THE EVOLUTION OF REAL DISPARITIES IN PORTUGAL AMONG THE NUTS III REGIONS. AN EMPIRICAL ANALYSIS BASED ON THE CONVERGENCE APPROACH.

Elias Soukiazis and Micaela Antunes
Faculty of Economics, University of Coimbra, Portugal

Abstract

The aim of this paper is to explain regional convergence in Portugal, at Nuts III level, in terms of per capita income and productivity. In doing so, we employ an alternative estimation approach based on panel data analysis that allows for individual differences across regions, avoiding with this way the omitted variable bias occurred in single cross-section regressions. The known concepts of absolute and conditional convergence are tested between the 30 Portuguese regions, as well as, the importance of some conditioning structural factors related to resource allocation and demand conditions. Our evidence shows that convergence among the 30 regions in Portugal is rather conditional than absolute, both, in terms of per capita income and productivity. On the other hand, labour shares in the main economic sectors as measures of resource reallocation are important in explaining convergence in per capita income and productivity. Output growth, reflecting demand conditions and labour composition by sectors are shown to be relevant conditioning factors in explaining the convergence process in productivity and controlling for differences in regional structures. Our evidence shows a more significant shift of labour from the primary to the tertiary sector and when this element is introduced into the convergence equations, convergence is shown to be higher.

Keywords: absolute and conditional convergence, per capita income, productivity, labour shares, panel regressions.

Correspondence Address: Faculdade de Economia Universidade de Coimbra, Av.Dias da silva, 165, 3004-512 Coimbra, Portugal. Email:elias@fe.uc.pt

1. Introduction

The purpose of this paper is mainly to understand the convergence process among the thirty Nuts III[1] Portuguese regions studying the evolution of per capita income and productivity during the period 1991-2000, where data is available.

Two theoretical approaches are used to test for regional convergence in Portugal. The first takes into account the neo-classical perspective of absolute convergence, derived from the Solow(1956) neoclassical model of the production function with diminishing marginal returns to capital properties. This approach predicts that poorer economies tend to grow faster than richer ones in earlier stages (due to the lower capital stock they possess) and then in the long run all grow at similar rates. Convergence is unconditional to a common steady-state for all economies and divergence is a transitory short term phenomenon reflecting adjustments towards a long run equilibrium level of per capita income. Absolute convergence is found when the inverse relationship between the growth of per capita income and its initial level is confirmed and this result is more likely to occur for a set of economies with similar economic and institutional characteristics. The higher the distance from the steady-state the higher the speed of convergence is expected to be found.

The second approach is derived from the new theory of endogenous growth (Barro, 1991, Sala-i-Martin, 1994). Convergence is conditional to some structural factors with increasing returns to scale properties, such as, human and capital accumulation, technological progress, innovation, among others. Economies converge to different steady-states because of differences in economic structures. Convergence is not the rule, but rather the exception, when economies are able to develop activities with increasing returns to scale characteristics. Convergence is found after differences in the steady states across economies are controlled for.

In this study, a panel data approach is used in order to estimate the convergence equations, both, in terms of absolute and conditional perspectives. The panel data methodology is chosen since it takes into account the individual specific effects of the

[1] NUTS stands for the Nomenclature of Territorial Units for Statistical Purposes. It is a regional territorial division defined by Eurostat that enables the elaboration of credible regional statistics at the European level.

aggregate production functions across regions. This approach is preferable to the single cross-sectional analysis[2], controlling for omitted variable bias and introducing dynamics into the estimated convergence equations.

The remainder of the paper is constituted by the following sections. In section 2 we explain briefly the neoclassical approach to absolute convergence and the appropriateness of the panel data estimation to search for convergence. In Section 3 we test the hypothesis of convergence in per capita income among the 30 Portuguese regions, both, in absolute and conditional terms. Section 4, in a similar way, tests the hypothesis of convergence in productivity(output per effective worker) and examines whether conditional convergence is the result of resource reallocation from less productive to more advanced activities or whether convergence is demand driven. The last section concludes.

2. The neoclassical approach to convergence and panel data regressions.

The idea of absolute convergence emerged from the Solow's growth model based on the Cobb-Douglas production function incorporating a labour-augmenting technological progress of the type:[3]

$$Y(t) = K(t)^{\alpha} \left[A(t)L(t)\right]^{1-\alpha}, \; 0<\alpha<1, \qquad (1)$$

where Y is output, K and L are capital and labour, respectively, A is technology and α the elasticity of output with respect to capital.

In this model L and A are assumed to grow exogenously at rates n and g, respectively, so that: $L(t) = L(0)\,e^{nt}$ and $A(t) = A(0)\,e^{gt}$.

Let assume that s is the constant fraction of output that is saved and invested (s=S/Y) and define output and capital stock "per unit of effective labour" as $\hat{y} = \frac{Y}{AL}$ and $\hat{k} = \frac{K}{AL}$, respectively. Then the fundamental dynamic equation for the growth of $\hat{k}$ is given by:

[2] For this methodology see Soukiazis(2003)

[3] The theoretical development follows closely Islam (1995), with the necessary adaptations.

$$\overset{\circ}{\hat{k}}(t) = s\hat{k}(t)^{\alpha} - (n + g + \delta)\hat{k}(t), \tag{2}$$

with δ the constant rate of capital depreciation, *n* the population growth rate[4] and *g* the growth rate of technological progress all exogenously given.

Since at steady state the growth rate of capital stock per unit of effective labour is constant ($\overset{\circ}{\hat{k}} = 0$), $\hat{k}^*$ meets the condition $s\hat{k}^*(t)^{\alpha} = (n + g + \delta)\hat{k}^*(t)$. Hence, the steady state expression for $\hat{k}$ is given by $\hat{k}^* = \left(\frac{s}{n + g + \delta}\right)^{\frac{1}{1-\alpha}}$, and consequently, the output value at steady state[5] as $\hat{y}^* = \left(\frac{s}{n + g + \delta}\right)^{\frac{\alpha}{1-\alpha}}$.

From the definition of output per unit of effective labour $\hat{y} = \frac{Y}{AL}$ and the expression for steady state output, it is possible to derive the expression for per capita income at the steady state, given by:[6]

$$\ln\left[\frac{Y(t)}{L(t)}\right] = \ln A(0) + gt + \left(\frac{\alpha}{1-\alpha}\right)\ln(s) - \left(\frac{\alpha}{1-\alpha}\right)\ln(n + g + \delta) \tag{3}$$

In equation (3) *gt* is a constant (technological progress is assumed to be the same for all economies and t is fixed), A(0) reflects not only the technological level but also resource endowments, climate and institutions, among others, and so it may be different across countries or regions (Mankiw et al., 1992). Therefore, the term $\ln A(0) = a + \varepsilon$ can be decomposed into two parts: one is constant (*a*) and the other is random (ε), representing a stochastic shock or a country (region)-specific change.

Substituting to the above equation (3) and inserting *gt* into the constant term, we get:

---

[4] According to the neoclassical growth theory, population and labour grow at the same rates.

[5] By definition $\hat{y}(t) = \hat{k}(t)^{\alpha}$.

