DYNREG
Dynamic Regions in a Knowledge-Driven Global Economy
Lessons and Policy Implications for the EU

WORKING PAPERS

Inequalities in Income and Education and Regional Economic Growth in Western Europe

Andrés Rodríguez-Pose
Vassilis Tselios

34 / 2008

Inequalities in income and education and regional economic growth in western Europe

by

Andrés Rodríguez-Pose and **Vassilis Tselios**

Department of Geography and Environment
London School of Economics
Houghton St
London WC2A 2AE, UK
Tel: +44-(0)20-7955 7971
Fax: +44-(0)20-7955 7412

E-mail: a.rodriguez-pose@lse.ac.uk, v.tselios@lse.ac.uk

Inequalities in income and education and regional economic growth in western Europe

Abstract

Does inequality matter for regional growth? This paper addresses this question by using microeconomic data for more than 100,000 individuals over a period of 5 years from the European Community Household Panel (ECHP) dataset, complemented with Eurostat's Regio data, in order to examine the impact of income and educational distribution on regional economic growth. Educational distribution is measured in terms of educational achievement as well as educational inequality, and income distribution in terms of income per capita and income inequality, not only for the whole of the population, but also for normally working people. Our results indicate that, given existing levels of inequality, an increase in a region's income and educational inequality has a significant positive relationship with subsequent economic growth. Nevertheless, the reverse does not seem to be the case, as we do not find a causal link between growth and changes in inequality levels. Despite the fact that educational achievement is positively correlated with economic growth, the results also suggest that inequalities in income and educational attainment levels matter more for economic performance than average income and educational attainment, respectively. Initial income levels, in contrast, are irrelevant for regional economic growth as they are very sensitive to the inclusion of control variables.

Keywords: Income inequality, educational attainment, educational inequality, economic growth, regions, Europe

1. Introduction

The linkage between inequality and growth is far from being well understood, especially at a regional level. When looking at the effects of income and educational inequality on regional economic growth, we are primarily interested in the ways in which distribution can affect aggregate output and growth through its impact on different channels. The impact of inequality on growth remains controversial and decades of economic, sociological, and political studies offer evidence that the inequality-growth relationship is, indeed, complex (Galor 2000; Galor and Moav 2004). There is a range of theoretical and empirical evidence suggesting that inequality can actually be good for growth (i.e. Mirrlees 1971; Rebelo 1991), while other studies support the idea that inequality may harm growth (i.e. Perotti 1996; Easterly 2001).

This paper aims at shedding light on the inequality-growth relationship at a regional level in western Europe. Do income and educational inequalities matter for growth? To what extent are inequalities associated with growth at a regional level? The focal point is to examine how microeconomic changes in income and educational distribution for a sample of more that 100,000 individuals across regions in Europe affect the evolution of regional economic growth. Microeconomic changes in income and in human capital endowments are measured by average and inequality levels. As this paper contributes to two different strands within the field of economic growth, income per capita, educational attainment and growth, on the one hand, and inequality and growth, on the other, it also tries to determine which of these factors prevails in shaping growth. On this ground, it discriminates between endowments and inequality in wealth and education. Finally, we also attempt to synthesise the impact of both inequalities on growth, comparing the magnitude and significance of their coefficients. The methodology is based on the estimation of static regression models.

The remainder of the paper proceeds as follows. In the next section, the theoretical underpinnings of the impact of income and educational inequalities on regional economic growth are presented. Section 3 illustrates the econometric specification and the regression results of growth models. The last section discusses the conclusions, the implications, and the limits of the results.

2. Theoretical considerations

2.1 The impact of income inequality on regional economic growth

A number of economic theories and arguments have been constructed in the quest to uncover the link between income inequality and economic growth. They are focused on in the ways in which distribution can affect aggregate output and growth through its impact on different channels (Aghion et al. 1999), such as incentives, investments in physical and human capital, and habits. What are the possible transition mechanisms that might link inequality and growth? A number of arguments have been made as to why more or less egalitarian societies can actually be good for growth and why redistribution policies from rich to poor and government interventions may harm or enhance growth.

First of all, the relationship between economic growth and income inequality is determined by *economic incentives*. The operation of the free market in the pursuit of private profit not only provides strong incentives for work, but may also generate inequalities (Champernowne and Cowell 1998). Many sociologists and economists — going back to Adam Smith — support the idea that inequality is fundamentally good for incentives and therefore should be viewed as being growth-enhancing (Mirrlees 1971; Rebelo 1991; Aghion et al. 1998). Inequality promotes a productive economy by creating incentives and encouraging competition. Free markets provide signals that can help to optimise production, resulting in greater gains, but not necessarily in lower income inequality (Heyns 2005, p. 167). Along these lines, Voitchovsky (2005, p. 276) argues that in an economic structure where ability is rewarded, effort, productivity, and risk-taking will also be encouraged, generating higher growth rates and income inequality as a result. Hence, the greater the income inequality, the stronger the incentive to invest either in physical or in human capital, and thus the higher the growth rate. Barro (2000) states that this is the case only if investments incur high costs in relation to median income that may only be in the range of very wealthy agents. Incentives appear to stimulate predominately the production of such goods and services that only the rich can afford to buy, rather than to enable the poor to buy the goods that they most urgently need. Without incentives, entrepreneurial and business activity and risk-taking might cease, capital markets would dry up and economic growth would grind to a halt (Heyns 2005, p. 165). Any public policy aimed at reducing

income inequality may produce negative incentives for economic efficiency and, therefore, may harm economic growth. Such policies include the taxation system and public housing policies, among the key devices used to redistribute income (Lui 1997; Chang 1998). Champernowne and Cowell (1998, p. 16) demonstrate that strong policies of redistribution may hamper the ability of exceptionally efficient and successful firms and entrepreneurs to expand and attract staff with the best talents by offering them the inducement of unusually high pay. Thus, in a *laissez-faire* economy, in which government intervention is minimal, inequality is fundamentally good for incentives, which, in turn, enhance growth. In contrast to this view, equality may also empower a greater number of individuals and increase activity in the market place (Austen, 2002; Gijsberts, 2002).

Income inequality can affect growth through *investments in physical and human capital*. Classical economists (i.e. Keynes 1920; Kaldor 1956) support the notion that more income inequality favours physical capital accumulation, because rich agents have a higher marginal propensity to save compared to the poor.[1] This increases aggregate savings which, in turn, increases growth rates. Contrary to the classical approach, recent work (Galor 2000; Galor and Moav 2000; 2004) suggests that the relationship between income inequality and growth depends on the stage of economic development (or industrialisation). During the early stages of economic development, physical capital accumulation is the prime engine of economic growth. High initial income inequality stimulates high aggregate savings that, in turn, increase physical capital accumulation. Physical capital then stimulates the process of economic development. Hence, income inequality enhances economic development by channelling resources towards individuals with a higher propensity to save. At later stages of economic development, human capital accumulation replaces the accumulation of physical capital as the prime engine of growth, due to capital-skill complementarity. During the economic process, the increased availability of physical capital raises the return on investment in human capital. However, due to credit market imperfections (Galor and Zeira 1993; Bénabou 1994; 2000; 2002), the poor may find their access to human capital

[1] Most empirical studies support the theory of a positive relationship between inequality and savings (Kelley and Williamson 1968). Smith (2001), however, has found evidence that income inequality affects savings only in countries with low levels of financial market development.

curtailed.[2] Thus, in sufficiently wealthy economies, equality may stimulate investment in human capital which promotes economic growth, because human capital accumulation is greater if it is shared by a larger segment of the society. In other words, equality promotes growth via investment in human capital, because more individuals are able to invest in human capital (Perotti 1996; Easterly 2001); and equality could alleviate the adverse effect of credit market constraints on human capital accumulation (Galor and Moav 2004). Furthermore, during the process of development, the constraints on the credit market gradually diminish, differences in savings behaviour between rich and poor agents decline, and the effect of income inequality on economic growth becomes insignificant (Galor and Moav 2004, p. 1021). Nevertheless, Bénabou (1994) argues that even minor imperfections in capital markets can lead to a high degree of stratification. Low levels of income inequality facilitate positive changes for regions, as they offer plenty of economic chances to both advantaged and disadvantaged groups. This allows for a better allocation of resources and more efficiency in physical and human capital investments. For instance, by lowering income inequalities, fewer people under-invest in education because of credit market imperfections (Galor and Zeira 1993; Galor and Moav 2000). Finally, taking only physical capital into consideration, Banerjee and Newman (1993) and Aghion and Bolton (1997) support the notion that with credit market imperfections, equality positively affects an individual's physical capital investment opportunities. In brief, the effect of inequality on economic growth depends not only on the region's level of income, but also on the relative returns to physical and human capital.

