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IS DUALISM STILL A SOURCE OF CONVERGENCE IN EUROPE?

Abstract: This paper aims at assessing whether dualistic mechanisms represent a significant component of the aggregate labour productivity convergence observed across the European regions in the 1980s. The potential of an explanation of convergence based – in part, at least – on the existence of dualism in some of the initially poorer regions has been largely ignored by the literature. We use a dualistic model based on Dixit (1970) and on Mas-Colell and Razin (1973) to obtain hypotheses to be tested in cross-region growth regressions. In particular, we wish to test whether a high initial allocation of labour in agriculture in fact generates -- in each sector as well as at the aggregate level -- the specific impact on productivity growth (and therefore on convergence) implied by the theory of the dual economy. We use the data-base *Regio-Eu* set up by CRENoS, with aggregate and sectoral data for 109 territorial units from 1980 to 1990. Our cross-section results are consistent with the major predictions of the dualistic model. While part of the influence exerted by dualistic mechanisms is not easily distinguishable from the one exerted by other mechanisms such as technology diffusion, still the former appears to be a significant component of the whole process of convergence. Ignoring such component could lead to misleading interpretations of the relative roles played by each of the forces behind the process, and to inexact assessments of what actions should be taken – if any – by the European regional policy to help the process become more pervasive.

Keywords: Dualism, Growth, Convergence, Regions, Europe
JEL: O40, O41, O52, R11

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This version: November 1997

1. Introduction

While the data on the dynamics of aggregate per capita income across European regions show that convergence is weak or absent during the 1980s – in contrast to what happened in the 1960s and in the 1970s –, similar data on labour productivity for the same decade are instead characterised by a slow but significant process of convergence [Barro and Sala-i-Martin (1991), Neven and Guyette (1995), Fagerberg and Verspagen (1996), Quah (1996), Paci (1997)].

In general, an ample variety of theoretical approaches has been used to account for aggregate convergence, ranging from the one-sector neoclassical transitional dynamics to models based on the existence of some form of increasing returns (economies of agglomeration, for instance) and on technology diffusion [see Barro and Sala-i-Martin (1995), De la Fuente (1995), Quah (1996), Fagerberg (1995), Krugman (1991) for a wide sample of different viewpoints on the problem].

Taking a different route, this paper tries to assess whether dualistic mechanisms may represent a significant component of the process of aggregate productivity convergence across European regions. The potential of an explanation based -- in part, at least -- on the existence of dualism in some of the initially poorer regions has been largely ignored by the literature. We find this state of the affairs a rather unsatisfactory one, since even a superficial glance at the European regional data would reveal that a significant part of the lagging regions are still characterised by very large labour shares allocated to the primary sector. Of course, this feature by itself is not direct evidence that dualistic mechanisms are at work and that they exert a strong impact on overall convergence -- high labour shares in agriculture might be the efficient outcome of comparative advantage in a highly integrated market. However, that feature makes the question of *whether* dualism is relevant worth investigating in some details – not least because detecting the existence of dualistic mechanisms could be important to design more effective convergence-enhancing regional policies.

As we have already observed, the recent empirical literature on regional growth has largely ignored the problem of dualism[1]. Only few studies have dealt with the related issue of how the economies' sectoral mix and its changes interact with aggregate convergence. Limiting our analysis to works dealing with the European regions, it is worth recalling the initial contribution by Barro and Sala-i-Martin (1991), which use an index of sectoral mix in several of their regressions, with the explicit aim to control for asymmetric shocks across economies. Fagerberg and Verspagen (1996) add the share of agriculture in employment to cross-region regressions on European regional data, but their

[1] For a less recent attempt to use a dualistic model to explain growth rates differentials across European countries in the fifties and in the early sixties, see Kindleberger (1967). Kaldor (1967) is a well-known interpretation of UK growth performance based on some dualistic features of a modern economy.

hypothesis is that it "act[s] as a growth retardant" (p. 438) -- i.e. the opposite of what would be expected if dualism were behind aggregate convergence. Paci and Pigliaru (1998) have shown that most of the catching up occurred among the European regions over the 1980s is due to a reallocation of labour from low to high productivity sectors faster in the initially poorer regions. At the single country level, Garcia-Mila and Marimon (1995) analyse the policy-induced sectoral changes across Spanish regions. Paci and Pigliaru (1997) points out how the observed productivity convergence across the Italian regions is indeed generated by a strong process of structural change. A number of other papers focuses on the differences in the patterns of convergence across sectors to explain the aggregate process, but again they do not test the hypothesis that dualism is part of it [for instance, Bernard and Jones (1997)].

There exist several ways to assess whether dualism is an important component of overall convergence. An indirect one is the following. First, evaluate how much of the aggregate convergence is due to changes in sectoral weights [simple methods have been proposed, among many others, by Bernard and Jones (1996) and by Paci and Pigliaru (1997)]. Second, assess whether the observed structural change is consistent with the pattern predicted by the dualistic model.

In this paper, we take a different, more direct route. We use a model of the dual economy [Dixit (1970) and on Mas-Colell and Razin (1973)] to obtain testable hypotheses about the impact of a high initial allocation of labour in agriculture on productivity growth (and therefore on convergence) in each sector as well as at the aggregate level. These hypotheses will be tested by means of cross-region growth regressions similar to those largely used in the empirical literature on convergence.

The paper is organised as follows. Section 2 gives some descriptive statistics about the dispersion of sectoral labour shares across regions of Europe. Section 3 discusses the main features of a dualistic economy and describes the implications for cross-region regressions. Section 4 presents the econometric evidence. Conclusions are in Section 5.

