence process occurring in industry and services but not in agriculture.

In short, the presence in the southern regions of a still large agriculture sector seems to be the key element in the analysis of regional growth in Europe. To document more accurately this point, let consider that in our initial year 1980 the correlation between the labour share in agriculture and the productivity level of the entire economy was negative and highly significant (r=-0.79). In Figure 2 we can see that regions (mainly in southern Europe) with an initial high specialisation in the primary sector were on average less productive. Moreover it should be noted that the initial agriculture labour share exhibits high negative correlation coefficients with all the sectoral productivity levels.

However this initial "bad" specialisation may gives room for improvements in the future period. We have already pointed out in section 2 that regions with initial higher agriculture shares are more likely to shift out from the primary sector in the subsequent period and this structural change process may induce a higher growth rate. Indeed over the period 1980-90 there is a negative relationship (r=-0.27)

[11] Again this result highlights the presence of esternalities, spillovers and agglomeration economies that benefit the northern regions characterised by a initial stronger industrial sector.

between the variation in the agriculture labour shares and the aggregate growth rate of the economy (see Figure 3).[12] Regions that show a higher migration away of agriculture tend to grow faster than the others.

Nonetheless, it clearly appears from our data that this is by far a mechanical process. In fact the correlation is not very strong and moreover it presents a large variation in the growth rates among the regions with higher agriculture decline. In other words, not all the southern regions have succeed in transforming their migration process out of agriculture in aggregate productivity gains. Where are these differences coming from is an important issue to be addressed with more details in the future research.

6. Conclusions

The European regions are still characterised by large differences in terms of sectoral specialisation, productivity levels and growth and these differences appear to play a crucial role in determining the overall growth rate of the regional economies. The key distinction seems between agriculture on one side and industry and services on the other. More specifically agriculture displays an average level of labour productivity less than half of the aggregate one; moreover the degree of regional disparities in this sector are enormous. This features explains the low aggregate productivity of several southern regions that are still characterised by the presence of large labour shares in agriculture. Indeed one of the main finding of the paper is the remark that several European regions in the south are still characterised by a dualistic economic structure that strongly affects their productivity level and growth.

In order to analyse how aggregate growth is influenced by sectoral mix, we have used two approaches: an econometric estimate of a modified version of Kaldor's third law and an accounting decomposition of the overall growth rate. Our results show that the major role in determining aggregate growth is played by the increase in the productivity within the services sector. This result is stronger among the more developed northern regions, while in the south a relevant contribution to overall growth also comes from the process of shifting employment.

[12] In Figure 3, the Greek region of Voreio Aigaio (G11) has been omitted because with a -24 percentage points of agriculture share reduction it results out of scale in the graph.

Other important issues analysed in the paper are the existence of a catching up mechanism and the sectoral sources of this process. We have documented a slow absolute convergence across the European regions. The catching up is reinforced once we control for national idiosyncratic elements; moreover it appears stronger among the northern regions while the south tends to converge to a locally lower steady state. At the sectoral level there is unconditional catching up in industry and services, but not in agriculture.

Finally, the accounting decomposition of the catching up has stressed that indeed large part of convergence is induced by a structural change process of shifting employment across sectors. More precisely there is a sectoral shift from the low to high productive sectors that is relatively faster in the initially less efficient regions of the south. However we have shown that not all the initially backward regions have been capable to initiate such a virtuous process of structural change and growth. Some initially agricultural regions have managed to transform rapidly to the advantage of productivity in agriculture and, more generally, in the entire economy, but other have not.

The key question to be addresses in the future research is therefore what lies behind such a highly differentiated pattern. Moreover more work has to be done to assess whether, and under which conditions, further convergence-enhancing structural change is likely to take place. A second important line of research refers to the appraisal of the economic impact of national and European sectoral policies, as well as to the role of spatial elements in the determination of patterns of localisation of the non agricultural sector. In general, the existence of a correlation between sectoral specialisation and growth, that we have clearly documented in this paper, points to the possibility that the pattern of specialisation, induced by the increasing integration in the European Union, will be a crucial determinant of the future evolution of productivity growth rates across the European regions.