[6] Analytically:

$$\ln\left[\frac{Y(t)}{L(t)}\right] - \ln A(t) = \left(\frac{\alpha}{1-\alpha}\right)\ln(s) - \left(\frac{\alpha}{1-\alpha}\right)\ln(n + g + \delta) \Leftrightarrow$$

$$\Leftrightarrow \ln\left[\frac{Y(t)}{L(t)}\right] - [\ln A(0) + gt] = \left(\frac{\alpha}{1-\alpha}\right)\ln(s) - \left(\frac{\alpha}{1-\alpha}\right)\ln(n + g + \delta)$$

$$\ln\left[\frac{Y(t)}{L(t)}\right] = a + \left(\frac{\alpha}{1-\alpha}\right)\ln(s) - \left(\frac{\alpha}{1-\alpha}\right)\ln(n+g+\delta) + \varepsilon \tag{4}$$

Cross-section regressions of equation (4) assume that n and s are independent of ε the error term and that g+δ is constant (the same to all countries, normally equal to 5%). This is an important statistical condition in cross-section estimations in order to apply OLS estimation techniques with valid statistical inferences. However, it is difficult to accept that saving and population growth rates fulfill the independence with the error term condition and they are not influenced by technological changes. The panel approach takes care of the specific differences among the different economies and provides a better control of the term ε that reflects technological shifts.

To show that, we consider the equation describing per capita income out of the steady state behaviour and then we analyze the pace of convergence towards the steady state, given by:

$$\frac{d\ln \hat{y}(t)}{dt} = \beta\left[\ln\left(\hat{y}^*\right) - \ln\left(\hat{y}(t)\right)\right] \tag{5}$$

where β represents the convergence rate, dependent on the population growth rate (n), the saving rate(s), the rate of technological progress(g), the depreciation rate(δ) and the elasticity of output with respect to capital(α). This equation farther implies that:

$$\ln \hat{y}(t_2) = \left(1-e^{-\beta T}\right)\ln \hat{y}^* + e^{-\beta T}\ln \hat{y}(t_1) \tag{6}$$

where $\hat{y}(t_1)$ is per worker income at the initial period and T is the time-span, T=(t_2-t_1). Subtracting $\ln \hat{y}(t_1)$ from both sides and rearranging terms, we obtain the following partial adjustment equation:

$$\ln \hat{y}(t_2) - \ln \hat{y}(t_1) = \left(1-e^{-\beta T}\right)\left[\ln \hat{y}^* - \ln \hat{y}(t_1)\right] \tag{7}$$

In this model, the optimal value of the dependent variable (the actual growth of output between period t_2 and t_1) is determined by the difference of the per worker income in the initial period t_1 to its steady state value. Since $\hat{y}^*$ depends on *s* and *n*, and these parameters remain constant during the time period T, the value of income per worker in the steady state also depends on the current values of the explanatory variables. Substituting $\hat{y}^*$ in the above equation, we get the following expression:

$$\ln \hat{y}(t_2) - \ln \hat{y}(t_1) = \left(1 - e^{-\beta T}\right)\left[\left(\frac{\alpha}{1-\alpha}\right)\ln(s) - \left(\frac{\alpha}{1-\alpha}\right)\ln(n + g + \delta) - \ln \hat{y}(t_1)\right] \quad (8)$$

In equation (8) the growth of income per worker is only explained by its initial level (the only convergence factor) assuming the same saving and population growth rates across different economies, which is the neoclassical definition of absolute convergence.

The convergence equation used in the neoclassical approach, equation (8), defines an expression for income per effective worker, and the problem of correlation between the unobservable value A(0) and the explanatory variables is not apparent. By using an alternative specification it is possible to identify such correlation.

Defining output per effective worker as $\hat{y}(t) = \frac{Y(t)}{A(t)L(t)} = \frac{Y(t)}{L(t)A(0)e^{gt}}$ and taking logs, we get: $\ln \hat{y}(t) = \ln\left[\frac{Y(t)}{L(t)}\right] - \ln A(t) \Leftrightarrow \ln \hat{y}(t) = \ln y(t) - \ln A(0) - gt$. Substituting for $\hat{y}(t)$ into equation (8) we derive a dynamic panel data model, given by

$$\begin{aligned} \ln y(t_2) - \ln y(t_1) &= \left(1 - e^{-\beta T}\right)\frac{\alpha}{1-\alpha}\ln(s) - \left(1 - e^{-\beta T}\right)\frac{\alpha}{1-\alpha}\ln(n + g + \delta) - \\ &- (1 - e^{-\beta T})\ln y(t_1) + \left(1 - e^{-\beta T}\right)\ln A(0) + g\left(t_2 - e^{-\beta T} t_1\right) + v_{it} \end{aligned} \quad (9)$$

where $\left(1 - e^{-\beta T}\right)\ln A(0)$ is the time-invariant individual effect term reflecting country(region) specific effects and v_{it} is the error term that varies across countries and time periods. Estimating equation (9) by using panel data techniques is the way to control for the individual country (region) effects. Another advantage is that in the single cross-section regression, s and n are assumed to be constant for the entire period studied. Such hypothesis is more realistic in panel data estimations that consider shorter periods of time, say, annual data.

The main problem with the cross-sectional regressions is that the individual specific effects of the aggregate production function are ignored. These effects can be correlated with the explanatory variables included in the convergence equation, creating estimation bias due to the omission of relevant variables. Hence, an apparent difficulty in cross-sectional regressions (especially in conditional convergence) lays on the fact that only differences in preferences and technology can be accounted for as can be properly observed and measured. Yet, differences in these parameters have dimensions not easily detectable and measured and so they are not considered in cross-section analysis. The use of panel data allows to take care of the variable omission problem and to test for convergence in a more consistent way.

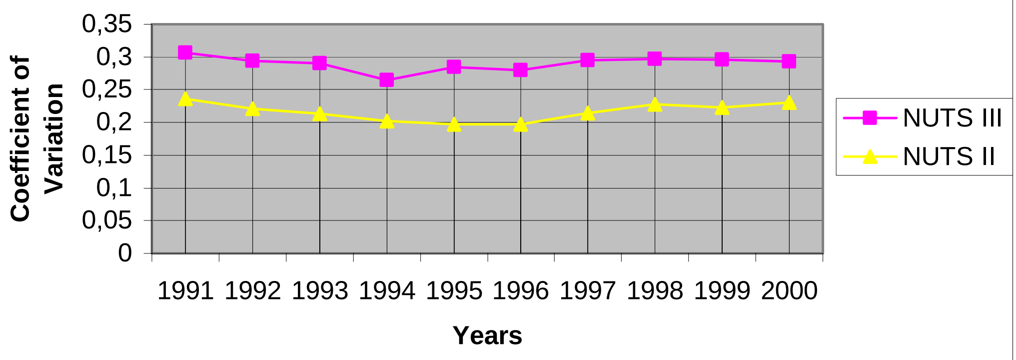
The fact that conditional convergence has been found to be higher in the panel regressions reinforces the idea for a higher policy activism. In order to increase the steady state level of per capita income, authorities must not only care about the rates of saving and labour force growth but also with every tangible and intangible factor that may be related to individual effects. These structural factors have direct positive effects on long-run income level and also indirect ones, through their influence on saving and population growth rates.