2. Sectoral specialisation in the European regions

During the 1980s the European regions were still characterised by remarkable differences in terms of sectoral mix and productivity levels, especially in agriculture. To show this point, we use data on employment shares and on sectoral labour productivity levels (agriculture, industry and services) for 109 European regions during the period 1980-90[2] (see Table 1). For each sector

2 See Paci (1997) for a detailed description of the data base. The data cover the 12 countries members of the European Community over the 1980s. In our data, Industry includes the Manufacturing, Constructions and Mining sectors; Services includes Private services and Public

we report the average values for the European Union and for the northern and southern regions, together with the lowest and highest regional values, in order to highlight the perhaps surprisingly high variation that exists across regions.

The agriculture sector shows the largest dispersion: labour shares span from less than 1% (Ile de France) to a maximum of 50% (Kriti in Greece). Comparing the coefficients of variation of all sectors, agriculture emerges as the sector characterised by a cross-regional dispersion enormously higher than in the rest of the economy, in all geographical areas.

As expected, the southern regions are characterised by agricultural shares much higher than average. This point is shown in details in Figure 1, where the data refer to 1980. We have set up four groups, two above and two below the average European share (9.4%). It is worth noticing that all 33 regions in the group characterised by very high agriculture shares (more than 20% of total employment) belong to south Europe. More precisely, there are all but one Portuguese, Greek and southern Italian regions and 10 out of 17 Spanish regions. Moreover in the two below-average groups we find all German, British, Belgian and 3 over 4 Netherlands regions. This representation is thus rather clear cutting. There is an evident north-south differentiation, with the southern European regions still characterised by very high proportions of the labour force employed in the primary sector. It is also worth remarking that in 1990 the average agricultural share in the north was still almost four times larger than in the south. Moreover, the dispersion in the south is increasing -- i.e., structural change in the southern regions is proceeding at different speeds.

Let now turn to sectoral labour productivity. In Table 1 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 the initial year, the highest labour productivity is in industry (relative index = 106), closely followed by services (105). Labour productivity in agriculture is less than half of the aggregate level (46).

As regards the differences across regions, our data show a large degree of disparities. In 1980 the gap between north and south was large (the indices are, respectively, 105 and 81) although it shows a slow tendency to decline. Again, regional disparities are tremendous in agriculture, where the labour productivity of Champagne (France) is fourteen times higher than the one recorded in Norte (Portugal). On average northern regions display an agriculture productivity level two times higher than the southern regions.

An interesting regularity lies behind this high cross-region disparity in agricultural productivity levels -- indeed, the latter are strongly negatively correlated to agricultural labour shares. In 1980 such correlation was equal to -

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Administration. Moreover, the southern regions group includes Greece, Spain, Portugal and the 8 Mezzogiorno's regions in Italy.

0.66. This a feature which is specific of agriculture, since the same correlation turns out to be was positive and weaker for industry and services (0.32 and 0.52 respectively).[3]

To sum up, southern regions are characterised by much higher agricultural labour shares; on average, agriculture is characterised by a relatively low level of labour productivity (the more so in the south); there exists a high dispersion in values of agricultural productivity across regions, and those values are strongly negatively correlated with the initial labour share of this sector. To this evidence we should add that intersectoral migration of labour follows the pattern expected in the presence of dualism, with workers moving from agriculture to the other sectors, and with the rates of migration proportional to the level of the initial share. On average, an initial higher agricultural share implies a faster out-migration from that sector (On this important point a more detailed analysis is postponed to section 4.)

All in all, the evidence discussed in this section suggests that dualistic mechanisms might be at work and might exert some influence on the process of aggregate convergence.

3. Structural change and growth in the dual economy

To assess the role of dualism in cross-region growth regressions, both at the sectoral and at the aggregate level, we will identify testable hypotheses about several relationships which characterise the dual economy in its transitional dynamics – namely, the relationship between an index of sectoral labour share and productivity growth in the agricultural and in the non-agricultural sectors; and between the same index and the growth of per capita non agricultural output and of overall productivity.

To this aim, we use a neoclassical model of the dual economy based on Dixit (1970) and Mas Colell and Razin (1973). This model adopts a definition of dualism that minimises the departure from the main assumptions of the neoclassical two-sector growth model and, more generally, of the (solovian) approach used in most recent studies to obtain cross-section evidence about the existence of per-capita and labour productivity convergence. Indeed, in this model the dualistic feature is simply that, while marginal productivity in agriculture in the initial year is neither zero nor constant, however differences in the values of marginal productivity (and therefore in the wages) are not instantaneously equalised across the two sectors. Contrary to what happens in non-dualistic models, equalisation takes time, with workers shifting from the low- to the high-wage sector. While other more complex models of dualism are

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3 The range between the most and least productive regions is also broad in industry, while it is smaller 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.

at least as influential as the one used here[4], they are perhaps better suited to analyse less developed economies, rather than lagging regions within developed countries. Moreover, the model used in this paper is simple and its dynamics are detailed enough to obtain testable hypotheses about the role of the sectoral mix during the transition to the steady-state.

In the following we first summarise the main results of Mas Colell and Razin (1973), and then identify the predictions of the model to be tested in the empirical section of the paper[5]. The main assumption of the model are as follows. The agricultural good A is for consumption only, while the non agricultural good N can be either consumed or invested in either sector. The saving rate s is exogenous as well as the proportion of the non agricultural output used for consumption (d). Further, full employment is assumed, as well as perfect mobility of capital across sectors, so that returns from this factor are continuously equalised.