Income inequality and economic growth are closely interlinked with *habits*. Champernowne and Cowell (1998, p. 16) argue that once people are accustomed to a degree of comfort they will regard it as a hardship to return to an earlier and lower standard of living. This means that a rapid reduction in income inequality is likely to slow down or even halt economic progress, highlighting the difficulty of the adjustment process.

---

[2] Flug et al. (1998), for example, show that economic volatility — lack of financial markets, income or employment volatility, and income inequality — has a negative effect on the accumulation of human capital. Dixit and Pindyck (1993) show that uncertainty also has a negative effect on investment in physical capital. Flug et al. (1998) argue that volatility has a stronger correlation with investment in human capital than with investment in physical capital.

The relationship between income inequality within a nation and economic growth can also be investigated through *political economy* models such as the voting models (i.e. Perotti 1992; Aghion et al. 1999), but it is not clear-cut. The basic argument for the negative effect of inequality on growth is that the higher the income inequality, the higher the rate of taxation, the lower the incentive to invest, and the lower the growth rate (Bertola 1993; Persson and Tabellini 1994). The argument in support of a positive effect, on the other hand, is that the higher the income inequality, the higher the rate of taxation, the larger the expenditure on public education programmes, and thus the higher the public investment in human capital, and the higher the growth rate (Aghion and Bolton 1990; Saint-Paul and Verdier 1993).[3] Hence, the trade-off between the incentive to invest (which is the fundamental mechanism of a *laissez-faire* economy) and the expenditure on public education programmes (which reflects a fundamental government policy) determines the inequality-growth relationship.

The effect of income inequality within a nation on economic growth also depends upon the effect of *socio-political instability* (i.e. Mauro 1995; Alesina and Perotti 1996). This channel plays a key role in the inequality-growth relationship of less-developed countries beset by political and social unrest or violence, such as some African and Latin American countries, but is less relevant for European countries. In a society with considerable income inequality, the gap between the mean income and the potential legal income of low-skilled workers is large, and hence this is likely to give incentives for the very poor to engage in disruptive activities such as crimes against property and crimes of violence (Nilsson 2004, p. 3). Additionally, the more unequal the distribution of income, the higher the probability for disruptive activities and protests, and the higher the frequency of government changes. Thus, when the gap between rich and poor widens, the poor may experience a greater temptation to engage in disruptive activities that are usually at the expense of the rich (Bénabou 1996). The above cases accentuate the negative effect of inequalities on growth.

[3] Nevertheless, Sylwester (2000) stresses that the larger the expenditure on public education programmes, the lower the growth rate.

The empirical research that has been carried out on the effect of income inequality on economic growth is less unambiguous than the theory. The vast majority of the reduced-form estimates find that inequality has a negative effect on growth (i.e. Persson and Tabellini 1994; Perotti 1996; Barro 2000). Less empirical studies support the positive effect of inequality on growth (i.e. Li and Zou 1999; Forbes 2000). For instance, Forbes (2000) uses panel estimation and her results suggest that in the short and medium term, an increase in a country's level of income inequality has a significant positive relationship with subsequent economic growth. Her estimates are highly robust across samples, variable definitions, and model specifications. Nonetheless, all the above studies examine the relationship between income inequality within a nation and economic growth, while the regional dimension has been virtually overlooked with the exception of Partridge (2005) or Ezcurra (2007).

2.2 The impact of educational inequality on regional economic growth

Economic performance depends increasingly on talent, creativity, knowledge, skills, and experiences. In modern economies, those characteristics shape opportunities and rewards (Wolf 2002, p. 14). Although educational attainment has gained a central role in economic growth analysis (i.e. Stokey 1991; Barro 2001), the link between educational inequality and economic performance is less straightforward than it may appear. The literature on the influence of educational inequality on economic growth is limited. We analyse the contributions of incentives, technological progress in production, and life expectancy to the relationship between educational inequality and growth.

As mentioned earlier, inequality is fundamentally good for *incentives* and therefore should be viewed as being growth-enhancing (Mirrlees 1971; Rebelo 1991; Aghion et al. 1998). Not only income inequality, but also educational inequality, could be good for incentives. The greater the educational inequality, the greater the incentive for an individual to attain a higher educational level and more academic qualifications and training. However, most people require qualifications that are not possessed by everyone (Wolf 2002). The existence of less talented and educated people implies incentives to seize the higher returns for ones skills (Voitchovsky 2005). As Chiswick (1974, p. 17) says

> ‘since human capital is created at a cost, no one would willingly invest in human capital unless it generated sufficient monetary or nonmonetary benefits to compensate for the cost’.

This is likely to enhance economic growth.

Educational inequality also determines growth through *technological progress*. In the early stages of economic development, a wide distribution of human capital might be a necessary condition for take-off. Inequality encourages members of the highly-educated segments of society to increase their investment in human capital, while equality traps the society as a whole at a low level of investment in human capital (Galor and Tsiddon 1997, p. 94). Inequality is essential for a region to increase the aggregate level of human capital and output. In addition, economic growth is affected by the percentage of individuals who inherit a large enough amount of wealth to enable them to invest in human capital (Galor and Zeira 1993, p. 51) and only rich people are able to do so. The parental level of human capital, which is known as the home (or local) environment externality is a critical factor in the positive inequality-growth relationship. The importance of the parental education input in the formation of the child’s education has been stressed in studies by Becker and Tomes (1986) and Coleman (1990). Local human capital externalities may also lock-in income inequality across generations (Bénabou 1994). In the mature stages of economic development, technological progress is positively related to the level of human capital in society (Schultz 1975). The growth process may increase the rate of adoption of new technologies, which induces income convergence via diffusion. More specifically, as the investment in human capital of the highly-educated increases, the accumulated knowledge trickles down to the less-educated via a technological progress in production which is known as the global production externality (Galor and Tsiddon 1997, p. 94).

The relationship between educational inequality and economic growth is also affected by *life expectancy*. Investment in human capital depends on the individual’s life expectancy, which, in turn, depends to a large extent on the environment in which individuals grow up. An individual’s level of human capital is not only an increasing function of the parental level of human capital, but also a function of the number of children born to their parents and life expectancy (de la Croix and Licandro 1999; Kalemli-Özcan 2002).

Due to the lack of available data on educational inequality, little attention has been paid to the empirical impact of inequality on growth (i.e. Birdsall and Londono 1997; López et al. 1998; Castelló and Doménech 2002). Most empirical studies use the international data on educational attainment of Barro and Lee (1993; 1996; 2001). Birdsall and Londono (1997) explored the impact of the distribution of assets (both physical and human capital) on growth. They placed emphasis on human capital accumulation via basic education and health. Their results illustrate a significant negative correlation between education dispersion and economic growth. López et al. (1998) demonstrated that the unequal distribution of education tends to have a negative effect on growth, while an increase in mean education has a positive impact. The impact of education on growth is also affected by the macroeconomic policy environment of a country, which determines what people can do with their education. For example, policy reforms can increase the returns from formal education and enhance the impact of education on growth through trade and investment. López et al. (1998) also showed that the distribution of education is related to technological progress and industrial upgrading. They emphasise the interaction of human capital distribution and policy reforms on economic growth. Finally, Castelló and Doménech (2002) found a negative relationship between human capital inequality and growth for a broad panel of countries. This negative relationship exists not only through the efficiency of resource allocation, but also through a reduction in investment rates. They argue that countries which showed higher educational inequality had experienced lower investment rates and less efficiency in resource allocation than countries which registered lower levels of human capital inequality. The lower the investment rates and the lower the efficiency in the allocation of resources, the lower the growth rates. Their educational inequality measures provide more robust results than the income inequality measures.

