Is It the Income Distribution or Redistribution That Affects Growth?

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Abstract
This study addresses the central question in political economy how the objectives of attaining welfare and restricting income inequality are related to each other. Thus far few studies scrutinise whether income inequality as such, or the redistributing public interventions to equalise incomes affect economic growth. This study aims to fill this gap using a panel design covering 30 OECD countries. Taking into account the limited data availability, this study finds a negative association between redistribution and growth that remains significant when the level of inequality is held constant. No evidence is found for a relationship between income inequality and growth. This finding is in line with the trade-off hypothesis, holding that redistribution limits the financial incentives to gain wealth, leading to lower output growth. Yet, the found association is small, and a causal interpretation of the negative association between redistribution and growth does not seem to be warranted.

JEL-codes: O11, E25, H23
Keywords: income inequality, redistribution, economic growth, trade-off

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1. Introduction

The attainment of welfare and growth and the restraining of income inequality, particularly by means of decreasing poverty, are amongst the most important socio-economic objectives of welfare states. Economic expansion implies a higher aggregate standard of living and more utility-enhancing consumption possibilities for the society as a whole. The goal of limiting income inequality pertains more to ideological concepts of fairness, humanitarianism, and equality of human beings. Rawls (1971), for example, argues that societies should have 'fair equality of opportunities', enabling every citizen to pursue personal goals, not limited beforehand by financial constraints. In addition, the objective of limiting inequality can be linked to the provision of a certain level of income security guaranteed by the state.

The question what the core objectives of society should be is largely ideological. Conversely, how the objectives of economic growth and limited income inequality can be reached is a more technical question, although not less contested in academic and political debates. The crux here is whether states are able to limit income inequality whilst at the same time stimulate economic growth through their policies – or the very absence of them. In order to attain high economic growth policies should not have too high costs in terms of foregone output, and the (financing of) public expenditures should not negatively affect incentives beneficial to growth (OECD 2012). Limiting income inequality requires that state actions benefit the poor relatively more in the long run.

Affluent states play an important role in alleviating inequality by redistributing income (Brady 2003). The general view in economics, however, is that redistribution based on economic outcomes, for instance on gained capital or income, reduces marginal benefits of gaining wealth, leading to lower incentives, which retards growth. Okun (1975) coins this the 'big trade-off', as this negative effect of redistribution on the attainment of welfare '[…] plagues us in dozens of dimensions of social policy'. The alleged trade-off is considered to be the primary problem for the contemporary welfare state by many politicians and applied researchers (Pierson and Castles 2006; Sapir 2006). Pontusson (2005) calls the 'market-liberal view' of a trade-off between efficiency and equality the 'economic orthodoxy of our times'.

Another substantial branch of mostly political economy literature has focused on the effects of income inequality on economic development. Inequality can affect growth for instance by leading to more social unrest, or by inhibiting people lacking financial means to invest in themselves to realise their potential. According to Benabou (1996) – although one can hold different views, as will be discussed in the second section – the empirical findings '[…] run over a variety of data sets and periods with many different measures of income distribution, deliver a consistent message: initial inequality is detrimental to long-run growth'.

We might thus expect an effect from the income distribution as well as from the policies put in place to equalise incomes on economic growth. Yet, surprisingly, few studies pay attention to both of these effects. In the substantial amount of literature on the effects of income inequality on growth, hardly any study controls for effects through the redistributive system (*e.g.*, Aghion, Caroli and Garcia-Penalosa 1999; Banerjee and Duflo 2003; Barro 2008). In fact, even in a number of inequality databases, including the often used Deininger and Squire database (1996), no consistent distinction is made between the income distribution before and after government intervention through taxes and transfers (Banerjee and Duflo 2003: 284). On their turn, studies investigating effects of redistribution in general do not take into account possible effects of income inequality (*e.g.*, Romer and Romer 2010). When inequality is indeed 'detrimental to long-run growth' as Benabou concludes, redistribution might have less negative effects than we should expect solely from trade-off arguments, whilst we might even underestimate negative effects when inequality stimulates growth.

This study investigates the associations between economic growth on the one hand, and inequality and redistribution on the other. Many scholars consider the relationship between redistribution and growth to be the primary problem for the contemporary welfare state

(Pierson and Castles 2006; Sapir 2006). It can also be seen as the question in which political science, generally occupied with questions related to distribution and redistribution of power and income, and economics, in which economic growth plays a central role, collide (Lübker 2007). A number of hypotheses are derived why income inequality and redistribution can affect growth. Employing a panel design of 25 to 30 OECD countries, this study does not find any obvious association between income inequality and economic growth, using multiple inequality indicators derived from a high-quality OECD database. Yet, there is empirical evidence that redistribution is associated with lower GDP growth, although the association does not appear to be particularly strong. This result remains firm when the level of inequality is held constant. This finding is in line with the trade-off hypothesis, holding that redistribution limits the financial incentives to gain wealth which leads to lower output growth, although a causal interpretation does not seem to be warranted.

2. Theoretical section

This section sets out theoretical reasons why income inequality and redistribution might affect economic growth in developed countries. An overview of empirical literature can be found in the Appendix.