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Appendix

In this paper we have used the data-base *Regio-Eu* set up by CRENoS [see Paci (1996)]. The 109 territorial units are:

B	**BELGIUM**
B1	BRUXELLES
B2	VLAAMS GEWEST
B3	REGION WALLONNE
D	**GERMANY**
D1	BADEN-WUERTTEMBERG
D2	BAYERN
D3	BERLIN
D4	BREMEN
D5	HAMBURG
D6	HESSEN
D7	NIEDERSACHSEN
D8	NORDRHEIN-WESTFALEN
D9	RHEINLAND-PFALZ
D10	SAARLAND
D11	SCHLESWIG-HOLSTEIN
DK	**DENMARK**
E	**SPAIN**
E1	GALICIA
E2	ASTURIAS
E3	CANTABRIA
E4	PAIS VASCO
E5	NAVARRA
E6	RIOJA
E7	ARAGON
G	**GREECE**
G1	ANATOLIKI MAKEDONIA,THRAKI
G2	KENTRIKI MAKEDONIA
G3	DYTIKI MAKEDONIA
G4	THESSALIA
G5	IPEIROS
G6	IONIA NISIA
G7	DYTIKI ELLADA
G8	STEREA ELLADA
G9	PELOPONNISOS
G10	ATTIKI
G11	VOREIO AIGAIO
G12	NOTIO AIGAIO
G13	KRITI
IR	**IRELAND**
I	**ITALY**
I1	PIEMONTE
I2	VALLE D'AOSTA
I3	LIGURIA
I4	LOMBARDIA
I5	TRENTINO-ALTO ADIGE
I6	VENETO
I7	FRIULI-VENEZIA GIULIA
I8	EMILIA-ROMAGNA
I9	TOSCANA
I10	UMBRIA

E8	MADRID
E9	CASTILLA-LEON
E10	CASTILLA-LA MANCHA
E11	EXTREMADURA
E12	CATALUNA
E13	COMUNIDAD VALENCIANA
E14	BALEARES
E15	ANDALUCIA
E16	MURCIA
E17	CANARIAS

I11	MARCHE
I12	LAZIO
I13	CAMPANIA
I14	ABRUZZI
I15	MOLISE
I16	PUGLIA
I17	BASILICATA
I18	CALABRIA
I19	SICILIA
I20	SARDEGNA

F	**FRANCE**
F1	ILE DE FRANCE
F2	CHAMPAGNE-ARDENNE
F3	PICARDIE
F4	HAUTE-NORMANDIE
F5	CENTRE
F6	BASSE-NORMANDIE
F7	BOURGOGNE
F8	NORD-PAS-DE-CALAIS
F9	LORRAINE
F10	ALSACE
F11	FRANCHE-COMTE
F12	PAYS DE LA LOIRE
F13	BRETAGNE
F14	POITOU-CHARENTES
F15	AQUITAINE
F16	MIDI-PYRENEES
F17	LIMOUSIN
F18	RHONE-ALPES
F19	AUVERGNE

LU	**LUXEMBURG**
N	**NETHERLANDS**
N1	NOORD-NEDERLAND
N2	OOST-NEDERLAND
N3	WEST-NEDERLAND
N4	ZUID-NEDERLAND
P	**PORTUGAL**
P1	NORTE
P2	CENTRO
P3	LISBOA E VALE DO TEJO
P4	ALENTEJO
P5	ALGARVE
U	**UNITED KINGDOM**
U1	NORTH
U2	YORKSHIRE AND HUMBERSIDE
U3	EAST MIDLANDS
U4	EAST ANGLIA

F20	LANGUEDOC-ROUSSILLON	U5	SOUTH EAST
F21	PROVENCE- ALPES COTE D'AZUR	U6	SOUTH WEST
F22	CORSE	U7	WEST MIDLANDS
		U8	NORTH WEST
		U9	WALES
		U10	SCOTLAND
		U11	NORTHERN IRELAND

The data base covers the period 1980-90 for the whole group of 109 regions. All monetary variables are expressed in purchasing parity power (PPP) terms and at constant 1985 prices.
The data sources are Eurostat's *Regio*, several statistical yearbooks and various National Statistical Offices.