To sum up, educational inequality is a significant factor in the economic process and economic growth rates. Although the theoretical and empirical literature on the impact of educational inequality on growth is more than limited, the existing literature provides much insight into the inequality-growth relationship.

3. Econometric specification, data and regression results

The combined impact of income and educational inequality on regional economic growth is given by the following econometric specification.

$$Growth_{i,t+2} = \beta_1' Incpc_{it} + \beta_2' IncIneq_{it} + \beta_3' EducAtt_{it} + \beta_4' EducIneq_{it} + \beta_5' x_{it} + u_{it}$$

with i denoting regions ($i = 1,...,N$) and t time ($t = 1,...,3$)[4]; $Growth_{i,t+2}$ is two-year regional economic growth; $Incpc_{it}$ is income per capita; $IncIneq_{it}$ is income inequality; $EducAtt_{it}$ is educational attainment; $EducIneq_{it}$ is educational inequality; x_{it} is a vector of control variables; $\beta_{1,...,5}$ are coefficients; and u_{it} is the composite error.

Table 1 shows the description and sources of the main and the control variables. The main novelty of this study will be the use of microeconomic data in order to measure intra-regional inequality in income and human capital endowment at a regional level in Europe. Microeconomic variables will be extracted from the European Community Household Panel (ECHP) data survey during the period 1994-2001[5] and complemented by macroeconomic variables from the Eurostat's Regio dataset.[6] The ECHP dataset is based on NUTS regions' version 1995 and the Eurostat's Regio one on NUTS regions' version 2002. The elaboration process of both datasets is coordinated by Eurostat, making comparisons reliable. However, some adjustment of regions in order to match different datasets is required. Additionally, the major limitation of Eurostat's Regio dataset is that regional economic development is not instantaneous, so that changes in economic development from one year to the next are probably too short term to be really useful. Although the payoff for panel data is over long time periods (i.e. five years), changes in economic development

[4] $t = 1$ denotes 1996, $t = 2$ denotes 1998 and $t = 3$ denotes 2000.

[5] The surveys were conducted regularly during the period 1994-2001 at approximately one-year intervals. In these surveys between 104,953 and 124,663 individuals were interviewed about their socioeconomic status and information is collected about their income changes, job changes, education status, living places, age etc. For a review of the ECHP, see Peracchi (2002).

[6] This type of panel data consists of repeated observations on larger entities, the individual regions (NUTS) of the EU.

(growth) are calculated every two years, because the data cover a short time span for each region.

Insert Table 1 around here

The estimates of growth equations are pooled Ordinary Least Square (OLS), Fixed Effects (FEs), and Random Effects (REs). To evaluate which technique is optimal, it is necessary to consider the relationship between the unobserved effect and the regressors.

The p-values of Breusch and Pagan's (1980) Lagrange Multiplier test fail to reject the validity of the pooled OLS estimates. Hence, the unobserved effect is uncorrelated with the explanatory variables and each region is independent and identically distributed, ignoring the panel structure of the data and the information it provides (Johnston and Dinardo 1997). Table 2 depicts the OLS regression results when independent variables are income per capita and income inequality for the whole of the population, while Appendix A.1 displays the OLS regression results for normally working people.[7] Finally, there is no much difference between the significance of the homoskedasticity and the heteroskedasticity consistent covariance matrix estimator, showing that the determinants of regional economic growth are robust to the model specification about the error term. Thus, Table 2 presents only the homoskedasticity consistent covariance matrix estimator.

Insert Table 2 around here

3.1 Growth and income inequality

The analysis performed here addresses the following model.

$$Growth_{i,t+2} = \beta_1' Incpc_{it} + \beta_2' IncIneq_{it} + u_{it}$$

Regression 1 illustrates the combined impact of the natural logarithm of income per capita and income inequality on regional economic growth. The *elasticity coefficient on income per capita* is negative indicating convergence. The findings also show the positive impact of existing *income inequality* on regional economic growth. Existing levels of inequality

[7] The FEs and REs results are not reported because of space constraints, but may be obtained upon request.

across regions in Europe seem to be fundamentally good for incentives and therefore should be viewed as growth-enhancing (Mirrlees 1971; Rebelo 1991; Aghion et al. 1998). The results underline the view of classical economists who claim that a certain level of income inequality favours capital accumulation, because rich agents have a higher marginal propensity to save compared to the poor, increasing aggregate savings and growth. The results also are inconsistent with more recent approaches. These indicate that at the current stage of European development, equality stimulates investment in human capital which promotes growth, as human capital accumulation is greater if it is shared by the largest segment of the society.

Income inequality has decreased slightly between 1995 and 2000 (Rodríguez-Pose and Tselios 2006). As mentioned earlier, Champernowne and Cowell (1998) argue that once people are accustomed to a degree of comfort they will regard it as a hardship to return to an earlier and lower standard of living. Thus, a rapid reduction in income inequality is likely to slow down economic progress, highlighting the difficulty of the adjustment process. Finally, considering the political economy models, the higher the income inequality, the higher the rate of taxation, the greater the expenditure on public education programmes, the higher the public investment in human capital, and the higher the (national) economic growth (Saint-Paul and Verdier 1993). [8]

3.2 Growth and educational inequality

The analysis performed here addresses the combined impact of educational attainment and inequality as in the following model.

$$Growth_{i,t+2} = \beta_3' EducAtt_{it} + \beta_4' EducIneq_{it} + u_{it}$$

The results are presented in Regression 2. The positive coefficient on *educational attainment* highlights, as expected, the importance of education in laying the basis for

[8] Considering the model $Growth_{i,t+2} = \beta_1' Incpc_{it} + \beta_2' IncIneq_{it} + \beta_5' x_{it} + u_{it}$, the elasticity coefficient on income per capita is very sensitive to the inclusion of additional variables, while the coefficient on income inequality is robust (the results are provided upon request).

sustained regional growth (Hannum and Buchmann 2005). The positive coefficient also points to the major role of education not only in increasing the individual's capacity, but also in facilitating the process of adaptation to new technologies so as to speed up the diffusion of technology throughout the EU (Aghion et al. 1998). Education seems to allow those European regions with currently less advanced technologies to learn more from advanced regions and thereby help the former to achieve a higher degree of productivity improvement when innovating, and thus a higher growth rate. The impact of education on growth may, however, hide that the role of the education system is not to help individual growth, but rather to sort individuals to fill slots in the labour market (Hannum and Buchmann 2005). Education also has implications for the optimal capital structure. Technologically advanced societies build more human capital relative to physical capital (Aghion et al. 1998).

The positive coefficient on *educational inequality* denotes the fact that existing levels of inequality are fundamentally good for incentives and growth-enhancing (Mirrlees 1971; Rebelo 1991; Aghion et al. 1998) as most people require qualifications that are not possessed by everyone. Hence, inequality seems to create an incentive for people to increase their returns on investment in human capital by enabling members of the highly-educated segments of society to increase their investment in human capital, while avoiding the risk of a low level of investment in human capital trap (Galor and Tsiddon 1997, p. 94).[9]

3.3 Growth and income and educational inequality

Regressions 3-13 show the combined impact of income inequality and educational inequality on regional economic growth.

The findings show an ambiguous impact of income per capita on growth: the elasticity coefficient on income per capita now becomes statistically insignificant. The coefficient on educational attainment, in contrast, remains positive, significant, and robust to the inclusion

[9] Considering the model $Growth_{i,t+2} = \beta_3' EducAtt_{it} + \beta_4' EducIneq_{it} + \beta_5' x_{it} + u_{it}$, the coefficients on educational attainment and inequality are robust (the results are provided upon request).

of additional control variables. The results also show that the higher the income and educational inequality, the higher the growth rate. This finding is also robust.