In this economy, labour productivity in the two sectors is $y_A \equiv Y_A / L_A = k_A^a$ and, $y_N \equiv Y_N / L_N = k_N^b$, where $k_i \equiv K_i / L_i$. The assumption of full employment implies that $r k_N + (1-r) k_A = k$, where r is the share of total labour in sector N. As for the allocation of capital across sectors, the sectoral capital-labour ratios turn out to be a constant proportion of the aggregate ratio: $k_N = f\,k/r$ and $k_A = (1-f)\,k/(1-r)$, where f is a constant.[6]

The growth rate of capital per worker k can be obtained as follows. Abstracting from population growth, $\dot{k}/k = l\bar{y}/k$, where $l \equiv s/(s+d)$ and $\bar{y} \equiv Y_N / L$. Since $\bar{y} = r k_N^b$ and $k_N = fk/r$, then:

$$\text{(3.1)} \qquad \frac{\dot{k}}{k} = l\, f^b \left(\frac{k}{r}\right)^{b-1} .$$

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4 Lewis (1954), Ranis and Fei (1961), Sen (1966) are obvious references for the classical approach to dualism. Among others, one difference between this approach and the model used in the present paper is that in the former migration towards the modern sector may leave unaffected the level of output in the traditional one.

5 The rather lengthy analysis of the dual economy in this section is justified by the fact that in their paper Mas Colell and Razin do not derive explicitly the testable hypotheses for a cross-section of similar economies discussed below.

6 $f = b(s+d)/[(s+d)b + (1-s-d)a]$. See Mas Colell and Razin (1973), p. 73.

Let us now turn to labour mobility across the two sectors. The speed of migration from agriculture to industry is a positive function of the difference in wage rates, w_i, which are equal to the values of sectoral labour productivity. Initially, $w_A < w_N$, and labour moves accordingly. As this happens, the initial wage differential decreases, due to constant returns in both sectors, and so does the rate of sectoral migration. Formally, let the proportional rate of change of r – i.e. $\dot{r}/r$ – depend on the wage differential according to $\dot{r}/r = g\left[(w_N - w_A)/w_A\right]$. Substituting wages with labour productivities and rearranging, $\dot{r}/r$ can be defined as a function of the level of r as follows:

$$\frac{\dot{r}}{r} = g\left[\frac{y\,(1-r)}{r} - 1\right], \qquad (3.2)$$

where g and y are constants[7]. Notice that $d(\dot{r}/r)/dr < 0$ and $d^2(\dot{r}/r)/dr > 0$, so that the decline in $\dot{r}/r$ is particularly fast when the economy moves from small values of r to higher ones. This dual economy converges towards a unique steady-state, in which intersectoral migration comes to an end and capital per (effective) labour is stationary [Mas-Colell and Razin (1973)]. Similar economies would therefore share common steady-state values of r^* and k^*.

For our purposes, it is now necessary to describe in some details the relation between changes in $\dot{k}/k$ and changes in r. Totally differentiating (3.1) and rearranging we obtain:

$$\frac{d(\dot{k}/k)}{dr} = l\,f^{\,b}\,(1-b)\left(\frac{k}{r}\right)^{b} k^{-1}\left(1 - \frac{\dot{k}/k}{\dot{r}/r}\right). \qquad (3.3)$$

The sign of (3.3) depends on the relative magnitudes of $\dot{k}/k$ and of $\dot{r}/r$. The sign is positive for low values of r, since, in general, economies far away from the steady-state are characterised by high values of $\dot{r}/r$ and by small values of $\dot{k}/k$ [Dixit (1970)][8]. In this *first phase*, therefore, economies closer to the steady-state enjoy a higher rate of accumulation than similar economies with a smaller share of labour in the non-agricultural sector. Further, notice that during this

[7] $y = (1-b)a/[(1-a)b]$. See Mas Colell and Razin (1973), p. 76.

[8] In equation (3.2), $\lim_{r \to 0} \dot{r}/r = +\infty$, and in equation (3.1) $\lim_{r \to 0} \dot{k}/k = 0$.

phase characterised by $\dot{r}/r > \dot{k}/k$, the increases of r taking place along the transition to the steady-state imply a decreasing $\dot{r}/r$ and an increasing $\dot{k}/k$. Therefore, a point will be reached in which the growing $\dot{k}/k$ equals (and then overtakes) the declining $\dot{r}/r$. The economy enters its *second phase*, in which the sign of (3.3) turns from positive to negative, and $\dot{k}/k$ starts declining.

We are now ready to define the main hypothesis to be tested by means of cross-region growth regressions. We start from productivity growth in the agricultural sector. Since $y_A = k_A^a = [(1-f)k/(1-r)]^a$, the growth rate of labour productivity in this sector is equal to:

$$\frac{\dot{y}_A}{y_A} = a\left(\frac{\dot{k}}{k} - \frac{\dot{J}}{J}\right), \tag{3.4}$$

where $J \equiv (1 - r)$. Notice that, since $\dot{r}/r = g[y\ (1-r)/r - 1]$, then

$$\frac{\dot{J}}{J} = g\left(\frac{r}{1-r} - y\right). \tag{3.5}$$

Differentiating (3.5) and using (3.3) we find:

$$\frac{d(\dot{y}_A / y_A)}{dr} = a\,l\,f^b\,(1-b)\left(\frac{k}{r}\right)^b k^{-1}\left(1 - \frac{\dot{k}/k}{\dot{r}/r}\right) - \frac{ag}{(1-r)^2}\ . \tag{3.6}$$

The sign of (3.6) is unambiguously negative for economies going through the "second phase", during which $\dot{k}/k > \dot{r}/r$. In this phase, an economy closer to the common steady-state has lower values of both $\dot{k}/k$ and of the rate of out-migration. As for the "first phase" – characterised by small values of r and by $\dot{k}/k < \dot{r}/r$ –, the sign of (3.6) can be either negative or positive, since economies closer to the steady-state have higher values of $\dot{k}/k$ together with smaller rates of out-migration. Assuming that ours are similar economies distributed along the time path leading to the steady state value of r^*, a cross-section of these economies should reveal the existence of either a negative or an inverted U relationship between $\dot{y}_A / y_A$ and r.