2.1 Inequality and growth

Four main channels through which inequality can affect economic growth can be discerned in the existing literature.

Two lines of reasoning predict a positive effect of income inequality on economic growth. First, higher dispersion can incite people to put forth additional effort, as the rewards of this additional effort are higher compared to the situation in an egalitarian society. From experimental economics there is evidence that relative incomes are important for perceived welfare or well-being (Gruen and Klasen 2008). Rooth and Stenberg (2011) provide explorative evidence that income inequality in Swedish regions were found to increase economic growth by stimulating commuting patterns. Within firms, a higher wage dispersion can enhance productivity (Mahy, Rycx and Volral 2011). This channel predicts effects of income inequality regardless of the level of wealth, as long as people are (linearly) inclined to gain more wealth.

A second reason why income inequality might positively affect growth comes from the alleged positive effects of inequality on savings. If high income classes have higher marginal propensities to save, and if the rates of savings and investment are positively related, more unequal societies will have a higher steady-state growth rate (Castelló-Climent 2010; Kaldor 1957). It could also be that a concentration of capital is crucial for the construction of new activities with high set-up costs (Galor and Tsiddon 1997). In this way, a more unequal society will have a higher output growth than the more equal one with the same wealth level. Yet, a more unequal society is only beneficial to growth when low income classes have no or a lower propensity to save – an overall higher wealth level so that more people can save would stimulate growth as well. Possibly, because of the internationalisation of the capital market, the relationship between inequality and savings has weakened. Firms in countries with lower saving rates can rely on the savings available in other countries to finance their investments.

Two reasons are commonly put forward why inequality can slow down growth. More unequal societies might well be less socio-politically stable as inequality lowers costs of participating in disruptive actions. Unequal countries experience more violent protests, ethnic tensions, and social polarisation, which can reduce the security of property and contract rights and, ultimately, discourage investment and reduce economic output (Keefer and Knack 2002). These factors may play a less important role in developed countries as property rights are relatively well-secured (Barro 2008). More directly, participation in disruptive events is a waste of resources as time and energy is not spent on productive events (Barro 2000). One

could expect that a very unequal distribution of wealth increases possibilities of social tensions regardless of the level of wealth, although instability especially is likely to be especially an issue when the poverty rate is high.

A second channel pertains to the alleged negative effects of inequality on the stock of human capital. Credit market imperfections inhibit people lacking financial means to fully realise their potential, dampening investment in human capital and overall knowledge building, thereby reducing economic output. This line of reasoning predicts a negative effect of income inequality on economic growth by decreasing the stock of human capital. As the economic importance of schooling has increased in current knowledge-based economies, this negative effect of inequality through the human capital channel might have become more imperative (Galor and Moav 2004). The credit market imperfections theory predicts an effect of a lack of financial means rather than overall income dispersion on growth. In the situation that everyone has enough wealth to invest in their education, the negative effects of income inequality on growth should disappear. It therefore is more appropriate to test this theory using an indicator that focuses on the inequality in the lower part of the distribution.

A difficulty in understanding the consequences of inequality on growth is the possibility of reverse effects. Unless all people benefit equiproportionally, growth itself also affects the income distribution. There is discussion whether growth mainly benefits the rich or whether it 'trickles down' and equalises incomes (Bruno, Ravallion and Squire 1998). Growth might benefit the poor by leading to higher tax revenues and higher demands for goods produced by low-income groups (Dollar and Kraay 2002). Famously, Kuznets (Barro 2008; Kuznets 1955) argues that the long-term effect of growth on inequality shows an inverted U-shape pattern. During initial phases of development only part of the labour moves towards modern sectors, leading to a higher wage dispersion, whilst the rest lags behind. Eventually more and more people become active in this modern sector, leading to a catch up and a more equalised distribution. In this sense, economic growth is the forerunner of income equality.

2.2 Redistribution and growth

Not only the level of inequality might affect growth, but also the policies put in place to equalise incomes through means-tested transfers, progressive taxing to finance public expenditures, and institutions such as a minimum wage (Goudswaard and Caminada 2010). A number of theories have been constructed to predict the effects of income redistribution on economic growth.

According to the well-known trade-off argument the alteration of market outcomes by public redistribution incites people to change their behaviour by reducing financial incentives to gain individual wealth, leading to a lower overall economic output (Allegrezza, Heinrich and Jesuit 2004). With lower marginal returns to work, substitution to leisure becomes more attractive. A related argument is that public provision, *e.g.*, in the form of unemployment benefits, can make people dependent on government support. The very creation of unemployment benefits might lead to higher unemployment rates, as people are less inclined to seek jobs (Kenworthy 2003).