Table 1. Labour and output shares in the European regions (percentage values**)**

	Labour shares				Output shares			
	1980		1990		1980		1990	
	value	coeff var	value	coeff var	value	coeff var	value	coeff var
				Agriculture				
Min	0.8		0.4		0.6		0.2	
Max	50.9		48.3		36.3		31.2	
European average	9.4	150	6.5	181	4.3	203	3.1	221
Northern regions	6.1	86	4.3	83	3.3	86	2.6	96
Southern regions	22.2	63	15.2	90	9.6	108	5.9	153
				Industry				
Min	16.9		18.5		22.9		15.9	
Max	48.9		44.6		55.0		45.3	
European average	36.4	23	31.3	23	38.5	21	33.3	23
Northern regions	37.3	18	32.0	20	39.2	17	33.7	18
Southern regions	31.2	27	28.8	28	35.3	26	31.0	29
				Services				
Min	25.1		36.2		26.7		34.7	
Max	69.5		75.4		73.0		79.1	
European average	54.2	20	62.1	17	57.1	16	63.6	14
Northern regions	56.2	13	63.7	11	57.5	12	63.7	10
Southern regions	46.5	22	56.0	20	55.1	20	63.1	18

Table 2. Productivity levels and growth in the European regions

	Index				Growth	
	Europe total = 100				% annual average	
	1980		1990		1980-90	
	value	coeff var	value	coeff var	value	coeff var
			Agriculture			
Min	14		12		-4.8	
Max	132		172		22.5	
European average	46	51	48	56	2.8	148
Northern regions	56	41	63	41	3.7	95
Southern regions	35	44	32	57	1.2	397
			Industry			
Min	51		33		-2.1	
Max	143		160		10.7	
European average	106	25	106	23	2.3	83
Northern regions	109	19	110	15	2.4	63
Southern regions	92	29	90	27	2.0	120
			Services			
Min	53		40		-2.1	
Max	131		145		5.4	
European average	105	23	102	22	1.9	64
Northern regions	107	17	104	16	1.9	61
Southern regions	96	27	94	26	2.0	66
			Total			
Min	38		37		-1.1	
Max	134		148		7.0	
European average	100	25	100	24	2.3	50
Northern regions	105	16	104	14	2.2	45
Southern regions	81	30	84	30	2.6	50

Table 3. Econometric estimates of sectoral sources of overall productivity growth.
dependent variable: growth rate of aggregate labor productivity, annual average 1980-90
explanatory variables: sectoral growth rate of output, annual average 1980-90

	Regr. 1	**Regr. 2** with national dummies
Constant	0.002	0.007
	(0.54)	(2.48)[b]
Agriculture	-0.003	0.032
	(-0.11)	(1.31)
Industry	0.101	0.106
	(2.00)[b]	(2.53)[a]
Services	0.489	0.423
	(6.22)[a]	(6.14)[a]
R^2 adj	0.33	0.71
F	18.7 [a]	25.3 [a]

Notes:
Estimation method: OLS; t-statistic in parentheses; 109 observations;
significance levels: a = 1%, b = 5%.

Table 4. Sources of productivity growth in the European regions, 1980-90.