As for the non-agricultural sector, $y_N = k_N^b = (f\,k/r)^b$, so that the growth rate of productivity is[9]:

$$\frac{\dot{y}_N}{y_N} = b\left(\frac{\dot{k}}{k} - \frac{\dot{r}}{r}\right) = b\,l\,f^{\,b}\left(\frac{k}{r}\right)^{b-1} - bg\left(\left[\frac{y\,(1-r)}{r}\right] - 1\right), \tag{3.7}$$

and therefore

$$\frac{d\left(\dot{y}_N / y_N\right)}{dr} = b\,l\,f^{\,b}\,(1-b)\left(\frac{k}{r}\right)^{b} k^{-1}\left(1 - \frac{\dot{k}/k}{\dot{r}/r}\right) + bgy\,r^{-2}\,. \tag{3.8}$$

Here $\dot{k}/k < \dot{r}/r$ is a sufficient condition for (3.8) to be positive. In this "first phase" economies closer to the steady-state enjoy faster productivity growth because capital accumulation is faster and because the labour force in this sector expands more slowly. In the "second phase", when r takes higher values, the sign of (3.8) can be either positive as in the "first phase", or can turn negative if the influence exerted by a declining growth rate of k exceed the positive one exerted by declining rate of expansion of the sector's labour force. Therefore, in cross-region regressions we should expect to find either a positive or an inverted U relationship between $\dot{y}_N / y_N$ and r.

As for $\bar{y} \equiv Y_N / L$ we have:

$$\frac{\dot{\bar{y}}}{\bar{y}} = b\left(\frac{\dot{k}}{k} - \frac{\dot{r}}{r}\right) + \frac{\dot{r}}{r}\ , \tag{3.9}$$

and

$$\frac{d\left(\dot{\bar{y}}/\bar{y}\right)}{dr} = b\,l\,f^{\,b}\,(1-b)\left(\frac{k}{r}\right)^{b} k^{-1}\left(1 - \frac{\dot{k}/k}{\dot{r}/r}\right) - (1-b)gy\,r^{-2}\,. \tag{3.10}$$

In the "first phase", with $\dot{r}/r > \dot{k}/k$, the sign of (3.10) can be either positive or negative, depending on the relative effects of an increasing $\dot{k}/k$ (which exerts a positive influence on $\dot{\bar{y}}/\bar{y}$) and of a declining $\dot{r}/r$ (which exerts a negative influence). In the "second phase" the sign of (3.10) is unambiguously

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9 A positive exogenous rate of technological progress would allow positive growth rates of productivity in the presence of a rate of migration higher than the growth rate of k [see Dixit (1970)]. In the text we assume it to be zero for simplicity.

negative. All this implies that in cross section a negative or an inverted U shaped relationship should be detected between $\dot{\bar{y}}/\bar{y}$ and the initial values of r.

At this point we have three hypotheses that can be tested in cross section regressions[10]. Finally, we turn to the relationship between aggregate labour productivity $\dot{y}/y$ and r. To derive a testable hypothesis for this case is a more complex task. One convenient way is to proceed as follows. Ignoring for simplicity changes in relative prices, the following relationship between $\dot{y}/y$ and $\dot{\bar{y}}/\bar{y}$ can be defined (see Appendix A):

$$\frac{\dot{\bar{y}}}{\bar{y}} - \frac{\dot{y}}{y} = (1-u)\left(\frac{\dot{Y}_N}{Y_N} - \frac{\dot{Y}_A}{Y_A}\right). \tag{3.11}$$

where $(1-u)$ is the share of agricultural in total output[11]. In the dual model, this share is negatively correlated to r. Moreover, along the transition to the steady-state $\left(\dot{Y}_N/Y_N - \dot{Y}_A/Y_A\right)$ is positive and decreasing in r (see Appendix A). Then, the difference $\dot{\bar{y}}/\bar{y} - \dot{y}/y$ as a whole is also expected to be decreasing in r. As a consequence, the prediction about overall productivity growth is linked to that about $\dot{\bar{y}}/\bar{y}$. For instance, if the coefficient of r is significantly negative in a cross-section regression with $\dot{\bar{y}}/\bar{y}$ as the dependent variable, then we could still find a negative but flatter relationship between $\dot{y}/y$ and r. Depending on the precise relationship linking the right hand side of (3.11) to r, an the dependence $\dot{y}/y$ on r can also take an inverted U shape.

To sum up, if "dualistic" mechanisms of the kind described above are present in the European regions, our data should be characterised by the following conditions:

(a) a negative (or inverted U) relation between the growth of agricultural labour productivity and the initial labour share of the non agricultural sector;

(b) a mainly positive (or inverted U) relation between the growth of non-agricultural labour productivity and the initial value of its labour share;

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[10] Notice that an increasing $\dot{y}_N/y_N$ may be consistent with a decreasing $\dot{\bar{y}}/\bar{y}$ over the same range of r. This is due to the fact that the rate of migration affects $\dot{y}_N/y_N$ through changes in the capital-labour ratio, while in the case of $\dot{\bar{y}}/\bar{y}$ it also exerts a direct impact. As a result, the decreasing trend of the rate of migration enter with a negative sign in (3.7) and with a positive one in (3.9).

[11] In our dataset on the European regions the correlation coefficient between the variables computed according to the two sides of equation (3.11) is equal to 0.99.