We assess the robustness of our findings in income and education levels and inequality by introducing a series of control variables in the model. These control variables cover a series of factors generally regarded to affect economic performance at a regional level. They include different aspects of population ageing, access to employment, infrastructure endowment, geography, and institutions – ranging from welfare regimes to family structures. The specific control variables and their sources are presented in Table 1.

Our first control variable is *population ageing* (Regression 4). Its coefficient is statistically insignificant. This seems to support Disney's (1996) finding that the relationship between an population ageing and productivity is unclear.[10]

We also control for *access to work* which is measured as the percentage of normally working respondents (source: ECHP) (Regression 4) and as the economic activity rate of total population (source: EUROSTAT) (Regression 5). The results show a positive and statistically significant coefficient on the latter proxy for access to work, but not for the former.[11] This results in doubts about whether at a regional level in Europe, first, high participation in the labour market contributes to a competitive economic environment, which promotes allocative efficiency (Azzoni and Silveira-Neto 2005), and second,

[10] Nevertheless, for normally working people, the coefficient on population ageing is negative and statistically significant (see Regression 7 in Appendix A.1). This may show that older workers are, on average, less productive than younger ones for several reasons (Tang and MacLeod 2006). First, younger and older workers differ in their levels of technology adoption, as the former are the primary adopters and beneficiaries of new technologies that are most probably more productive than old technologies, while the latter tend to be more set in their ways and less willing to learn new ways of doing things (Galenson and Weinberg 2000). Second, both types of workers differ in work effort, as younger workers tend to work more hours and are able to concentrate more on the job, they are healthier on average and thus take fewer days in sick leave than older workers (Cheal 2000). Since productivity declines as a worker gets closer to retirement (Bhattacharya and Russell 2001), population ageing has a negative impact on regional economic growth. Hence, differences in technology adoption and work effort may lead to different productive capacities across different age groups of the workforce. A somewhat different view has been built on the assumption that retired people tend to spend their savings, decreasing capital investment, while working people save for their retirement. (Futagami and Nakajima 2001).

[11] However, this variable is not statistically significant when explanatory variable is income per capita and income inequality for normally working people (see Appendix A.1).

whether high labour force participation implies high work-related education and training which are positively associated with wage and growth (Lynch 1992; Parent 1999).

We then control for unemployment and inactivity. While the coefficient on *unemployment* is not statistically significant, the positive and statistically significant coefficient on *inactivity* accords well with the theoretical work of Hall (1991) and Caballero and Hammour (1994), which emphasise that recessions may stimulate growth. More specifically, inactivity may stimulate efficiency gains by causing less efficient firms to exit, and may encourage firms to adopt reorganising investments and innovative activities. The findings seem to reject the view that the higher the inactivity, the higher the skill losses, the greater the unexploited opportunities for learning-by-doing and the greater the inefficiencies in the production of human capital, and thus the lower the regional growth rate (Stadler 1990; Muscatelli and Tirelli 2001).

Our final labour force control is *the female participation in the labour market* (Regression 6), as work access differs by gender. Women and men, on average, occupy different positions, with women traditionally more likely to be poor and less-educated relative to the position of men, implying gender wage and social differentials. The results of the impact of women's work access on growth are positive and statistically significant. A higher female work access is likely to stimulate growth, because higher employment means greater level of inputs and firms can produce more. However, economic inefficiencies arise from persisting gender differentials in the labour market (Tzannatos 1999). Hence, higher women's participation in the labour market increases the economic efficiency.

The influence of *transport infrastructure* on growth is examined in Regression 8. Most studies (Aschauer 1989; Banister and Berechman 2000) have accepted the position that transport infrastructure contributes positively to economic growth for many reasons. The net benefits associated with public transport infrastructure are related to increases in the net local income, which stem from either private investments due to the reductions in transport costs and travel times, or positive externalities as the income of the non-users of the infrastructure may increase due to increases in local demand on the part of the infrastructure users (McCann and Shefer 2004). An increase in the level of connectivity implies a greater ability on the part of local firms to develop profitable market relationships

with firms and consumers. Firms that are located in areas with a better infrastructure will be more integrated into the market system and more exposed to competition and, thus, under more pressure to improve productivity (Vickerman 1991; Deichmann et al. 2004). Therefore, infrastructure can contribute to growth, either directly as a measurable final product, or indirectly as an intermediate input, because infrastructure enhances the productivity of all other inputs in producing output (Wang 2002) and generates positive externalities. These views are, nevertheless, opposed by our results. While the coefficient on road infrastructure is not statistically significant, the coefficient on rail infrastructure is negative and significant.[12] This is likely to show that while a transport infrastructure may encourage development in under-developed regions, its construction alone will not be enough to bring about the desired economic changes (McCann and Shefer 2004, p. 179). Other factors such as the resource endowments of the region, the economic climate in the region, the prices of input factors of production, government policies, or historically developed infrastructure would tend to determine the economic viability of a region far more than its transport infrastructures (Vickerman 1991; McCann and Shefer 2004). Our results are consistent with the studies of Holtz-Eakin (1994) and Holtz-Eakin and Lovely (1996). The negative impact of the rail infrastructure is likely to show more limited benefits than other modes of transport infrastructure. However, bearing in mind that data for only a few regions were available, some caution is called for in the interpretation of the results.

The findings for *urbanisation* (Regression 9) show that the higher the urbanisation level within a region, the higher the growth rate. [13] Urbanisation seems to spur economic growth, because city-regions are full of technological and pecuniary externalities. Cities allow

[12] Since the transport infrastructure of 1995-2000 has been constructed over a great many years, both variables may reflect lagged requirements and patterns of development rather than current and prospective ones (European Commission 1999). Additionally, the physical scale measurement does not give a clear picture of infrastructure stock, because it is extremely difficult to approach the estimation of the qualitative characteristics of the infrastructure capacity (Rovolis and Spence 2002, p. 394). Questions related to infrastructure measurements remain open to be analysed in greater depth (Haughwout 1998; European Commission 1999). Nevertheless, indicators neither of scale nor of quality can convey how the existing transport endowment in any region is suitable to its regional development needs (European Commission 1999, p. 122). Therefore, the indicators devised need to be interpreted with caution.

[13] This variable is not statistically significant when explanatory variable is income per capita and income inequality for normally working people (see Appendix A.1).

goods, ideas and people to come together for the purposes of exchange and production (Polese 2005). This, in turn, allows regions to reap the gains from trade and specialisation, enhancing growth. Additionally, cities foster and facilitate flows of local knowledge, the creation of dense social networks, and the production of behavioural and cultural change. In cities, people have face-to-face contact which is a fundamental condition of tacit knowledge spillovers. The interaction between people promotes innovation, continually pushing up productivity and growth (Jacobs 1970). At the European regional level, the economic benefits of urbanisation seem to outweigh its potential costs. The benefits of urbanisation arise due to the presence of knowledge spillovers among firms in an industry (Marshall 1890), a buildup of knowledge and ideas associated with historical diversity (Jacobs 1970), the local competition of an industry, and the lower infrastructure, information, transaction, training and recruitment costs (Polese 2005); while the costs arise due to the commuting expenditures within cities, the substantial pollution, and the pervasive traffic congestion (Bertinelli and Black 2004). The economic costs also arise from the pressure posed by geographic concentration on urban factor markets that bids up prices and from dispersed demand (Martin and Ottaviano 2001).

We then examine the impact of *latitude* on growth (Regression 10). We include this variable in our analysis, because a number of cross-country studies (Gallup et al. 1999; Masters and McMillan 2001) have found latitude to be an important factor in accounting for differences in cross-country economic growth rates. However, the coefficient on latitude is not statistically significant.