3. Per capita income convergence among the Portuguese regions

In this section we examine the convergence process in per capita income among the 30 Nuts III Portuguese regions for the period 1991-2000, where data is available, and by using a panel data approach. Farther, the global period of 10 years is divided into two subsets, 1991 to 1994 and 1995 to 2000. The reason to split the whole period into two subsets and to provide different period regressions is to confirm some preliminary results based on σ-convergence[7] that indicated a lower dispersion of per capita income in the first sub-period than in the latter (Figure 1). Data on σ-convergence shows a slight reduction of the dispersion of per capita income among the Nuts III regions (and it is even smoother for the Nuts II regions) over the whole period. This performance of regional asymmetries can be explained by the significant improvement of some regions, (Madeira, Azores, Beira Interior Sul, Medio Tejo) in the catching-up process towards the richest region (Grande Lisboa) which however is offset by the increasing gap of some other regions relatively to the frontier. Table A in the Appendix illustrates analytically this relative regional position over the period 1991-2000.

[7] σ-convergence is a concept used to measure the dispersion of per capita income over time for a sample of different economies. The coefficient of variation is used to measure σ-convergence given by the standard deviation over the sample mean.

Figure 1. Sigma-convergence in per capita income among NUTS II and NUTS III portuguese regions, 1991-2000



The panel data approach considers from period to period convergence in per capita income instead of the average growth rate for a given period that is the practice of the cross-sectional procedure. On the other hand, it allows the introduction of individual effects that reflect structural differences among regions. Three different methods of estimation are used to provide consistent and comparable results. The usual OLS estimation by pooling the data, the least squares with dummy variables (LSDV) assuming that regional specific effects are fixed and the GLS estimation assuming that regional differences are random.

We first test the neoclassical hypothesis of absolute convergence in per capita income among the 30 Portuguese regions using the following equation, which is a simplification of equation (9):

$$\Delta \ln y_{i,t} = a + b \ln y_{i,t-1} + u_{i,t} \qquad (10)$$

In this equation the dependent variable is the annual growth rate of per capita income[8] and the only explanatory variable is the log of the initial level of per capita income (lagged income), $i = 1,\ldots,30$ is the index for the Portuguese regions (30 regions), $t=1,\ldots,10$ is the time index (10 years) and $u_{i,t}$ is the error term. Equation (10) reflects the

[8] Per capita income is obtained by dividing regional real GDP to total population of the respective region.

basic neoclassical idea that the more backwards an economy (region) is the higher is its growth rate, assuming same preferences, same investment and population growth rates, and technology as a public good. This high homogeneity of the economies is depicted in the constant term *a* representing the common steady state value[9]. Finally, $b=(1-e^{-\beta T})$ is the convergence coefficient and shows the annual convergence rate. The estimation results of the convergence equation (10) are reported in Table 1.

.

TABLE 1. ABSOLUTE CONVERGENCE IN PER CAPITA INCOME AMONG THE PORTUGUESE REGIONS, AT NUTS III LEVEL. PANEL REGRESSIONS.

Method	Period	Constant	b coefficient	R^2	SEE	F-stat.	DW	D.F.
Pooling OLS	1991-2000	0.1438 (8.9828)	-0.0361 (-4.1981)	0.062	0.0461	17.6239	2.24	268
	1991-1994	0.2 (6.4859)	-0.0673 (-3.5179)	0.123	0.0483	12.3757	2.35	88
	1995-2000	0.0827 (5.0162)	-0.0085 (-1.0348)[(n)]	0.01	0.028	1.0707	1.87	148
Fixed Effects LSDV	1991-2000	*	-0.0835 (-6.4213)	0.224	0.0444	2.2966	2.46	239
	1991-1994	*	-0.2915 (-4.2986)	0.366	0.0501	1.1363	2.54	59
	1995-2000	*	-0.0308 (-1.367)[(n)]	0.281	0.0266	1.5509	2.48	119
Random Effects GLS	1991-2000	0.1511 (9.0035)	-0.0401 (-4.4507)	0.069	0.0456	19.8084	2.27	268
	1991-1994	0.1711 (10.8448)	-0.0491 (-5.0154)	0.222	0.0666	25.1538	1.56	88
	1995-2000	0.0858 (4.4603)	-0.0101 (-1.0517)[(n)]	0.007	0.0265	1.1060	2.06	148

Notes: OLS- Ordinary Least Squares Method, Pooling estimation.,LSDV- Least Squares Dummy, Fixed effects and GLS- Generalized Least Squares, Random effects.
Figures in parenthesis are t-ratios, F-stat. tests the overall significance of the coefficients and D.F. are the post estimation degrees of freedom.
[(n)] Estimated coefficient is not statistically significant at the 5% significance level.
"*" All dummies are statistically significant.

We can observe from this table, that the convergence coefficient is negative (as expected) and statistically significant, except in the latter sub-period, 1995-2000. In all estimation methods used the convergence coefficient is higher in the first sub-period, 1991-1994. This evidence is in conformity with our preliminary findings of higher σ-convergence during the first sub-period. For the whole period, our evidence suggests an annual

[9] The common steady state depends on the saving and depreciation rates-*s* and *n*-, the population growth rate-*n*-, the rate of technological progress-*g*- and the level of technology in the initial period-A(0) which are all constant and exogenously given.

convergence rate in per capita income between 4 to 8% across the 30 Portuguese regions. Convergence is found to run at a higher rate in the first sub-period, especially in the case when specific-regional effects are controlled by the individual dummy variables in the estimation with fixed effects. The fact that all dummies are statistically significant can be taken as evidence that convergence is conditional rather than absolute, capturing differences in regional structures.

The next step is to test for conditional convergence. The convergence we found in Table 1 can be the outcome of resource reallocation from less to more productive activities. Labour force is transferred from less productive activities with decreasing returns to scale properties (e.g. agriculture) to more productive activities (e.g. industry and services) with increasing returns to scale characteristics, as human capital qualifications improve and technical progress develops. The higher the improvements in human capital qualifications and technology the higher the reallocation of labour from less efficient to more advanced economic activities is expected to take place. This hypothesis is very close to the endogenous growth theory of conditional convergence stressing that human capital and technical progress are important arguments in explaining the convergence process between different economies

To introduce the idea of resource reallocation into the convergence equation we use the sectoral labour share as an additional conditioning variable. The augmented convergence equation which takes into account a better reallocation of labour force between the main economic activities is specified in the following way:

$$\Delta \ln y_{i,t} = a_i + b \ln y_{i,t-1} + c_j X^j_{i,t} + u_{i,t} \qquad \text{with j=1,2,3} \qquad (11)$$

Equation (11) relates the annual growth rate of per capita income ($\Delta \ln y_{i,t}$) to the convergence factor ($\ln y_{i,t-1}$)- the log of per capita income of the previous year- and to the conditioning factor X^j, that captures regional diversity in labour share, with j=1,2,3 corresponding to each of the main sectors, primary, secondary and tertiary, respectively[10]. The shares of employment in each sector (primary- PRIM, secondary- SEC and tertiary-

[10] The National Institute of Statistics makes the following classification: 1-Agriculture, animal production, hunt and forestry (primary sector); 2-Industry (energy included) and civil construction (secondary sector); 3-Services (tertiary sector).

TERC) were used over the shorter period from 1995 to 2000, to test for conditional convergence[11]. Table 2 reports the results obtained from the estimation of equation (11).

The evidence from Table 2 shows that the convergence coefficient is negative in all cases (as expected) but it is only statistically significant in two cases: the case of fixed effect estimation when labour share in the primary sector is introduced and again in the same method of estimation when labour share in secondary sector is included. This is an encouraging result, since in Table 1 no significant convergence in per capita income was found for the same period. Therefore, primary or secondary labour shares are important conditioning factors in explaining the convergence process in per capita income between the Portuguese regions. When these factors are controlled in the estimated equations convergence in per capita income runs at an annual rate of 11 and 6.8%, respectively.