(c) a negative (or inverted U) relation between non-agricultural output growth per overall workers and the initial labour share of the non agricultural sector.

Moreover, we expect to find a relation between aggregate productivity growth and the initial labour share of the non agricultural sector similar to that under point *(c)*.

Finally, notice that in this model the initial value of k (and therefore of y) is generally correlated negatively with productivity growth, both at the sectoral and at the aggregate levels. For any given value of r, the higher is k (and y), the lower the growth rates of k [see equation (3.1)] and consequently of our various growth rates in equations (3.4 -7 -9) are. This is an important feature for our empirical analysis, and will be discussed in the next section.

4. Evidence

The discussion of our empirical evidence is organised as follows. First we show some data on intersectoral migration (paragraph 4.1). Then we present the results of the cross-region regressions based on the dualistic conditions identified in the previous section (paragraph 4.2). Finally we discuss some estimation problems (paragraph 4.3).

4.1 Intersectoral migration

For an explanation of convergence in which dualism plays a role, necessary conditions are that intersectoral labour migration characterises the data, and that it follows the expected pattern, with labour moving from the low to the high productivity sector. In the absence of such pattern, a statistically significant r in cross-region regressions could not be interpreted as a signal that dualistic mechanisms are present. To assess whether this condition is fulfilled in our data -- as well as to test whether the hypotheses stated in section 3 are corroborated -- we split our economies in two broadly defined sectors, agriculture and non agriculture, the latter being the sum of industry and services, both private and public.[12]

Figure 2 shows that a strong correlation exists between the initial non agricultural labour share and the rate of change of the same variable in the subsequent period ($r=-0.72$), as implied by the model in section 3. Having initially a large agricultural sector implies a structural transformation proportional -- on average -- to that initial condition. One further point is worth noticing in Figure 2. Regions with an initial small non-agricultural share are

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[12] For the time being, our data do not allow us to assess whether a migration of labour from agriculture to public services has a differential impact on growth as compared with that of migration into industry and private services. This is a point worth analysing in the future, as soon as the relevant data are made available.

characterised by a very high variability, while a much smaller variance is found for regions with initial shares higher than 75%. More generally, we do not find the convex negative relationship which characterises the dualistic model described above.

4.2 Cross-region regressions

Before discussing the results of our cross-region regressions, it is necessary to discuss briefly the inclusion, in all our estimations, of the initial level of *aggregate* labour productivity. The reason is twofold. First, as we have noticed above, in the dual economy for any given value of r, the higher is k (and y), the lower is the growth rates of k and consequently of all the growth rates used in our regressions ahead. Second, we do not model diffusion of technology explicitly. Diffusion of technology is another important source of convergence, as strongly underlined by the literature on the technology gap hypothesis [Fagerberg (1995)]. As it is a standard practice, the initial value of overall productivity can be interpreted as a proxy of such a gap. By doing so, we assume implicitly that the rate of technology diffusion is not affected by the sectoral mix of the economy and by its changes. Future research should try to go beyond such a simplification, which however is a very useful one for our present purpose. While the two effects attached to the initial value of overall productivity are very different ones, they both implies a negative correlation between this variable and the growth rates. The simultaneous presence of the initial values of r and y in our cross-region regressions poses an econometric problem, since in our data the correlation between the two variables is high. We will come back on this problem in section 4.3. Finally our regressions include a set of national dummies to control for country-specific omitted variables that affect sectoral and aggregate productivity growth.[13]

Productivity growth in the agricultural sector [point (*a*) in section 3]. The dualistic model predicts a negative or an inverted U relation between the growth rate of agricultural productivity and the initial non agricultural labour share. The estimates of the two functional forms are reported respectively in regressions 1 and 1a in Table 2. It seems that an inverted U relation fits the data remarkably better, although the unexplained variance of the dependent variable remains quite high ($\overline{R}^2$ =0.21). This outcome is not surprising given the pattern shown in Figure 2, where the regions with initial high agriculture shares do not always experience fast rates of intersectoral shifts. In other words, those regions do not seem to share a unique, mechanistic relationship between the size of the agricultural sector and the rate of out-migration of labour. Some evidence in favour of this hypothesis can be obtained by noting that a “weaker” prediction

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[13] If we exclude the national dummies the explanatory power of the regression decreases but we obtain the same qualitative results in term of the signs and the significance of the regressors.

of equation (3.4) -- that is, the faster the rate at which the agricultural sector shrinks, the faster will be its productivity growth -- is strongly corroborated by our data, as shown by regression 2[14]. This is a implicative result, on which we will come back later.

Productivity growth in the non-agricultural sector [point (*b*) in section 3]. Regression results are in Table 3. The initial labour share in regression 1 is significant with the positive sign predicted by the theoretical model. As a consequence, one way of interpreting this result is as follows. Regions with higher overall gaps enjoy faster growth of productivity in the non-agricultural sector, while a small initial non-agricultural share hampers growth, since it is associated to faster immigration which, in turn, exerts a negative impact on the sector's capital-labour ratio. Notice that since the initial gap and the initial non-agricultural share are positively correlated, omitting the non-agricultural share in the estimations causes a downward bias in the absolute value of the coefficient of the initial gap. Indeed, excluding the non-agricultural share in regression 1, the coefficient of the initial gap would be significant at 1% and equal to −0.016. Once the correct specification is used, the coefficient of the initial gap becomes equal to −0.026. Finally no inverted U relationship has been detected in the data (regression 1a).