	Within sector		Structural change		Total effect	
	value	%	value	%	value	%
			Europe			
Agriculture	0.10	5	-0.15	-7	-0.05	-2
Industry	0.82	36	-0.60	-26	0.23	10
Services	1.19	52	0.91	40	2.10	92
Total	2.11	93	0.17	7	2.28	100
			Northern regions			
Agriculture	0.10	5	-0.12	-5	-0.01	-1
Industry	0.87	39	-0.66	-30	0.20	9
Services	1.19	53	0.85	38	2.03	91
Total	2.16	97	0.07	3	2.22	100
			Southern regions			
Agriculture	0.10	4	-0.32	-12	-0.22	-8
Industry	0.69	26	-0.30	-11	0.39	15
Services	1.23	47	1.23	47	2.46	94
Total	2.01	77	0.61	23	2.62	100

Table 5. Aggregate productivity catching up across European regions.

Dependent variable: gap of labour productivity, annual average growth rate 1980-90.

	Regr. 1	**Regr.2** with dummy South	**Regr. 3** ** with national dummies	**Regr. 4** 66 Northern regions	**Regr. 5** 43 Southern regions
Constant *	-0.65	-0.42	0.72	0.00	0.94
	(-0.73)	(-0.39)	(0.99)	(0.09)	(0.65)
Productivity gap 1980	-0.011	-0.011	-0.018	-0.029	-0.005
	(-4.20) [a]	(-3.60) [a]	(-5.55) [a]	(-5.30) [a]	(-1.36)
Dummy South *		-0.84			
		(-0.40)			
R^2 adj	0.13	0.13	0.64	0.32	0.02
F test	17.6 [a]	8.81 [a]	33.7 [a]	31.3 [a]	1.77
White Heter. F-test	2.95	2.06	2.40 [b]	3.78 [b]	3.97 [b]

Notes:
OLS; whole sample: 109 regions; t-statistics in parentheses; significance levels: a = 1%, b = 5%.
* coefficients x 1000
** Regr. 3 includes only significant national dummies: F (+), E (+), N (-), I (-), G (-).
When the White F-test is significant at 1% or 5% the reported t-statistics are corrected for eteroskedasticity.

Table 6. Sectoral productivity catching up across European regions.

Dependent variable: gap of labour productivity, annual average growth rate 1980-90.