The coefficient of the labour share variable in the primary sector is negative, as expected, but shows significance only in the LSDV estimation. The argument is that, the higher the employment rate in the primary sector the lower the growth in per capita income is, since labour is dedicated to activities with decreasing returns to scale characteristics. On the other hand, the higher is the possibility of transferring labour to more productive activities with increasing returns to scale characteristics and higher gains in productivity. The coefficient of labour share in the secondary sector is positive, as expected, with statistical significance only in the LSDV estimation. The higher the rate of employment in activities with increasing returns to scale properties (industry and manufacturing) the higher the growth of per capita income is expected to be found. Finally, labour share in services has not any significant effect in explaining regional convergence in per capita income in Portugal.

Table B in the Appendix, reports the respective labour shares of each region distributed among the three main economic activities. The tendency of transferring labour force from the primary to other sectors is very apparent. From 1995 to 2000 labour share has been reduced, on average, by 3.75 percentage points in the primary sector while in the secondary and tertiary sectors labour shares increased by 1.11 and 2.65 p.p., respectively. The main cause for convergence in per capita income seems to be the exit of

[11] Unfortunately, labour statistics at Nuts III level are not available before 1995.

TABLE 2.THE IMPACT OF RESOURCE REALLOCATION ON REGIONAL CONVERGENCE. PANEL REGRESSIONS, 1995-2000.

(2.A.)	**Estimated equation: $\Delta\ lny_{i,t} = a_i + b\ lny_{i,t-1} + c_1\ PRIM_{i,t}+u_{i,t}$**							
	Constant	$lny_{i,t-1}$	$PRIM_{i,t}$	R^2	SEE	F-stat.	DW	D.F.
Pooling OLS	0.1124 (4.62)	-0.0191 (-1.84)$^{(n)}$	-0.0005 (-1.65)$^{(n)}$	0.025	0.0278	1.9078	1.91	147
Fixed Effects LSDV	**	-0.1108 (-3.17)	-0.006 (-2.94)	0.33	0.0258	1.8751	2.46	118
Random Effects GLS	0.1187 (4.20)	-0.0217 (-1.81)$^{(n)}$	-0.0005 (-1.58)$^{(n)}$	0.024	0.0264	1.8313	2.08	147
(2.B.)	**Estimated equation: $\Delta\ lny_{i,t} = a_i + b\ lny_{i,t-1} + c_2\ SEC_{i,t}+u_{i,t}$**							
	Constant	$lny_{i,t-1}$	$SEC_{i,t}$	R^2	SEE	F-stat.	DW	D.F.
Pooling OLS	0.0777 (4.35)	-0.0081 (-0.98)$^{(n)}$	0.0001 (0.74)$^{(n)}$	0.011	0.0281	0.8080	1.88	147
Fixed Effects LSDV	***	-0.0684 (-3.07)	0.0131 (4.69)	0.394	0.0245	2.4772	2.45	118
Random Effects GLS	0.0804 (3.85)	-0.0097 (-1.01)$^{(n)}$	0.0002 (0.68)$^{(n)}$	0.011	0.0266	0.8055	2.07	147
(2.C.)	**Estimated equation: $\Delta\ lny_{i,t} = a_i + b\ lny_{i,t-1} + c_3\ TERC_{i,t}+u_{i,t}$**							
	Constant	$lny_{i,t-1}$	$TERC_{i,t}$	R^2	SEE	F-stat.	DW	D.F.
Pooling OLS	0.0829 (5.02)	-0.0124 (-1.13)$^{(n)}$	0.0001 (0.54)$^{(n)}$	0.009	0.0281	0.6759	1.87	147
Fixed Effects LSDV	****	-0.0251 (-0.71)$^{(n)}$	-0.0005 (-0.21)$^{(n)}$	0.281	0.027	1.4902	2.48	118
Random Effects GLS	0.0857 (4.45)	-0.0147 (-1.16)$^{(n)}$	0.002 (0.56)$^{(n)}$	0.01	0.0266	0.6843	2.05	147

Notes:
PRIM, SEC and TERC are regional shares of labour in the primary, secondary and tertiary sectors. Figures in parenthesis are t-ratios, F-stat. tests the overall significance of the coefficients and D.F. are the post estimation degrees of freedom.
$^{(n)}$ Indicates that the estimated coefficient is not statistical significant at the 5% significance level.
"**"- All dummies have statistical significance.
"***"- Seventeen dummies are statistically significant.
"****"- Only three dummies are statistically significant.

labour from the primary sector. A possible explanation for the insignificance of labour share in the tertiary sector (with the higher relative increase) may lie on the fact that this sector receives mostly unskilled or low skilled labour (restaurants, hotels, supermarkets, commerce, etc.) characterized by a low level of remuneration. These activities are mostly seasonal, are no tradable sectors and finally are characterised by a low profile in economies to scale achievements.

4. Convergence in productivity among the Portuguese regions

The same methodology is used to test for convergence in productivity among the Nuts III Portuguese regions. Productivity is defined as the ratio of real regional GDP to total employed population in each region. In this way, productivity is proxied by output per unit of effective labour. The equation used to estimate absolute convergence in productivity with panel data structure, is the following:

$$\Delta \ln p_{i,t} = a + b \ln p_{i,t-1} + u_{i,t} \qquad (12)$$

In this equation, the annual growth rate in productivity ($\Delta \ln p_{i,t}$) is related to the convergence factor (the log of productivity level of the initial period), *i* is the index of the 30 Portuguese regions and *t* is the time span covering a six-year period, from 1995 to 2000, where data is available. The total number of observations is 180 and the results of the estimated convergence equation in productivity are given in Table 3. The evidence are clearly against the neo-classical hypothesis of absolute convergence. Despite the negative sign of the convergence coefficient its statistical significance is not accepted in all methods of estimation. There are no evidence of absolute convergence in productivity levels among the Portuguese regions, therefore, regions converge to uncommon steady states and differences in structures have to be controlled for.

TABLE 3. ABSOLUTE CONVERGENCE IN PRODUCTIVITY AMONG THE PORTUGUESE REGIONS. PANEL REGRESSIONS, 1995-2000.

Method	Constant	$\ln p_{i,t-1}$	R^2	SEE	F-stat.	DW	D.F.
Pooling OLS	0.0598 (1.8298)$^{(n)}$	-0.0051 (-0.4186)$^{(n)}$	0.001	0.0321	0.1752	1.98	148
Fixed Effects LSDV	*	-0.0546 (-1.4465)$^{(n)}$	0.253	0.031	1.3454	2.41	119
Random Effects GLS	0.0645 (1.7693)$^{(n)}$	-0.0068 (-0.5045)$^{(n)}$	0.002	0.031	0.2545	2.08	148

Notes: OLS- Ordinary Least Squares Method, Pooling estimation, LSDV- Least Squares Dummy Method, Fixed Effects and GLS- Generalized Least Squares Method, Random Effects. Figures in parenthesis are t-ratio, F-stat. tests the overall significance of coefficients and D.F. are the post estimation degrees of freedom.
$^{(n)}$ indicates that the estimated coefficient is not statistical significant at the 5% significance level.
"*" Only 6 "dummies" are statistically significant at 5% significance level.