Per-capita growth of the non-agricultural output [point (*c*) in section 3]. Regression results are in Table 4. In regression 1, the initial labour share is significant and takes the predicted negative sign. Again, an interpretation of these results consistent with the theoretical model is as follows. Regions with higher overall gaps enjoy faster growth of per capita non-agricultural output. Excluding the non-agricultural share in regression 1, the coefficient of the initial gap would be significant at 1% and equal to −0.024. However, part of such "convergence" speed is associated with the initial non-agricultural labour share -- the smaller this share, the higher the growth rate. Once this factor is controlled for, the coefficient of the initial gap becomes equal to −0.017. Moreover, we tested for the presence of an inverted U relationship between the dependent variable and the non-agricultural initial share, but could not generate any robust result favourable to this hypothesis (regression 1a).

Finally we examine the relation between aggregate productivity growth and the initial labour share. In Table 5, regression 1, the sign of the coefficient of the non-agricultural share in 1980 is negative but statistically not significant. This result is not entirely surprising, given eq. (3.11) above and the results in Table 4. As we noticed, in dual models the right hand side of (3.11) is expected to be

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[14] The negative sign of the coefficient of the rate of change of the share in regression 3 is due to the fact that fast out-migration from agriculture implies a negative proportional rate, the absolute value of which is large.

decreasing in r. In fact, this hypothesis is corroborated by our data: the correlation between a variable computed using the right hand side of (3.11) and the non agricultural labour share is equal to -0.81. Since the existence of an inverted U shaped relationship is also a possibility consistent with the model, we test it in regression 1a, and find that our data strongly confirm this hypothesis.

4.3 Estimation problems

A comment on multicollinearity is now in order. As already noticed, these result are obtained in the presence of a strong correlation between labour productivity and the labour share in the initial year (r=0.79), so the (large) common variation is not used to estimate the individual coefficients. However, in our case the variation that is unique to each variable is enough to obtain estimates of the coefficients which generally are statistically significant with the expected signs. Moreover, to make sure that the initial shares in the regressions are capturing the specific dualistic mechanisms associated with reallocation of labour across sectors, we have substituted the initial share with its proportional rate of change over the whole period[15]. Results are those shown as regressions 2 in Tables 2-5. The signs of the coefficients are the expected ones (i.e. the opposite as for the labour shares), and are statistically significant, with the only exception of regression 2 in Table 5.

5. Conclusions

The aim of this paper was to test whether dualism has played a role in the slow convergence process in labour productivity recorded across the European regions during the 1980s. We found some detailed evidence in favour of the idea that dualism is still an active component of that process along the specific hypotheses listed at the end of section 3. While part of the influence exerted by dualistic mechanisms is not easily distinguishable from the one due to other mechanisms such as technology diffusion, still the former appears to be a significant component of the whole process of convergence. Ignoring such component could lead to misleading interpretations of the relative role played by each of the forces behind the process, and to inexact assessments of what actions should be taken – if any – by the European regional policy to help the process become more pervasive.

An example of how a wrong conclusion can be reached when the analysis ignores the existence of structural change due to dualism has been given in Table 3 where the results of the non agricultural sector are shown. As we noticed, during the transition to the steady-state large flows of out-migration of labour from agriculture should be expected to take place. Such flows exert a

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[15] The rate of change of the non agricultural labour share has a correlation of –0.5 with the initial overall productivity, and of -0.72 with the initial value of the share.

negative influence on the rate at which the poorer regions converge to the richer ones. Ignoring this aspect could lead to the wrong conclusion that the slow speed of the process in the non-agricultural sector is entirely due to non-transitory features of the involved economies, such as obstacles to technology adoption, or to the existence of pervasive forms of localised increasing returns. Of course, both these two latter features can be relevant, but a precise assessment of their roles should be obtained in a framework in which dualism and its transitory effects are also considered.

More generally, the presence of dualistic features in the aggregate convergence process makes the following questions relevant: Has the source of convergence based on dualism been exhausted? Or are there reasons to believe that it has not been fully exploited?

These questions are clearly important from the point of view of European economic policy in general, and of sectoral policy in particular. A satisfactory answer to them is beyond the scope of the present article. However, we propose some exploratory remarks. One signal that sectoral shifts might still play a role in generating further convergence is the following.[16] In our data, small levels of initial non-agricultural shares were *not* a systematic source of high rate of sectoral shifts. As we have seen, the rate of growth of the non-agricultural share is characterised by high variability for low initial values (Figure 2). Moreover, a strong correlation exists between the growth of agricultural productivity and the rate of labour out-migration, but does not exist between the former and the initial level of the non-agricultural share. Some initially agricultural regions have managed to transform rapidly to the advantage of productivity in agriculture, other have not.

The key question is therefore what lies behind such a highly differentiated pattern. The economic impact of national and European sectoral policies should be consider at the next stage of the research, as well as the role of spatial elements in the determination of patterns of localisation of the non agricultural sector.

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[16] Such conclusion would be wrong in the case that the observed small non-agricultural shares were largely the result of specialisation induced by economic integration. However, if this were the case, equalisation of the sectoral productivity levels across regions should prevail, leaving no room for significant relationships between the relative size of the sector and its labour productivity. In fact, as we noticed, such a relationship does strongly characterises our data, and is consistent with the idea that regions with small non-agricultural shares can still gain from structural change.