We finally control for the influence of some institutional factors such as *welfare state* (Regression 11), *religion* (Regression 12), and *family structure* (Regression 13). The findings show that regional growth is lowest in countries with a 'residual' welfare state regime (Portugal, Spain, Italy, and Greece), while Anglican and Orthodox areas have the highest growth rate; and that the nationally-based definition of family structure we use (Berthoud and Iacovou 2004) does not matter for growth. More specifically, although it is difficult to disentangle the mixture of incentives and disincentives of the welfare state because it is a conglomerate of different targeted programmes (Herce et al. 2001), when

controlling for income and educational levels and inequality, growth rates are lower in Greece, Italy, Spain, and Portugal.

None of the control variables introduced in the model altered the significance and the direction of the coefficients for the variables depicting income and educational levels and inequality, making the positive association between educational attainment and economic growth and between income and educational inequality and growth robust to changes in the specification of the model.

Finally, considering the standardised coefficients for the above regressions (Appendix A.3), educational attainment, income inequality and educational inequality explain the largest variation in growth rate. The results also suggest that inequalities in income and educational attainment levels matter more for economic performance than average income and educational attainment, respectively. Nonetheless, no matter how income inequality is defined, the low adjusted R-squared depicts that income and human capital variables account for a relatively low proportion of the variation in regional economic growth level differences.

3.4 Causality

The theoretical arguments advocate a causal link between inequality and economic growth. Yet the number of studies on this topic is limited. The empirical impact of growth on inequality has attracted less attention than vice versa. Mocan (1999), for instance, argued that growth is not necessarily associated with an improvement in income inequality, because growth can coexist with increased unemployment. Aghion et al. (1999), on the other hand, found that growth may increase wage inequality, both across and within education cohorts, and that technical change is a crucial factor in explaining this relationship. Finally, Griffin and Khan (1972) and Papanek and Kyn (1986) posit that a high rate of growth increases inequality because it requires great rewards for higher income groups such as inventors, managers, and land owners. The question addressed here is: ‘does regional economic growth increase income and educational inequality?’

Table 3 reports the OLS, FEs, and REs results for the impact of regional economic growth on inequality. The statistical evidence is in favour of the FEs models. The findings show

that the impact of growth on income and educational inequality is not statistically significant. Hence, our result do not support the causal link between inequality and growth.

Insert Table 3 around here

5. Concluding remarks and further research

Both income and educational distributions are basic determinants in regional economic growth analyses. First, there are arguments that have been made so as to why more or less skewed income distributions can actually be good for growth and why government interventions may harm or enhance growth. Second, educational distribution is also seen as the engine of economic growth and so is central to any modern economy. Wolf (2002, p. 244), for instance, argued that education now matters for growth more than ever before in history, but only when individuals have the right qualifications, they are studying the right subjects, and they are in the right institutions. However, the combined impact of both income and educational distribution on growth is far from being well understood and is indeed complex.

This is especially the case at a regional level in Europe where the issue has been hardly addressed. The limited existing theoretical and empirical literature shows that there is a high correlation between income and educational inequalities (Rodríguez-Pose and Tselios 2006). This paper has addressed using a microeconomic analysis of income and educational distribution, measured by average and inequality levels, whether this link also affects the economic performance of regions across Europe and whether any potential correlation is affected by the introduction of other variables.

As a whole, our results indicate that both income and educational inequality matter for regional growth. Existing levels of income and education inequality seem to be fundamentally good for socioeconomic incentives and thus should be considered as growth-enhancing. The statistical analysis performed in this paper does, however, not favour causality. The findings also suggest that the impact of income per capita of any region is irrelevant for regional growth in the EU as the elasticity coefficient on income per capita is very sensitive to the inclusion of income inequality, education, and other control variables. Our results also concur with the general belief that educational achievement has a positive

relationship with economic growth. The above findings are robust to the definition of income distribution.

One of the major difficulties in this study is that multiple direct and indirect linkages exist among income distribution, educational distribution, and regional economic growth, and common factors, such as population ageing, unemployment, inactivity and work access exert their influence on them. Despite this complexity, the results show clearly that on the whole, the association between inequality in income and growth across regions in western Europe is stronger than that between growth and levels of income, as well as the association between inequality in education and growth is stronger than that between growth and educational attainment.

The findings have important policy implications. Existing income and human capital inequality are likely to increase growth, but the magnitude of their impact is small. Nevertheless, increasing inequality does not emerge as a simple remedy for increasing growth due to their direct and indirect linkages and to the fact that changes in the level of income and educational inequality towards greater or lower inequality may tilt the positive influence they currently have on economic incentives beyond the threshold in which the incentives become disincentives. Policy-makers should also take into account that the reverse effect does not seem to be valid.

Bibliography

Aghion P, Bolton P (1990) Government domestic debt and the risk of default: a political economic model of the strategic role of debt. In: Dornbusch R, Draghi M (eds.), Public debt management: theory and history, Cambridge University Press, Cambridge.

Aghion P, Bolton P (1997) A theory of trickle-down growth and development. Review of Economic Studies 64:151-172.

Aghion P, Caroli E, Garcia-Penalosa C (1999) Inequality and economic growth: the perspective of the new growth theories. Journal of Economic Literature 37:1615-1660.

Aghion P, Howitt P, Brant-Collett M, García-Peñalosa C (1998) Endogenous growth theory. MIT Press, Cambridge, Mass.

Alesina A, Perotti R (1996) Income distribution, political instability, and investment. European Economic Review 40:1203-1228.

Aschauer DA (1989) Is public expenditure productive. Journal of Monetary Economics 23:177-200.

Azzoni CR, Silveira-Neto R (2005) Decomposing regional growth: labor force participation rates, structural changes, and sectoral factor reallocation. Annals of Regional Science 39:221-239.

Banerjee AV, Newman AF (1993) Occupational choice and the process of development. Journal of Political Economy 101:274-298.

Banister D, Berechman J (2000) Transport investment and economic development. UCL Press, London.

Barro RJ (2000) Inequality and growth in a panel of countries. Journal of Economic Growth 5:5-32.

Barro RJ (2001) Human capital and growth. American Economic Review 91:12-17.

Barro RJ, Lee JW (1993) International comparisons of educational attainment. Journal of Monetary Economics 32:363-394.

Barro RJ, Lee JW (1996) International measures of schooling years and schooling quality. American Economic Review 86:218-223.

Barro RJ, Lee JW (2001) International data on educational attainment: updates and implications. Oxford Economic Papers-New Series 53:541-563.

Becker GS, Tomes N (1986) Human capital and the rise and fall of families. Journal of Labor Economics 4:S1-S39.

Bénabou R (1994) Theories of persistent inequalities - human capital, inequality, and growth - a local perspective. European Economic Review 38:817-826.

Bénabou R (1996) Inequality and growth. National Bureau of Economic Research, Cambridge, MA.

Bénabou R (2000) Unequal societies: income distribution and the social contract. American Economic Review 90:96-129.

Bénabou R (2002) Tax and education policy in a heterogeneous agent economy: what levels of redistribution maximize growth and efficiency? Econometrica 70:481-517.

Berthoud R, Iacovou M (2004) Social Europe: living standards and welfare states. Edward Elgar, Cheltenham, UK, Northampton, MA.

Bertinelli L, Black D (2004) Urbanization and growth. Journal of Urban Economics 56:80-96.

Bertola G (1993) Factor shares and savings in endogenous growth. American Economic Review 83:1184-1198.

Bhattacharya M, Russell S (2001) Aging and productivity among judges: some empirical evidence from the high court of Australia. Australian Economic Papers 40:199-212.

Birdsall N, Londono JL (1997) Asset inequality matters: an assessment of the World Bank's approach to poverty reduction. American Economic Review 87:32-37.

Breusch TS, Pagan AR (1980) The Lagrange multiplier test and its applications to model specification in econometrics. Review of Economic Studies 47:239-253.

Caballero RJ, Hammour ML (1994) The cleansing effect of recessions. American Economic Review 84:1350-1368.

Castelló A, Doménech R (2002) Human capital inequality and economic growth: some new evidence. Economic Journal 112:C187-C200.

Champernowne DG, Cowell FA (1998) Economic inequality and income distribution. Cambridge University Press, Cambridge [England]; New York.