As we did in the case of convergence in per capita income, regional labour structure can be used to control for differences in productivity performance between the Portuguese regions. Setting data in a panel form, the augmented equation to test for conditional convergence in productivity takes the following form:

$$\Delta \ln p_{i,t} = a_i + b \ln p_{i,t-1} + c_j X_{i,t}^{j} + u_{i,t} \qquad (13)$$

where X^j stands for labour share in the three main economic activities, primary, secondary and tertiary sectors, respectively. The introduction of these conditioning variables in the convergence equation makes it possible to test for the relevance of resource reallocation in explaining convergence in productivity between the 30 Portuguese regions. Through the three already mentioned estimation methods it is possible to detect the influence of the proportion of employed people in the primary (PRIM), secondary (SEC) and tertiary (TERC) sectors on the productivity growth rate. The outcome of the estimations is reported in Table 4.

Once more, the more satisfactory results obtained are from the estimation with fixed effects. In all cases the convergence coefficient in productivity carries its correct negative sign but only in the LSDV estimation presents statistical significance [and also in the GLS estimation in part (4.C) of the table]. When labour share in the primary sector is included [part (4.A) of the table] convergence in productivity among the Portuguese regions runs at a very high rate of 26% per annum, suggesting that the lower the employment occupation in the primary sector the higher the increase in productivity. This is an expected result since the transfer of labour force from activities with diminishing returns to scale characteristics to sectors with higher efficiency, improves productivity of the whole economy. This is the basic idea of better resource allocation (especially labour) to improve economic efficiency. The impact of labour share in primary sector on productivity growth is also substantial. For every 1 percentage point fall in labour share in the primary sector, total productivity for the Portuguese regions increases by 0.01 percent.

When labour share in the secondary sector is considered convergence in productivity runs at 9.3% per annum [part (4.b) of Table 4, LSDV estimation]. The impact of this conditioning variable is also substantial on productivity growth. For every

TABLE 4. THE IMPACT OF RESOURCE REALLOCATION ON REGIONAL CONVERGENCE IN PRODUCTIVITY. PANEL REGRESSIONS, 1995-2000.

(4.A.)	**Estimated equation: $\Delta \ln p_{i,t} = a_i + b \ln p_{i,t-1} + c_1 PRIM_{i,t} + u_{i,t}$**							
	Constant	$\ln p_{i,t-1}$	$PRIM_{i,t}$	R^2	SEE	F-stat.	DW	D.F.
Pooling OLS	0.1043 (2.3712)	-0.0183 (-1.228)$^{(n)}$	-0.0005 (-1.5037)$^{(n)}$	0.016	0.032	1.2190	1.98	147
Fixed Effects LSDV	**	-0.2594 (-5.2819)	-0.0114 (-5.7096)	0.415	0.0275	2.6993	2.45	118
Random Effects GLS	0.1176 (2.3772)	-0.0226 (-1.3486)$^{(n)}$	-0.0006 (-1.5816)$^{(n)}$	0.018	0.0308	1.3824	2.09	147
(4.B.)	**Estimated equation: $\Delta \ln p_{i,t} = a_i + b \ln p_{i,t-1} + c_2 SEC_{i,t} + u_{i,t}$**							
	Constant	$\ln p_{i,t-1}$	$SEC_{i,t}$	R^2	SEE	F-stat.	DW	D.F.
Pooling OLS	0.0667 (1.9157)$^{(n)}$	-0.0062 (-0.5029)$^{(n)}$	-0.0001 (-0.5839)$^{(n)}$	0.003	0.0322	0.2577	1.97	147
Fixed Effects LSDV	***	-0.0927 (-2.4049)	0.0103 (3.0628)	0.308	0.0299	1.6962	2.48	118
Random Effects GLS	0.0707 (1.8317)$^{(n)}$	-0.0077 (-0.5683)$^{(n)}$	-0.0001 (-0.4982)$^{(n)}$	0.003	0.0312	0.2486	2.07	147
(4.C.)	**Estimated equation: $\Delta \ln p_{i,t} = a_i + b \ln p_{i,t-1} + c_3 TERC_{i,t} + u_{i,t}$**							
	Constant	$\ln p_{i,t-1}$	$TERC_{i,t}$	R^2	SEE	F-stat.	DW	D.F.
Pooling OLS	0.107 (2.9375)	-0.0401 (-2.2885)	0.0009 (2.7149)	0.049	0.032	3.7768	1.97	147
Fixed Effects LSDV	****	-0.2122 (-4.1268)	0.0111 (4.2182)	0.351	0.029	2.0596	2.44	118
Random Effects GLS	0.1116 (2.8435)	-0.0429 (-2.2707)	0.001 (2.6437)	0.0469	0.0307	3.6147	2.04	147

Notes: PRIM, SEC and TERC are regional shares of labour in the primary, secondary and tertiary sectors.
Figures in parenthesis are t-ratio.
$^{(n)}$ Indicates that the estimated coefficient is not statistical significant at the 5% significance level.
"**"- All "dummies" are statistically significant.
"***"- Only one dummy presents statistical significance.
"****"- Only three dummies have statistical significance.

1 percentage point increase in labour share in the secondary sector, total productivity increases by 0.01 percent. The reallocation of labour force from the primary to secondary sector improves productivity, since labour shifts from less productive activities to technologically more advanced sectors.

Finally, the inclusion of labour share in the tertiary sector gives also interesting insides. The statistical significance of this factor is confirmed in all methods of estimation. The evidence from our preferable equation (with fixed effects) shows an average rate of convergence in productivity of 21 % per annum. As we have seen earlier from Table B (in the Appendix), labour in Portugal shifts from the primary sector and mainly concentrates to services and this improves regional productivity.

Once more we find evidence that structural changes due to labour shifts from less to more efficient activities are relevant factors in explaining the convergence process in productivity in Portugal and that these factors can be used to control for differences in regional structures.

5. The role of demand in the process of productivity convergence

The Keynesian approach to growth emphasizes the role of effective demand as the driving force to boost growth. In contrast to the neo-classical theory, factors of production are endogenous and the strength of demand explains the growth of factor inputs. Total factor productivity or technical progress are not exogenous, as the neoclassical theory assumes (the known Solow´s residual). Productivity growth is endogenous depending on the expansion of output and this dynamic relationship captures technological progress properties of the production function related to static and dynamic returns to scale.

Kaldor(1966) revived the known Verdoorn Law[12], arguing that the growth of output is the major determinant of productivity growth rates and that this dynamic relationship is stronger in the industrial sector. The same relationship plays a central role in explaining growth processes with cumulative causation characteristics.

Verdoorn's Law refers to the simple relationship $p=a+bq$, where p is productivity growth, q is the growth of output (representing demand forces) and b is the so-called Verdoorn's coefficient that measures the elasticity of labour productivity with respect to output. When this coefficient is positive and less than one indicates the presence of increasing returns to scale properties in the production function.[13]

Our analysis of conditional convergence in productivity may be improved by introducing into the equation the Verdoorn effect. Accordingly, the augmented convergence equation in terms of productivity takes into consideration the usual convergence factor (the lagged productivity level) and additionally the growth of output

[12] Verdoorn(1949), "Fattori che regolano lo sviluppodella produtivita del lavoro" , L´Industria.