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Appendix A

In this Appendix we show that the difference $\dot{\bar{y}}/\bar{y} - \dot{y}/y$ is defined by the right hand side of (3.11). Since

$$\text{(A.1)} \qquad \frac{\dot{\bar{y}}}{\bar{y}} - \frac{\dot{y}}{y} = \frac{\dot{Y}_N}{Y_N} - \frac{\dot{Y}}{Y} \ ,$$

we need to define the growth rate of overall output. Assuming a relative price constant and equal to one, we have $Y = Y_A + Y_N$ and $\dot{Y} = \dot{Y}_A + \dot{Y}_N$. Then

$$\frac{\dot{Y}}{Y} = \frac{\dot{Y}_A}{Y} + \frac{\dot{Y}_N}{Y} = (1-u)\frac{\dot{Y}_A}{Y_A} + u\,\frac{\dot{Y}_N}{Y_N} \ ,$$

where *u* is the share of non agricultural in total output. We substitute this result in eq. (A.1) to obtain eq. (3.11):

$$\text{(A.2)} \qquad \frac{\dot{\bar{y}}}{\bar{y}} - \frac{\dot{y}}{y} = (1-u)\left(\frac{\dot{Y}_N}{Y_N} - \frac{\dot{Y}_A}{Y_A}\right).$$

Finally, using equations (3.4) and (3.7) we find

$$\frac{\dot{Y}_N}{Y_N} - \frac{\dot{Y}_A}{Y_A} = (b-a)\frac{\dot{k}}{k} + (1-b)\frac{\dot{r}}{r} - (1-a)\frac{\dot{J}}{J} \ .$$

Both $\dot{r}/r$ and $-\dot{J}/J$ are at their highest levels as r is close to zero, and then both decline steadily. Moreover, (1−*u*) varies inversely with r. We conclude that (A.2) also varies inversely with r.

Appendix B

In this paper we have used the data-base *Regio-Eu* set up by CRENoS (see Paci, 1997). 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
E8	MADRID
E9	CASTILLA-LEON
E10	CASTILLA-LA MANCHA
E11	EXTREMADURA
E12	CATALUNA
E13	COMUNIDAD VALENCIANA
E14	BALEARES
E15	ANDALUCIA
E16	MURCIA
E17	CANARIAS
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
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
F20	LANGUEDOC-ROUSSILLON
F21	PROVENCE- ALPES COTE D'AZUR
F22	CORSE

LU	**LUXEMBURG**
N	**NETHERLANDS**
N1	NOORD-NEDERLAND
N2	OOST-NEDERLAND
N3	WEST-NEDERLAND
N4	ZUID-NEDERLAND
P	**PORTUGAL**
P1	NORTE
P2	CENTRO (P)
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
U5	SOUTH EAST (UK)
U6	SOUTH WEST (UK)
U7	WEST MIDLANDS
U8	NORTH WEST (UK)
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 power parity (PPP) terms and at constant 1985 prices. The data sources are Eurostat's *Regio* and regional yearbooks, and the National Statistical Offices.

Table 1. Labour shares and productivity in the European regions

	Labour shares Percentage values				Labour productivity level Index, Europe total = 100			
	1980		1990		1980		1990	
	value	c.v.	value	c.v.	value	c.v.	value	c.v.
Agriculture								
Min	0.8		0.4		14		12	
Max	50.9		48.3		132		172	
European average	9.4	150	6.5	181	46	51	48	56
Northern regions	6.2	86	4.3	83	56	41	63	41
Southern regions	22.3	63	15.2	90	35	44	32	57
Industry								
Min	16.9		18.5		51		33	
Max	48.9		44.6		143		160	
European average	36.4	23	31.3	23	106	25	106	23
Northern regions	37.5	18	32.0	20	109	19	110	15
Southern regions	31.2	27	28.8	28	92	29	90	27
Services								
Min	25.1		36.2		53		40	
Max	69.5		75.4		131		145	
European average	54.2	20	62.1	17	105	23	102	22
Northern regions	56.3	13	63.7	11	107	17	104	16
Southern regions	46.5	22	56.0	20	96	27	94	26
Total								
Min					38		37	
Max					134		148	
European average	100.0		100.0		100	25	100	24
Northern regions	100.0		100.0		105	16	104	14
Southern regions	100.0		100.0		81	30	84	30

Table 2. Agriculture: productivity growth and initial labour share.
Dependent variable: agricultural labour productivity, annual average growth rate 1980-90.

	Regr. 1	**Regr. 1.a** #	**Regr. 2**
Constant	-0.11 (-0.91)	-0.22 (-1.86)	-0.01 (-0.19)
Overall Productivity 1980	0.014 (0.98)	0.0002 (0.011)	0.002 (0.27)
Non-agric. lab. share 1980	-0.002 (-0.06)	0.66 (2.22) [b]	
Square of non-agr. share 1980		-0.41 (-2.24) [b]	
Rate of change of agric. share			-0.085 (-8.98) [a]
R^2 adj	0.15	0.21	0.52
F test	7.5 [a]	8.01 [a]	30.0 [a]
White F test	0.6	3.3 [a]	1.7
Included national dummies	I(-)	I(-)	I(-), E(-)

Notes: OLS; whole sample: 109 regions; t-statistics in parentheses; significance levels: a = 1%, b = 5%.
All regressions include statistically significant national dummies (in parentheses the coefficient's sign).
t-statistics corrected for heteroskedasticity.

Table 3. Non agricultural sector: productivity growth and initial labour share.
Dependent variable: non agricultural labour productivity, annual average growth rate 1980-90.

	Regr. 1 #	**Regr. 1.a** #	**Regr. 2** #
Constant	0.25 (5.80) [a]	0.10 (1.98) [b]	0.29 (7.50) [a]
Overall Productivity 1980	-0.026 (-5.45) [a]	-0.015 (-2.28) [b]	-0.027 (-7.00) [a]
Non agricultural lab. share 1980	0.03 (3.02) [a]	0.14 (1.47)	
Square non agr. lab. share, 1980		-0.07 (-1.27)	
Rate of change of share			-0.095 (-8.23) [a]
R^2 adj	0.49	0.44	0.64
F test	22.1 [a]	18.2 [a]	32.8 [a]
White F test	9.48 [a]	7.3 [a]	5.2 [a]
Included national dummies	N(-), G(-), F(+)	N(-), I(-)	N(-) G(-) F(+) E(+)

Notes: OLS; whole sample: 109 regions; t-statistics in parentheses; significance levels: a = 1%, b = 5%.
All regressions include statistically significant national dummies (in parentheses the coefficient's sign).
t-statistics corrected for heteroskedasticity.