Chang R (1998) Political party negotiations, income distribution, and endogenous growth. Journal of Monetary Economics 41:227-255.

Cheal D (2000) Aging and demographic change. Canadian Public Policy - Analyse De Politiques 26:S109-S122.

Chiswick BR (1974) Income inequality. Columbia University Press, New York.

Coleman JS (1990) Foundations of social theory. Harvard University Press, Cambridge, Mass.

de la Croix D, Licandro O (1999) Life expectancy and endogenous growth. Economics Letters 65:255-263.

Deichmann U, Fay M, Koo J, Lall SV (2004) Economic structure, productivity, and infrastructure quality in Southern Mexico. Annals of Regional Science 38:361-385.

Disney R (1996) Can we afford to grow older?: a perspective on the economics of aging. MIT Press, Cambridge, Mass.

Dixit AK, Pindyck RS (1993) Investment under uncertainty. Princeton University Press, Princeton, N.J.

Easterly W (2001) The middle class consensus and economic development. Journal of Economic Growth 6:317-335.

Esping-Andersen G (1990) The three worlds of welfare capitalism. Polity, Cambridge.

European Commission (1999) The European regions: sixth periodic report on the socio-economic situation in the regions of the European Union. Luxembourg: Official Publication Office.

Ezcurra R (2007) Is income inequality harmful for regional growth? evidence from the European Union. Urban Studies 44:1953-1971.

Ferrera M (1996) The “southern model” of welfare in social Europe. Journal of European Social Policy 6:17-37.

Flug K, Spilimbergo A, Wachtenheim E (1998) Investment in education: do economic volatility and credit constraints matter? Journal of Development Economics 55:465-481.

Forbes KJ (2000) A reassessment of the relationship between inequality and growth. American Economic Review 90:869-887.

Futagami K, Nakajima T (2001) Population aging and economic growth. Journal of Macroeconomics 23:31-44.

Galenson DW, Weinberg BA (2000) Age and the quality of work: the case of modern American painters. Journal of Political Economy 108:761-777.

Gallup JL, Sachs JD, Mellinger AD (1999) Geography and economic development. International Regional Science Review 22:179-232.

Galor O (2000) Income distribution and the process of development. European Economic Review 44:706-712.

Galor O, Moav O (2000) Ability-biased technological transition, wage inequality, and economic growth. Quarterly Journal of Economics 115:469-497.

Galor O, Moav O (2004) From physical to human capital accumulation: inequality and the process of development. Review of Economic Studies 71:1001-1026.

Galor O, Tsiddon D (1997) The distribution of human capital and economic growth. Journal of Economic Growth 2:93-124.

Galor O, Zeira J (1993) Income distribution and macroeconomics. Review of Economic Studies 60:35-52.

Griffin K, Khan AR (1972) Growth and inequality in Pakistan. Macmillan, London.

Hall RE (1991) Recessions as reorganisations. NBER Macroeconomics Annual.

Hannum E, Buchmann C (2005) Global Educational Expansion and Socio-Economic Development: an Assessment of Findings from the Social Sciences. World Development 33:333-354.

Haughwout AF (1998) Aggregate production functions, interregional equilibrium, and the measurement of infrastructure productivity. Journal of Urban Economics 44:216-227.

Hausman JA (1978) Specification tests in econometrics. Econometrica 46:1251-1271.

Herce JA, Sosvilla-Rivero S, de Lucio JJ (2001) Growth and the welfare state in the EU: a causality analysis. Public Choice 109:55-68.

Heyns B (2005) Emerging inequalities in Central and Eastern Europe. Annual Review of Sociology 31:163-197.

Holtz-Eakin D (1994) Public-sector capital and the productivity puzzle. Review of Economics and Statistics 76:12-21.

Holtz-Eakin D, Lovely ME (1996) Scale economies, returns to variety, and the productivity of public infrastructure. Regional Science and Urban Economics 26:105-123.

Jacobs J (1970) The economy of cities. Cape, London.

Johnston J, Dinardo J (1997) Econometric methods. McGraw-Hill, New York.

Kaldor N (1956) Alternative theories of distribution. Review of Economic Studies 23:83-100.

Kalemli-Özcan S (2002) Does the mortality decline promote economic growth? Journal of Economic Growth 7:411-439.

Kelley AC, Williamson JG (1968) Household saving behavior in developing economies - Indonesian case. Economic Development and Cultural Change 16:385-403.

Keynes JM (1920) The economic consequences of the peace. Macmillan, London.

Li H, Zou H-F (1999) Income inequality is not harmful for growth: theory and evidence. Review of Development Economics 2:318-334.

López RE, Thomas V, Wang Y (1998) Addressing the education puzzle: the distribution of education and economic reforms. World Bank, Economic Development Institute, Office of the Director and Macroeconomic Management and Policy Division, Washington, DC.

Lui H-K (1997) Income inequality and economic development. City University of Hong Kong Press, Hong Kong.

Lynch LM (1992) Private sector training and the earnings of young workers. American Economic Review 82:299-312.

Marshall A (1890) Principles of economics. Macmillan and Co., London; New York.

Martin P, Ottaviano GIP (2001) Growth and agglomeration. International Economic Review 42:947-968.

Masters WA, McMillan MS (2001) Climate and scale in economic growth. Journal of Economic Growth 6:167-186.

Mauro P (1995) Corruption and growth. Quarterly Journal of Economics 110:681-712.

McCann P, Shefer S (2004) Location, agglomeration and infrastructure. Papers in Regional Science 83:177-196.

Mirrlees JA (1971) Exploration in theory of optimum income taxation. Review of Economic Studies 38:175-208.

Mocan HN (1999) Structural unemployment, cyclical unemployment, and income inequality. Review of Economics and Statistics 81:122-134.

Muscatelli VA, Tirelli P (2001) Unemployment and growth: some empirical evidence from structural time series models. Applied Economics 33:1083-1088.

Nilsson A (2004) Income inequality and crime: the case of Sweden. Working Paper Series 2004:6, IFAU - Institute for Labour Market Policy Evaluation.

Papanek GF, Kyn O (1986) The effect on income distribution of development, the growth rate and economic strategy. Journal of Development Economics 23:55-65.

Parent D (1999) Wages and mobility: the impact of employer-provided training. Journal of Labor Economics 17:298-317.

Partridge MD (2005) Does income distribution affect U.S state economic growth? Journal of Regional Science 45:363-394.

Peracchi F (2002) The European Community Household Panel: a review. Empirical Economics 27:63-90.

Perotti R (1992) Income distribution, politics, and growth. American Economic Review 82:311-316.

Perotti R (1996) Growth, income distribution, and democracy: what the data say. Journal of Economic Growth 1:149-187.

Persson T, Tabellini G (1994) Is inequality harmful for growth. American Economic Review 84:600-621.

Polese M (2005) Cities and national economic growth: a reappraisal. Urban Studies 42:1429-1451.

Rebelo S (1991) Long-run policy analysis and long-run growth. Journal of Political Economy 99:500-521.

Rodríguez-Pose A, Tselios V (2006) Education and income inequality in the regions of the European Union. ERSA conference papers ersa06p370, European Regional Science Association.

Rovolis A, Spence N (2002) Promoting regional economic growth in Greece by investing in public infrastructure. Environment and Planning C-Government and Policy 20:393-419.

Saint-Paul G, Verdier T (1993) Education, democracy and growth. Journal of Development Economics 42:399-407.

Schultz TW (1975) Value of ability to deal with disequilibria. Journal of Economic Literature 13:827-846.

Smith D (2001) International evidence on how income inequality and credit market imperfections affect private saving rates. Journal of Development Economics 64:103-127.

Stadler GW (1990) Business-cycle models with endogenous technology. American Economic Review 80:763-778.

Stokey NL (1991) Human capital, product quality, and growth. Quarterly Journal of Economics 106:587-616.

Sylwester K (2000) Income inequality, education expenditures, and growth. Journal of Development Economics 63:379-398.