[13] From Verdoorn's Law: $p=a+bq$ and given by definition that $p=q-e$ (with **e** the growth of employment), Kaldor derives the following expression: $q=(a/1-b)+(1/1-b)e$. Therefore, **b** = 0 validates the neoclassical hypothesis of constant returns to scale, but $b< 1$ confirms the Keynesian hypothesis of increasing returns to scale given by $(1/1-b)$.

in each region as a measure of the demand strength. The conditional convergence equation adjusted to include the Verdoorn effect is given by:

$$\Delta \ln p_{i,t} = a_i + b \ln p_{i,t-1} + d \Delta \ln q_{i,t} + u_{i,t} \tag{14}$$

where productivity growth rate for a given region *i* in moment *t* ($\Delta lnp_{i,t}$) is explained by the convergence factor ($lnp_{i,t-1}$) and the growth of real regional output as the conditioning factor ($\Delta lnq_{i,t}$) [14].

Table 5 bellow provides the obtained estimation results of equation (14) by using panel data regressions. We can observe that the convergence coefficient carries its correct negative sign but it is not significant in all estimations. On the other hand, the Verdoorn coefficient is highly significant with an elasticity of productivity with respect to output less than one, therefore, validating the Keynesian assumption of increasing returns to scale characteristics in the production function. It is important to note that the degree of explanation (R^2) has increased significantly in comparison to the previous estimations revealing that the growth of real output plays an important role in explaining productivity growth. The omission of the output variable in the convergence equation can create a bias misspecification overestimating the converge coefficient.

TABLE 5.THE ROLE OF DEMAND FORCES IN EXPLAINING REGIONAL CONVERGENCE IN PRODUCTIVITY. PANEL REGRESSIONS, 1995-2000.

Estimated equation: $\Delta\ lnp_{i,t} = a_i + b\ lnp_{i,t-1} + d\Delta\ lnq_{i,t} + u_{i,t}$

	Constant	$lnp_{i,t-1}$	$\Delta\ lnq_{i,}$	R^2	SEE	F-stat.	DW	D.F.
Pooling OLS	0.0106 (0.4578)$^{(n)}$	-0.0062 (-0.7311)$^{(n)}$	0.7926 (12.4614)	0.5143	0.02248	77.8223	1.96	147
Fixed Effects LSDV	**Constant**	**$lnp_{i,t-1}$**	**$\Delta\ lnq_{i,}$**	**R^2**	**SEE**	**F-stat.**	**DW**	**D.F.**
	**	-0.0356 (-1.3255)$^{(n)}$	0.8159 (10.8378)	0.6258	0.02202	6.3651	2.23	118
Random Effects GLS	**Constant**	**$lnp_{i,t-1}$**	**$\Delta\ lnq_{i,}$**	**R^2**	**SEE**	**F-stat.**	**DW**	**D.F.**
	-0.012 (-0.4835)$^{(n)}$	-0.0068 (-0.7499)$^{(n)}$	0.7962 (12.4166)	0.5126	0.02205	77.3077	2.01	147

Notes:
"**" None of the dummy variables shows statistical significance.

[14] q is gross value-added at base prices for each region.

Not being able to find any significant convergence in productivity when demand forces are introduced into the convergence equation we next turn to an alternative specification where we test jointly the importance of output growth and the structure of labour in the convergence equation.

To investigate whether demand forces together with labour structure explain properly the convergence process in productivity, we estimate again the conditional convergence equation, by taking into account, at the same time, the employment sectoral structure in each region and the Verdoorn effect:

$$\Delta \ln p_{i,t} = a_i + b \ln p_{i,t-1} + c_j X_{i,t}^{j} + d \, \Delta \ln q_{i,t} + u_{i,t} \qquad (15)$$

Equation (15) relates the growth of regional productivity to the convergence factor (the initial level of productivity), the labour shares in the main activities (primary, secondary and tertiary, alternatively) and the Verdoorn effect (the growth of real output). The time span is from 1995 to 2000 and the results from the panel data regressions are exposed in Table 6.

Once more, the most satisfactory results are obtained from the LSDV estimation where specific regional effects are controlled by individual dummy variables. The Verdoorn effect is the most significant confirming the presence of increasing returns to scale. With respect to the convergence coefficient and the labour structure the most satisfactory results are when labour share in the tertiary sector is considered [part (6.C) of Table 6]. This is an expected result since, as we have seen before, the concentration of labour in this sector is more intensive. The estimation with fixed effects shows that, convergence in productivity runs at 20% per annum and the effects of the other conditioning factors are stronger. In general, the results are more robust in comparison to Table 4, where the demand forces are ignored. It is shown that growth of real output is a very significant factor for controlling differences in structures between regions explaining fairly well the convergence process in productivity in conjunction with the labour structure in the main economic activities.

TABLE 6. THE ROLE OF DEMAND FORCES AND LABOUR STRUCTURE IN EXPLAINING REGIONAL CONVERGENCE IN PRODUCTIVITY. PANEL REGRESSIONS, 1995-2000.

(6.A.)	**Estimated equation: $\Delta\ lnp_{i,t} = a_i + b\ lnp_{i,t-1} + c_1\ PRIM_{i,t} + d\Delta\ lnq_{i,t} + u_{i,t}$**								
	Constant	$lnp_{i,t-1}$	$PRIM_{i,t}$	$\Delta\ lnq_{i,t}$	R^2	SEE	F-stat.	DW	D.F.
Pooling OLS	-0.021 $(-0.65)^{(n)}$	0.0027 $(0.26)^{(n)}$	0.0003 $(1.39)^{(n)}$	0.8182 (12.39)	0.5206	0.022	52.857	2.0	146
	Constant	$lnp_{i,t-1}$	$PRIM_{i,t}$	$\Delta\ lnq_{i,t}$	R^2	SEE	F-stat.	DW	D.F.
Fixed Effects LSDV	**	-0.1745 (-4.76)	-0.0076 (-5.08)	0.7279 (10.31)	0.6936	0.020	8.275	2.3	117
	Constant	$lnp_{i,t-1}$	$PRIM_{i,t}$	$\Delta\ lnq_{i,t}$	R^2	SEE	F-stat.	DW	D.F.
Random Effects GLS	-0.0204 $(-0.63)^{(n)}$	0.0026 $(0.24)^{(n)}$	0.0003 $(1.36)^{(n)}$	0.818 (12.38)	0.5202	0.022	52.759	2.0	146
(6.B.)	**Estimated equation: $\Delta\ lnp_{i,t} = a_i + b\ lnp_{i,t-1} + c_2\ SEC_{i,t} + d\Delta\ lnq_{i,t} + u_{i,t}$**								
	Constant	$lnp_{i,t-1}$	$SEC_{i,t}$	$\Delta\ lnq_{i,t}$	R^2	SEE	F-stat.	DW	D.F.
Pooling OLS	0.0335 $(1.41)^{(n)}$	-0.0103 $(-1.23)^{(n)}$	-0.0005 (-3.08)	0.8255 (13.16)	0.544	0.022	58.059	2.04	146
	Constant	$lnp_{i,t-1}$	$SEC_{i,t}$	$\Delta\ lnq_{i,t}$	R^2	SEE	F-stat.	DW	D.F.
Fixed Effects LSDV	***	-0.0350 $(-1.21)^{(n)}$	-0.0002 $(-0.06)^{(n)}$	0.8177 (9.96)	0.6258	0.022	6.114	2.22	117
	Constant	$lnp_{i,t-1}$	$SEC_{i,t}$	$\Delta\ lnq_{i,t}$	R^2	SEE	F-stat.	DW	D.F.
Random Effects GLS	0.0325 $(1.45)^{(n)}$	-0.0099 $(-1.26)^{(n)}$	-0.0005 (-3.28)	0.8253 (13.29)	0.5492	0.022	59.281	2.01	146
(6.C.)	**Estimated equation: $\Delta\ lnp_{i,t} = a_i + b\ lnp_{i,t-1} + c_3\ TERC_{i,t} + d\Delta\ lnq_{i,t} + u_{i,t}$**								
	Constant	$lnp_{i,t-1}$	$TERC_{i,t}$	$\Delta\ lnq_{i,t}$	R^2	SEE	F-stat.	DW	D.F.
Pooling OLS	0.0524 (2.06)	-0.0368 (-3.05)	0.0008 (3.44)	0.7844 (12.77)	0.5507	0.022	59.649	1.99	146
	Constant	$lnp_{i,t-1}$	$TERC_{i,t}$	$\Delta\ lnq_{i,t}$	R^2	SEE	F-stat.	DW	D.F.
Fixed Effects LSDV	****	-0.1958 (-5.84)	0.0113 (6.58)	0.8195 (12.69)	0.7269	0.019	9.7313	2.17	117
	Constant	$lnp_{i,t-1}$	$TERC_{i,t}$	$\Delta\ lnq_{i,t}$	R^2	SEE	F-stat.	DW	D.F.
Random Effects GLS	0.0525 (2.05)	-0.0369 (-3.04)	0.0008 (3.43)	0.7847 (12.77)	0.5505	0.022	59.599	1.99	146