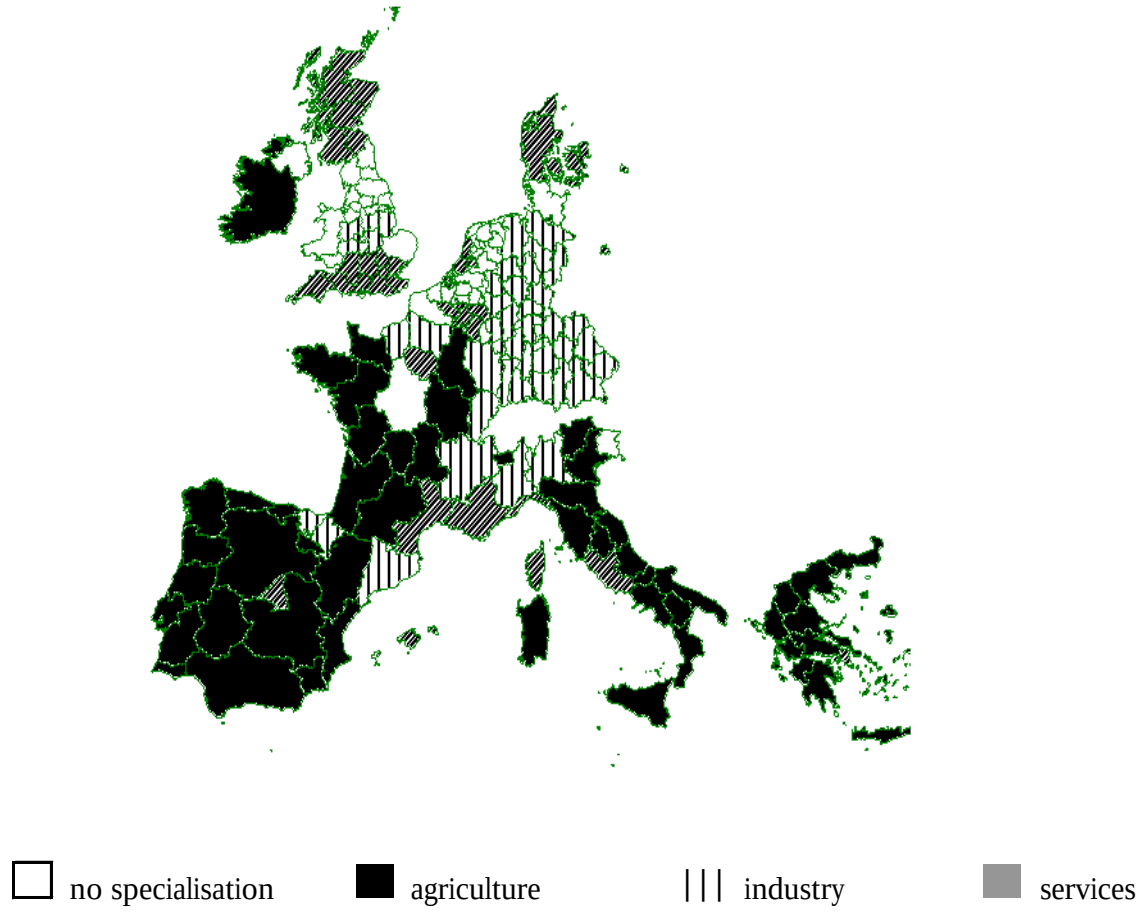
	Regr. 1	**Regr.2** with dummy South	**Regr. 3** ** with national dummies	**Regr. 4** 66 Northern regions	**Regr. 5** 43 Southern regions
Agriculture					
Constant *	1.78	10.6	22.8	11.5	-9.76
	(0.61)	(2.75) [a]	(5.39) [a]	(3.14) [a]	(-1.47)
Productivity gap 1980	-0.006	-0.019	-0.025	-0.023	-0.013
	(-0.99)	(-2.64) [a]	(-3.81) [a]	(-2.10) [b]	(-0.97)
Dummy South *		-22.1			
		(-3.24) [a]			
R^2 adj	0.00	0.082	0.30	0.10	0.00
F test	0.98	5.91 [a]	8.82 [a]	8.35 [a]	0.95
White Heter. F-test	1.09	1.78	1.32	7.66 [a]	0.77
Industry					
Constant *	-2.94	0.31	10.5	1.06	-7.40
	(-2.70) [a]	(0.25)	(5.85) [a]	(0.93)	(-3.48) [a]
Productivity gap 1980	-0.016	-0.024	-0.021	-0.042	-0.016
	(-2.19) [b]	(-3.94) [a]	(-3.25) [a]	(-6.95) [a]	(-1.54)
Dummy South *		-9.87			
		(-3.21) [a]			
R^2 adj	0.09	0.16	0.45	0.42	0.06
F test	11.9 [a]	11.7 [a]	13.6 [a]	48.2 [a]	3.79
White Heter. F-test	21.9 [a]	14.4 [a]	2.62 [a]	0.59	7.75 [a]
Services					
Constant *	-0.81	-0.23	-2.28	-0.25	-0.47
	(-0.78)	(-0.19)	(-3.53) [b]	(-0.20)	(-0.34)
Productivity gap 1980	-0.011	-0.013	-0.018	-0.025	-0.007
	(-3.39) [a]	(-2.90) [a]	(-2.66) [a]	(-4.00) [a]	(-1.10)
Dummy South *		-1.81			
		(-1.12)			
R^2 adj	0.08	0.073	0.52	0.18	0.01
F test	9.94 [a]	5.27 [a]	24.5 [a]	15.3 [a]	1.56
White Heter. F-test	4.48 [b]	3.00 [b]	10.1 [a]	3.00 [b]	4.98 [a]