Tang HM, MacLeod C (2006) Labour force ageing and productivity performance in Canada. Canadian Journal of Economics-Revue Canadienne D Economique 39:582-603.

Tzannatos Z (1999) Women and labor market changes in the global economy: growth helps, inequalities hurt and public policy matters. World Development 27:551-569.

Vickerman RW (1991) Infrastructure and regional development. Pion, London.

Voitchovsky S (2005) Does the profile of income inequality matter for economic growth? Journal of Economic Growth 10:273-296.

Wang EC (2002) Public infrastructure and economic growth: a new approach applied to East Asian economies. Journal of Policy Modeling 24:411-435.

Wolf A (2002) Does education matter?: Myths about education and economic growth. Penguin, London.

Table 1: Variables

Variable	Description	Sources
Growth	Two-year regional economic growth	EUROSTAT
Natural logarithm of income per capita	(a) Natural logarithm of income per capita for the whole of the population (/1000) (b) Natural logarithm of income per capita for normally working (15+ hours/week) people (/1000)	ECHP
Income inequality	(a) Income inequality for the whole of the population (Theil index) (b) Income inequality for normally working (15+ hours/week) people (Theil index)	ECHP
Educational attainment	Average in education level completed	ECHP
Educational inequality	Inequality in education level completed (Theil index)	ECHP
Population ageing	The average age of respondents	ECHP
Work access	(a) The percentage of normally working (15+ hours/week) respondents (b) The percentage of economic activity rate of total population	ECHP EUROSTAT
Unemployment	The percentage of unemployed respondents	ECHP
Inactivity	The percentage of inactive respondents	ECHP
Female's work access	The percentage of female's economic activity rate	EUROSTAT
Road stock (*time-invariant*)	The average of the length of road-motorways per square kilometres (1995-2000)	EUROSTAT
Rail capital (*time-invariant*)	The average of the length of railways per square kilometres (1995-2000)	EUROSTAT
Urbanisation (*time-invariant*)	The percentage of respondents who live in a densely populated area (1999-2000)	ECHP
Latitude (*time-invariant*)	Latitude	GIS
Welfare State		Esping-Andersen (1990), Ferrera (1996), Berthoud and Iacovou (2004)
Socialism (social-democratic)	Sweden, Denmark	
Liberal	United Kingdom, Ireland	
Corporatist (conservatism)	Luxembourg, Belgium, France, Germany, Austria	
Residual ('Southern')	Portugal, Spain, Italy, Greece	
Religion		http://www.cia.gov http://csi-int.org; http://www.wikipedia.org/
Mainly Protestant	Sweden, Denmark, Northern Germany, Scotland	
Mainly Catholic	France, Ireland, Luxembourg, Portugal, Spain, Italy, Austria, Southern Germany, Belgium	
Mainly Orthodox	Greece	
Mainly Anglicans	England	
Family Structure		Berthoud and Iacovou (2004)
Nordic (Scandinavian)	Sweden, Denmark	
North/Central	UK, Belgium, Luxembourg, France, Germany, Austria	
Southern/Catholic	Ireland, Portugal, Spain, Italy, Greece	

Table 2: OLS results

	(1)		(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
	OLS	FEs												
Natural logarithm of income per capita	-0.0135 (0.0082)	-0.0480 (0.0208)**		0.0011 (0.0114)	0.0022 (0.0118)	0.0028 (0.0117)	-0.0013 (0.0130)	0.0000 (0.0117)	0.0390 (0.0244)	-0.0180 (0.0203)	-0.0028 (0.0136)	-0.0181 (0.0162)	0.0096 (0.0146)	-0.0044 (0.0161)
Income inequality	0.0452 (0.0227)**	0.1697 (0.0701)**		0.0644 (0.0236)***	0.0575 (0.0289)**	0.1031 (0.0308)***	0.0981 (0.0338)***	0.0749 (0.0345)**	0.1384 (0.0474)***	0.1409 (0.0476)***	0.1045 (0.0379)***	0.1313 (0.0347)***	0.0918 (0.0356)**	0.1021 (0.0361)***
Educational attainment			0.0542 (0.0173)***	0.0782 (0.0196)***	0.0804 (0.0209)***	0.0559 (0.0228)**	0.0635 (0.0229)***	0.0726 (0.0228)***	0.0630 (0.0479)	0.0492 (0.0292)*	0.0634 (0.0229)***	0.0237 (0.0273)	0.0290 (0.0282)	0.0623 (0.0242)**
Educational inequality			0.0625 (0.0114)***	0.0644 (0.0122)***	0.0666 (0.0134)***	0.0604 (0.0142)***	0.0613 (0.0151)***	0.0631 (0.0140)***	0.0410 (0.0245)*	0.0350 (0.0194)*	0.0619 (0.0152)***	0.0384 (0.0167)**	0.0502 (0.0180)***	0.0602 (0.0158)***
Population ageing					-0.0004 (0.0014)	0.0005 (0.0014)	-0.0002 (0.0014)	-0.0025 (0.0017)		0.0000 (0.0018)	-0.0002 (0.0014)	0.0011 (0.0015)	0.0000 (0.0015)	-0.0001 (0.0015)
Work access (source: ECHP)					-0.0222 (0.0575)									
Work access (source: Eurostat)						0.0015 (0.0007)**								
Unemployment							-0.0811 (0.1013)			-0.1199 (0.1718)	-0.0808 (0.1015)	-0.0097 (0.1127)	0.0646 (0.1142)	-0.0862 (0.1075)
Inactivity								0.2355 (0.0890)***						
Female's work access							0.0008 (0.0006)	0.0017 (0.0006)***		0.0018 (0.0008)**	0.0008 (0.0006)	0.0005 (0.0007)	0.0010 (0.0006)	0.0008 (0.0007)
Road stock (fixed)									0.2324 (0.4618)					
Rail capital (fixed)									-0.4222 (0.2435)*					
Urbanisation (fixed)										0.0315 (0.0167)*				
Latitude (fixed)											0.0003 (0.0008)			
Liberal												0.0087 (0.0146)		
Corporatist												-0.0159 (0.0137)		
Residual												-0.0422 (0.0213)**		
Mainly Catholic													0.0066 (0.0091)	
Mainly Orthodox													0.0296 (0.0175)*	
Mainly Anglicans													0.0211 (0.0098)**	
North/Central family structure														-0.0007 (0.0137)
Southern/Catholic family structure														-0.0042 (0.0133)
Constant	0.1140 (0.0262)***	0.1491 (0.0562)***	0.0105 (0.0214)	-0.0365 (0.0401)	-0.0110 (0.0855)	-0.1447 (0.0899)	-0.0544 (0.0933)	-0.1011 (0.0830)	-0.1030 (0.0814)	-0.0724 (0.1225)	-0.0701 (0.1022)	-0.0125 (0.1004)	-0.0802 (0.0943)	-0.0496 (0.0986)
Adjusted R-squared	0.0632	0.0533	0.1129	0.1327	0.1273	0.1647	0.1546	0.1746	0.0716	0.1512	0.1518	0.1941	0.1680	0.1484
Observations	306		298	298	298	270	270	270	114	163	270	270	270	270
LM test (p-value)	4.94 (0.0262)		0.20 (0.6536)	0.02 (0.8845)	0.04 (0.8482)	0.08 (0.7840)	0.08 (0.7818)	0.00 (0.9903)	1.93 (0.1642)	0.42 (0.5194)	0.09 (0.7598)	0.00 (0.9934)	0.03 (0.8594)	0.11 (0.7455)
HAUSMAN test (p-value)	6.11 (0.0471)		3.89 (0.1428)	18.89 (0.0008)	30.23 (0.0000)	27.31 (0.0001)	44.31 (0.0000)	34.96 (0.0000)						

NOTES: (*), (**), and (***) indicates significance at the 10%, 5% and 1% level, respectively. LM test is the Lagrange Multiplier test for the random effects model based on the OLS residuals (Breusch and Pagan 1980). HAUSMAN test is the Hausman (1978) test for fixed or random effects.