Notes:
$\Delta lnq_{i,t}$ is annual growth rate of real output (gross value added) for each region, during the period 1995-2000.
Figures in parenthesis are t-ratio.
$^{(n)}$ indicates that the estimated coefficient is not statistically significant at 5% significance level.
"**"- All dummies are statistically significant.
"***"- None of the dummies has statistical significance.
"****"- Only six dummies have statistical significance.

6.Summary and Conclusions

In this study, an attempt has been made to understand the convergence process both in per capita income and productivity among the Nuts III Portuguese regions. A panel data approach has been used as the preferable method of estimating the convergence equations, since it allows to take into account the specific differences in economic structures between regions and solves the problem of omitted variable bias.

Our empirical analysis shows that convergence is conditional rather than absolute (the neoclassical argument) both, in terms of per capita income and productivity. Therefore, regions converge to different steady states rather than to a common one. Our argument is that labour shares in the main economic activities can be used to count for differences in regional structures. The convergence which has occurred can be the result of better reallocation of resources from less to more efficient sectors.

When labour shares are included into the estimated equations convergence in per capita income becomes more significant. Convergence runs at an annual rate of 11 and 6.8% when the share of labour in the primary or the secondary sector is used, alternatively. Labour share in the tertiary sector has no significant effect on the growth of per capita income and convergence is slow. The explanation can be that this sector attracts mostly unskilled or low skilled labour with lower remuneration levels. The outflow of labour from the primary sector is the main cause of higher convergence in per capita income among the Portuguese regions.

The process of convergence in productivity is similar. No absolute convergence is found, on the contrary, convergence in productivity is more robust when differences in regional structures are controlled by differences in labour shares in the main activities and differences in demand strength reflected in the growth of output. Convergence in productivity runs at an annual rate of 26, 9.3 and 21% when the share of labour in the primary, secondary or tertiary sector is used, alternatively. A better reallocation of resources is shown to be a relevant factor in explaining the convergence process in productivity between the Portuguese regions.

Finally, the growth of output variable is shown to be very significant in the productivity convergence equations, which according to Kaldor, captures returns to scale effects. Evidence of increasing returns to scale are apparent from the estimated equations and convergence is shown to be more robust, especially when labour share in the tertiary sector is included in the convergence equation of productivity.

APPENDIX

TABLE A. PER CAPITA INCOME OF EACH REGION IN RELATION TO THE RICHEST REGION (Grande Lisboa), 1991-2000 (percentage)

Regions					**Years**					
	1991	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
Norte										
Minho-Lima	35,25	37,82	37,73	40,65	38,69	39,15	37,87	36,86	36,76	36,21
Cávado	40,66	44,28	44,96	47,83	46,54	47,07	45,08	43,83	43,98	43,60
Ave	50,19	53,04	51,72	53,11	50,40	50,18	48,43	47,20	47,33	45,46
Grande Porto	70,85	75,57	73,68	73,70	69,21	68,75	66,78	64,93	64,18	61,50
Tâmega	28,46	30,64	30,16	32,25	28,31	28,30	28,17	27,79	27,92	28,05
Entre Douro e Vouga	50,09	54,08	52,75	55,36	50,98	52,31	50,98	51,31	51,71	48,90
Douro	42,82	40,29	43,78	44,97	39,52	41,39	37,19	35,39	36,07	35,15
Alto Trás-os-Montes	37,66	40,02	38,55	40,16	38,05	38,16	35,28	35,05	34,66	34,22
Centro										
Baixo Vouga	57,13	61,65	60,83	62,50	56,90	56,15	54,59	53,66	53,50	53,09
Baixo Mondego	50,82	55,45	54,40	57,88	59,40	57,51	55,76	54,10	53,35	53,29
Pinhal Litoral	54,60	58,28	57,38	60,45	57,42	58,21	57,25	55,55	56,84	55,55
Pinhal Interior Norte	32,65	35,51	34,77	37,32	32,04	33,04	31,77	32,23	31,82	32,93
Dão-Lafões	36,60	39,22	38,58	39,04	33,84	35,23	34,17	33,86	34,82	35,80
Pinhal Interior Sul	35,84	35,70	35,98	45,07	39,54	41,47	38,46	38,29	35,31	35,57
Serra da Estrela	32,20	35,11	33,86	35,53	30,37	30,91	30,81	30,40	31,05	31,86
Beira Interior Norte	41,00	43,04	42,03	42,91	39,43	39,84	38,42	37,80	37,84	38,43
Beira Interior Sul	47,34	50,01	48,60	51,01	55,64	53,79	51,96	50,73	50,51	51,29
Cova da Beira	40,72	44,95	42,05	43,69	43,46	44,63	41,87	40,71	40,80	40,91
Lisboa e Vale do Tejo										
Oeste	48,99	50,76	49,27	49,21	46,38	47,57	46,38	46,54	46,51	45,43
Península de Setúbal	49,00	49,98	48,13	48,70	51,61	51,62	52,00	52,42	49,80	46,99
Médio Tejo	45,36	47,14	47,22	48,94	52,90	54,73	53,72	53,51	53,84	52,56
Lezíria do Tejo	47,79	48,55	47,02	49,97	52,15	54,65	57,20	56,16	54,37	53,76
Alentejo										
Alentejo Litoral	78,12	76,65	73,22	70,49	67,82	71,05	70,72	65,45	61,97	55,77
Alto Alentejo	43,59	42,83	43,98	44,35	44,82	45,75	43,55	43,19	42,56	42,39
Alentejo Central	44,33	44,94	46,88	47,41	47,95	49,22	48,82	47,18	46,33	48,51
Baixo Alentejo	42,33	39,36	39,24	42,87	47,26	43,83	42,52	39,35	39,01	38,44
Algarve	62,47	66,53	62,54	60,51	59,21	58,69	57,49	56,15	56,29	56,74
R. A. Açores	42,27	44,51	44,08	44,50	44,99	45,38	43,45	43,02	44,30	45,02
R. A. Madeira	43,14	46,31	46,09	47,30	58,40	58,76	60,97	62,94	63,31	67,71

Data source: National Institute of Statistics, Regional Accounts 1995, 1995-1999 and 2000.