Table 4. Per capita non agricultural output: growth and initial labour share.
Dependent variable: Per capita non agricultural output, annual average growth rate 1980-90.

	Regr. 1[#]	Regr. 1.a[#]	Regr. 2[#]
Constant	0.22 (5.78) [a]	0.19 (5.37) [a]	0.23 (5.90) [a]
Overall Productivity 1980	-0.017 (-4.07)[a]	-0.019 (-3.40)[a]	-0.021 (-5.33) [a]
Non agr. labour share 1980	-0.02 (-2.15) [b]	0.10 (1.00)	
Square non agr. lab. share, 1980		-0.08 (-1.29)	
Rate of change of share			0.030 (2.36) [b]
R^2 adj	0.69	0.69	0.68
F test	48.1 [a]	42.4 [a]	47.4 [a]
White F test	7.42 [a]	8.19 [a]	5.21 [a]
Included national dummies	N(-), I(-) G(-)	N(-), I(-) G(-)	N(-), I(-) G(-)

Notes: OLS; whole sample: 109 regions; t-statistics in parentheses; significance levels: a=1%, b=5%.
All regressions include statistically significant national dummies (in parentheses the coefficient's sign).
[#] t-statistics corrected for heteroskedasticity.

Table 5. Aggregate labour productivity: growth and initial labour share.
Dependent variable: Annual average growth rate 1980-90.

	Regr. 1[#]	Regr. 1.a[#]	Regr. 2[#]
Constant	0.18 (4.95) [a]	0.05 (1.10)	0.17 (4.59) [a]
Overall Productivity 1980	-0.015 (-3.72)[a]	-0.012 (-2.05)[b]	-0.015 (-3.99) [a]
Non agr. labour share 1980	-0.003 (-0.26)	0.24 (3.21) [a]	
Square non agr. lab. share, 1980		-0.15 (-3.32) [a]	
Rate of change of share			0.014 (1.25)
R^2 adj	0.63	0.56	0.63
F test	37.1 [a]	28.4 [a]	37.9 [a]
White F test	6.72 [a]	5.69 [a]	2.98 [a]
Included national dummies	N(-), I(-) G(-)	N(-), I(-)	N(-), I(-) G(-)

Notes: OLS; whole sample: 109 regions; t-statistics in parentheses; significance levels: a=1%, b=5%.
All regressions include statistically significant national dummies (in parentheses the coefficient's sign).
[#] t-statistics corrected for heteroskedasticity.

Fig. 1. Agricultural labour shares in the European regions. 1980
A = agricultural labour shares, percentage values
European Community average = 9.4

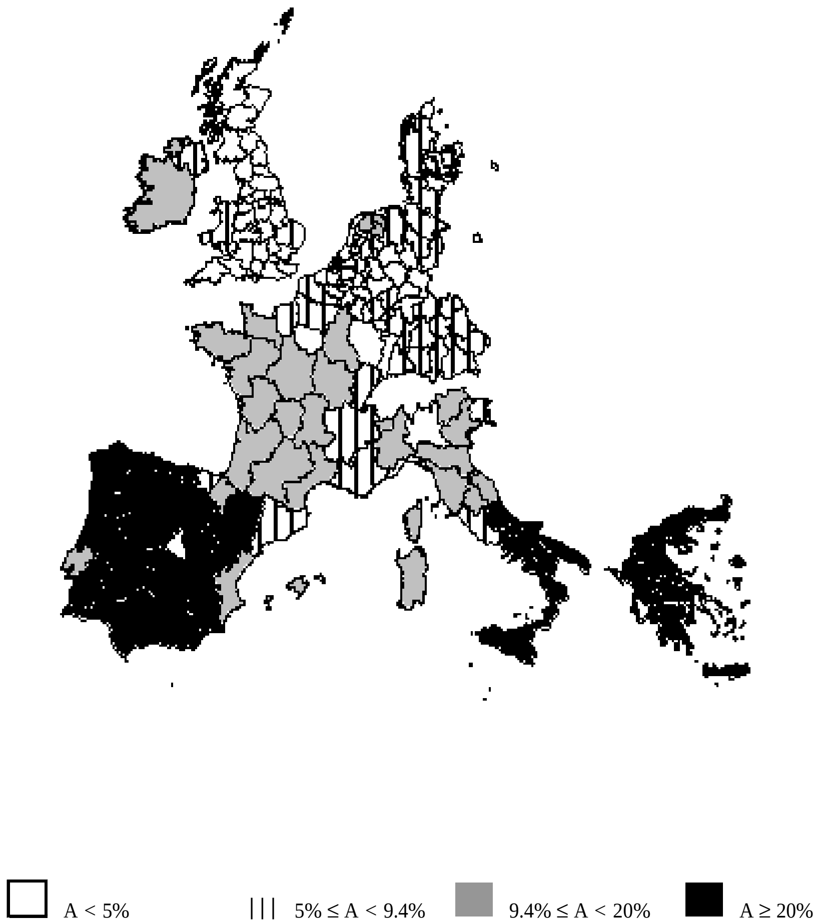

Fig. 2

Labour share and migration in the non agricultural sector