Table 3: Causality (1998, 2000)

	Dependent Variable: Income iequality			Dependent Variable: Educational Inequality		
	(a) OLS	**(b) FEs**	(c) REs	(a) OLS	**(b) FEs**	(c) REs
Income per capita	-0.0119 (0.0028)***	-0.0008 (0.0036)	-0.0093 (0.0020)***	-0.0159 (0.0053)***	-0.0149 (0.0048)***	-0.0098 (0.0032)***
Income inequality				-0.0062 (0.1300)	0.0299 (0.1423)	-0.0015 (0.1135)
Educational attainment	-0.1922 (0.0562)***	0.0113 (0.1217)	-0.2011 (0.0579)***	-0.9710 (0.0806)***	-1.3111 (0.1091)***	-1.1372 (0.0586)***
Educational Inequality	-0.0018 (0.0386)	0.0151 (0.0717)	0.0020 (0.0425)			
Regional economic growth	0.3226 (0.1835)*	-0.0624 (0.1174)	0.1066 (0.1046)	1.4183 (0.3239)***	0.0874 (0.1655)	0.1506 (0.1544)
Constant	0.6358 (0.0676)***	0.3659 (0.1662)**	0.6329 (0.0797)**	1.5376 (0.1017)***	1.9371 (0.1389)***	1.7380 (0.0908)***
Adjusted R-squared	0.4870	0.0061		0.7717	0.6406	
Observations	204			204		
LM test (p-value)	74.08 (0.0000)			73.66 (0.0000)		
HAUSMAN test (p-value)	10.85 (0.0283)			304.83 (0.0000)		

NOTES: (*), (**), and (***) indicates significance at the 10%, 5% and 1% level, respectively. LM TEST is the Lagrange Multiplier test for the random effects model based on the OLS residuals (Breusch and Pagan 1980). HAUSMAN TEST is the Hausman (1978) test for fixed or random effects.

Appendix A.1: OLS results when independent variables are income per capita and income inequality for normally working people

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Natural logarithm of income per capita	-0.0136 (0.0076)*		0.0009 (0.0116)	0.0031 (0.0117)	0.0027 (0.0120)	0.0030 (0.0130)	-0.0022 (0.0120)	0.0267 (0.0227)	-0.0141 (0.0206)	0.0044 (0.0135)	-0.0066 (0.0158)	0.0141 (0.0143)	0.0072 (0.0156)
Income inequality	0.1450 (0.0346)***		0.0980 (0.0376)**	0.0853 (0.0384)**	0.1084 (0.0402)***	0.1022 (0.0416)**	0.0830 (0.0411)**	0.1787 (0.0629)***	0.1601 (0.0542)***	0.0963 (0.0446)**	0.1278 (0.0435)***	0.0730 (0.0444)	0.1005 (0.0452)**
Educational attainment		0.0542 (0.0173)***	0.0528 (0.0176)***	0.0694 (0.0209)***	0.0446 (0.0231)*	0.0550 (0.0233)**	0.0666 (0.0233)***	0.0157 (0.0444)	0.0465 (0.0294)	0.0556 (0.0234)**	0.0186 (0.0275)	0.0293 (0.0285)	0.0590 (0.0244)**
Educational inequality		0.0625 (0.0114)***	0.0529 (0.0132)***	0.0614 (0.0142)***	0.0589 (0.0150)***	0.0630 (0.0154)***	0.0594 (0.0148)***	0.0121 (0.0248)	0.0391 (0.0198)*	0.0625 (0.0155)***	0.0426 (0.0170)**	0.0570 (0.0183)***	0.0650 (0.0158)***
Population ageing				-0.0013 (0.0013)	-0.0009 (0.0013)	-0.0009 (0.0014)	-0.0034 (0.0016)**		-0.0011 (0.0019)	-0.0008 (0.0014)	-0.0002 (0.0015)	-0.0008 (0.0015)	-0.0010 (0.0015)
Work access (source: ECHP)				-0.0682 (0.0455)									
Work access (source: Eurostat)					0.0004 (0.0005)								
Unemployment						-0.0010 (0.0987)			0.0867 (0.1660)	-0.0063 (0.0999)	0.0893 (0.1076)	0.1160 (0.1088)	-0.0076 (0.1022)
Inactivity							0.2570 (0.0883)***						
Female's work access						0.0000 (0.0005)	0.0011 (0.0006)**		0.0007 (0.0007)	0.0001 (0.0005)	-0.0006 (0.0006)	0.0003 (0.0005)	0.0000 (0.0006)
Road stock (fixed)								0.5623 (0.4483)					
Rail capital (fixed)								-0.4232 (0.2396)*					
Urbanisation (fixed)									0.0221 (0.0165)				
Latitude (fixed)										-0.0003 (0.0008)			
Liberal											0.0015 (0.0153)		
Corporatist											-0.0233 (0.0145)		
Residual											-0.0370 (0.0222)*		
Mainly Catholic												0.0081 (0.0091)	
Mainly Orthodox												0.0362 (0.0177)**	
Mainly Anglicans												0.0193 (0.0098)*	
North/Central family structure													0.0047 (0.0145)
Southern/Catholic family structure													0.0057 (0.0126)
Constant	0.1032 (0.0248)***	0.0105 (0.0214)	-0.0054 (0.0394)	0.0668 (0.0717)	0.0072 (0.0751)	0.0183 (0.0872)	-0.0173 (0.0739)	-0.0173 (0.0693)	0.0406 (0.1173)	0.0263 (0.0899)	0.0967 (0.1015)	-0.0158 (0.0893)	0.0088 (0.0983)
Adjusted R-squared	0.0962	0.1129	0.1271	0.1301	0.1498	0.1448	0.1716	0.0638	0.1314	0.1420	270	270	270
Observations	306	298	298	298	270	270	270	114	163	270	0.1731	0.1585	0.1397
LM test (p-value)	2.06 (0.1510)	0.20 (0.6536)	0.03 (0.8644)	0.05 (0.8147)	0.47 (0.4933)	0.52 (0.4712)	0.05 (0.8163)	1.07 (0.3016)	1.62 (0.2035)	0.44 (0.5092)	0.31 (0.5751)	0.21 (0.6434)	0.35 (0.5513)
HAUSMAN test (p-value)	2.77 (0.2506)	3.89 (0.1428)	10.75 (0.0295)	25.98 (0.0002)	23.32 (0.0007)	39.97 (0.0000)	31.54 (0.0000)						

NOTES: (*), (**), and (***) indicates significance at the 10%, 5% and 1% level, respectively. LM test is the Lagrange Multiplier test for the random effects model based on the OLS residuals (Breusch and Pagan 1980). HAUSMAN test is the Hausman (1978) test for fixed or random effects.

Appendix A.2: Standardised coefficients

	REGR. 1	REGR. 2	REGR. 3	REGR. 5	REGR. 6	REGR. 7	REGR. 8	REGR. 9	REGR. 10	REGR. 11
Natural logarithm of income per capita	-0.1290		0.0109	0.0207	0.0262	-0.0126	-0.0002	0.3839	-0.1845	-0.0263
Income inequality	0.1560		0.2175	0.1940	0.3495	0.3326	0.2540	0.5163	0.4691	0.3542
Educational attainment		0.3404	0.4913	0.5049	0.3373	0.3828	0.4377	0.2840	0.3293	0.3821
Educational inequality		0.5933	0.6109	0.6317	0.5290	0.5366	0.5525	0.3285	0.3182	0.5419
Population ageing				-0.0160	0.0214	-0.0083	-0.1037		-0.0020	-0.0065
Work access (source: ECHP)				-0.0362						
Work access (source: Eurostat)					0.2194					
Unemployment						-0.0584			-0.0839	-0.0581
Inactivity							0.3207			
Female's work access						0.1569	0.3381		0.3775	0.1529
Road stock (fixed)								0.0676		
Rail capital (fixed)								-0.2735		
Urbanisation (fixed)									0.1685	
Latitude (fixed)										0.0459