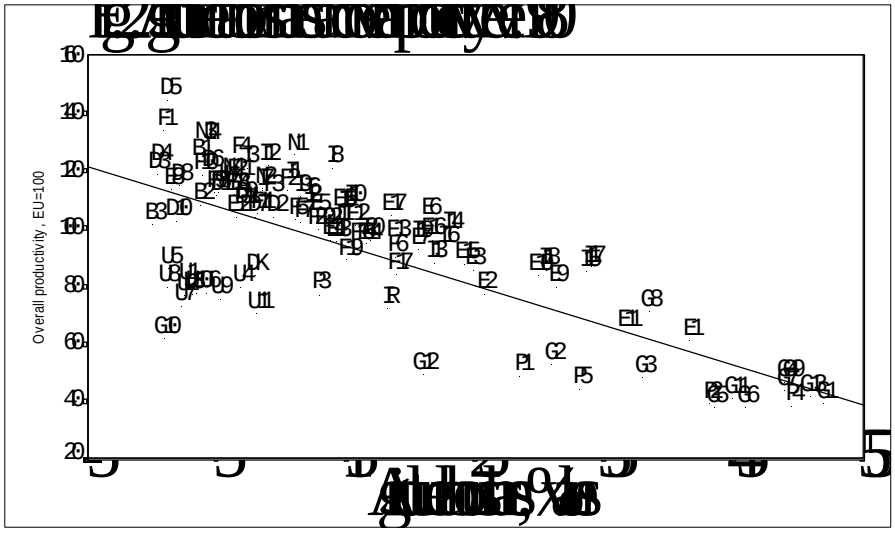
Notes:
OLS; whole sample: 109 regions; t-statistics in parentheses; significance levels: a = 1%, b = 5%.
* coefficients x 1000
** Regr. 3 includes only significant national dummies;agriculture: D (-), E (-), I (-), P (-), G (-);
industry: D (-), F (-), N (-), E (-), I (-),G (-); services: F (-), N (-).
When the White F-test is significant at 1% or 5% the reported t-statistics are corrected for eteroskedasticity.

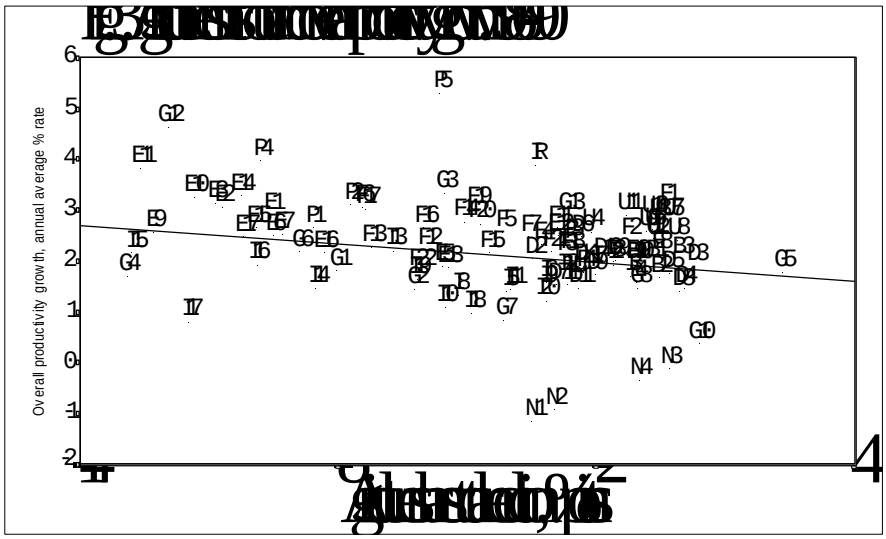
Table 7. Source of convergence in European regions, 1980-90.

	Within sector		Structural change		Total effect	
	value	%	value	%	value	%
Agriculture	0.11	74	-0.12	-82	-0.01	-8
Industry	-0.07	-46	0.12	79	0.05	32
Services	-0.01	-4	0.12	79	0.11	75
Total	0.04	24	0.12	76	0.15	100

Figure 1. Sectoral specialisation across European regions. 1990




Overall productivity, EU=100


Overall productivity growth, annual average % rate