TABLE B. REGIONAL SHARES OF LABOUR BY SECTORS, 1995-2000.

Sectors	Primary			Secondary			Tertiary		
Regions	1995	2000	Variation	1995	2000	Variation	1995	2000	Variation
Norte									
Minho-Lima	25,69	19,85	-5,84	30,63	35,67	5,05	43,68	44,57	0,89
Cávado	12,26	9,18	-3,08	46,60	47,71	1,11	41,15	43,12	1,97
Ave	8,54	5,16	-3,37	56,16	63,51	7,34	35,30	31,33	-3,97
Grande Porto	1,91	1,59	-0,32	36,70	35,36	-1,34	61,39	63,03	1,64
Tâmega	19,13	13,79	-5,34	49,24	50,71	1,47	31,63	35,55	3,92
Entre Douro e Vouga	6,18	4,82	-1,36	62,52	60,55	-1,97	31,30	34,71	3,41
Douro	47,73	38,46	-9,27	13,15	15,06	1,91	39,12	46,37	7,25
Alto Trás-os-Montes	47,85	38,89	-8,96	10,29	14,71	4,41	41,86	46,51	4,66
Centro									
Baixo Vouga	13,26	10,47	-2,80	42,54	40,84	-1,71	44,19	48,64	4,45
Baixo Mondego	14,07	11,94	-2,12	23,89	23,89	0,00	62,04	64,17	2,12
Pinhal Litoral	12,73	9,84	-2,88	38,91	39,29	0,38	48,36	50,94	2,58
Pinhal Interior Norte	23,42	18,54	-4,88	36,29	36,89	0,60	40,30	44,57	4,27
Dão-Lafões	28,46	22,46	-6,00	25,81	27,37	1,56	45,73	50,08	4,35
Pinhal Interior Sul	36,36	31,42	-4,95	28,64	28,76	0,12	35,00	39,82	4,82
Serra da Estrela	27,17	21,57	-5,61	29,89	33,33	3,44	42,93	45,10	2,16
Beira Interior Norte	32,81	26,79	-6,03	22,07	25,89	3,82	45,12	47,14	2,03
Beira Interior Sul	24,23	20,74	-3,49	26,03	29,38	3,35	49,74	49,88	0,13
Cova da Beira	19,72	17,26	-2,47	35,78	34,51	-1,27	44,50	48,23	3,73
Lisboa e Vale do Tejo									
Oeste	24,11	17,20	-6,91	31,32	31,25	-0,06	44,57	51,48	6,91
Grande Lisboa	0,51	0,38	-0,13	21,16	19,65	-1,50	78,33	79,96	1,62
Península de Setúbal	5,05	3,36	-1,69	30,37	29,83	-0,54	64,58	66,81	2,23
Médio Tejo	18,06	13,13	-4,93	31,38	32,08	0,71	50,56	54,79	4,22
Lezíria do Tejo	23,51	16,76	-6,75	26,55	28,20	1,65	49,94	55,04	5,10
Alentejo									
Alentejo Litoral	20,60	19,90	-0,70	23,85	21,19	-2,66	55,56	58,91	3,36
Alto Alentejo	22,13	21,83	-0,31	22,53	22,20	-0,33	55,34	56,16	0,82
Alentejo Central	18,55	16,25	-2,30	24,78	26,83	2,04	56,67	56,93	0,26
Baixo Alentejo	25,16	23,21	-1,95	14,66	16,07	1,41	60,18	60,71	0,54
Algarve	15,59	12,75	-2,84	15,03	18,18	3,15	69,38	69,07	-0,31
R. A. Açores	24,62	24,64	0,02	19,96	20,00	0,04	55,42	55,36	-0,06
R. A. Madeira	19,56	14,19	-5,37	26,67	27,80	1,13	53,78	58,10	4,32
Average Variation			**-3,75**			**1,11**			**2,65**

Data source: National Institute of Statistics, (Classification A3, CAE Rev. 2)
Series begin in 1995, based on the European System of Accounting, 1995 (SEC 95).

References

♦Barro, R. J. (1991) "Economic Growth in a Cross-Section of Countries", *The Quarterly Journal of Economics*, 407-443.

♦Barro, R. J.; Sala-i-Martin, X. (1991) "Convergence across States and Regions", *Brooking Papers on Economic Activity*, 1, 107-182.

♦Barro, R. J.; Sala-i-Martin, X. (1992) "Convergence", *Journal of Political Economy*, 100, 2, 223-251.

♦Barro, R. J.; Sala-i-Martin, X. (1995) "Economic Growth", McGraw Hill, New York.

♦Dobson, Stephen; Ramlogan, Carlyn (2002) "Convergence and Divergence in Latin America, 1970-1998", *Applied Economics*, 465-470.

♦Ferreira, A. (2000) "Convergence in Brazil: Recent Trends and Long Run Prospects", *Applied Economics*, 32, 79-90.

♦Islam, Nazrul (1995) "Growth Empirics: A Panel Data Approach", *The Quarterly Journal of Economics*, 1127-1171.

♦Kaldor, N.(1966) "Causes of the slow rate of economic growth in the U.K." edited in Targetti F. and Thirlwall A.P.(1989), *"The Essential Kaldor"*, Duckworth, London.

♦Kangasharju, A. (1998) "β Convergence in Finland: Regional Differences in Speed of Convergence", *Applied Economics*, 30, 679-687.

♦Mankiw, G.; Romer, D.; Weil, D. N. (1992) "A Contribution to the Empirics of Economic Growth", *The Quarterly Journal of Economics*, 407-437.

♦Marques, A.; Soukiazis, E. (2000) "Per Capita Income Convergence across Countries and across Regions in the European Union. Some New Evidence", *Discussion Paper nº1*, CENEUROP, FEUC.

♦Pekkala, S. (2000) "Aggregate Economic Fluctuations and Regional Convergence: The Finish Case 1988-1995", *Applied Economics*, 32, 211-219.

♦Pigliaru, F.; Adams, J. (1999) "Economic Growth and Change: National and Regional Patterns of Convergence and Divergence", Cheltenham, UK.

♦Sala-i-Martin, X. (1994) "Economic Growth, Cross-Sectional Regressions and the Empirics of Economic Growth", *European Economic Review*, 38, 739-747.

♦Sala-i-Martin, X. (1996) “Regional Cohesion: Evidence and Theories of regional Growth and Convergence”, *European Economic Review*, 40, 1325-1352.

♦Solow, R.M. (1956) “A Contribution to the Theory of Economic Growth”, *Quarterly Journal of Economics*, LXX, 65-94.

♦Soukiazis, E. (2000 a) “Are Living Standards Converging in EU? Empirical Evidence from Time-Series Analysis”, *Discussion Paper nº3*, CENEUROP, FEUC.

♦Soukiazis, E. (2000 b) “Productivity Convergence in the EU. Evidence from Cross-Section and Time-Series Analyses”, *Discussion Paper nº4*, CENEUROP, FEUC.

♦Soukiazis, E. (2001) “The Cumulative Growth Model as an Alternative Approach to the Convergence Process: Some Theoretical and Empirical Considerations”, *Notas Económicas*, 15, FEUC, 19-39.

♦Soukiazis, E. (2003) “Regional Convergence in Portugal”, *Discussion Paper nº14*, CENEUROP, FEUC.