Empirical evidence for the trade-off hypothesis on macro level is more mixed, see also the empirical literature overview in the Appendix. Romer and Romer (2010) present macroeconomic evidence for 'exogenous tax changes' in the US, which are fiscal changes implemented to influence long-term growth rather than short-term countercyclical reactions, using a VAR model. They estimate that a 1 per cent increase in exogenous tax lowers growth with 2.5 per cent permanently. Conversely, Lindert (2004) stresses that the welfare state is a free lunch. He shows that growth patterns of states that strongly redistribute wealth, for instance in Sweden, have not been surpassed by economic growth in more liberal states such as the US or the UK. According to Lindert generous welfare states have come up with strategies to minimise behavioural changes, most notably by universal provision instead of means testing,

and by relying on taxes for which elasticities are relatively low. In addition, as Lindert denotes, it is likely that people that are already less motivated or less productive drop out first, leading to minimal welfare effects. According to Kenworthy (2003) the negative effects of public intervention on employment also prove better than expected from the trade-off argument. He only reports a weak negative effect of higher replacement rates on employment.

Other arguments focus on the alleged lower effectiveness of public allocation of recourses. Reallocation increases transaction costs, as aptly captured by Okun's (1975) metaphor of a leaky bucket: 'The money must be carried from the rich to the poor in a leaky bucket. Some of it will simply disappear in the transit, the poor will not receive all the money that is taken from the rich'.

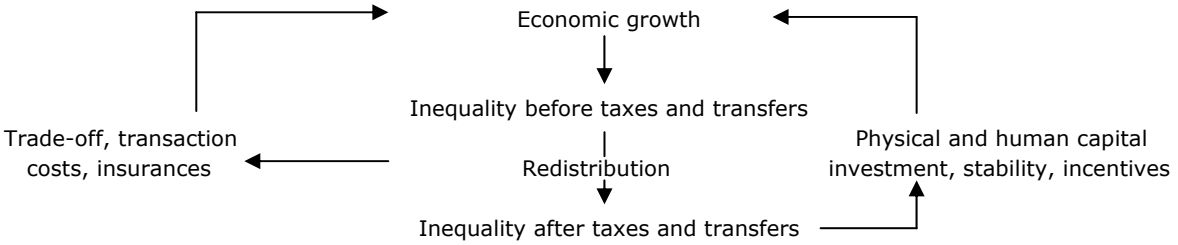
Public policies that potentially have redistributing effects may facilitate growth by publicly providing for insurances against risks such as unemployment, disabilities, and old age that markets cannot (efficiently) provide for (Boadway and Keen 2000). In addition, the existence of a safety net might also make people less risk-averse and more innovative which might be beneficial to economic growth. Lastly, redistribution might stimulate growth by decreasing income inequality, which is further discussed in sub section 2.3.

Yet, there might also be a reverse effect in the situation that economic growth influences the need and demand for redistribution. Growth shapes possibilities for public policies. In case of a positive income elasticity of demand for social spending, a richer country will be more willing to publicly purchase insurances against unemployment, sickness, or on pensions, commonly referred to as Wagner's law (Meltzer and Richard 1983). Second, in a system with automatic stabilisers, greater inequality because of economic turmoil leads to more redistribution by default (Immervoll and Richardson 2011). In addition, countries can implement short-term policies to respond to economic downturns, which are generally designed to stimulate employment and in this way affect redistributive levels (Chung and Thewissen 2011).

2.3 Combining the lines of reasoning

Figure 1 schematically displays the arguments discussed in sub sections 2.1 and 2.2 why we might expect effects of income inequality and redistribution, in some way isolated from each other, on economic growth. Yet, there are also likely to be direct links between redistribution and income inequality. All current welfare states decrease income inequality through redistribution, at least in the short run (Immervoll and Richardson 2011). This implies that the 'total' effect of redistribution on growth consists of a direct effect of redistribution on growth, and an effect on growth by alleviating income inequalities. For instance, in the scenario that both income inequality and redistribution have a direct negative effect on growth, the total effect of redistribution on economic growth will be less negative or even positive, as it also decreases harmful inequality. Thus, when inequality hampers growth, redistribution can be seen as a social investment – so that '[…] the welfare state can be an irrigation system which supports economic efficiency and growth' (Korpi 1985) – albeit with possible costs on its own.

Figure 1. Schematic overview of the hypotheses



There might also run a causal relationship from inequality to redistribution by influencing preferences for redistribution (Finseraas 2010; Lübker 2007). Most of this literature employs

median voter models, in which each potential voter has equal weight and in which voting preferences are determined by income. Based on these assumptions it can be derived that the majority will favour distorting redistribution when the (gross) mean income exceeds the (gross) median income (Alesina and Giuliano 2009; Lübker 2007). The more dispersed the wealth, the lower the wealth of the median voter relative to the mean income, which will increase the level of redistribution. Yet, the empirical literature on the effects of inequality on the amount of redistribution is quite inconclusive. Kenworthy and McCall (2008) do not find any evidence for a positive effect of inequality before taxes and transfers on the level of redistribution, tracking eight countries during the 1980s and 1990s. Lübker (2007) also does not find evidence that public support for redistribution rises with inequality across countries. Due to these empirical problems, Karabarbounis (2010) and Lupu and Pontusson (2011) present further refinements of the median voter model, taking into account the income level of the different income groups relative to the mean and the distance between the incomes of those groups.

Banerjee and Duflo (2003) also make use of political economy arguments, but they predict a nonlinear relationship between inequality and growth, concluding that '[…] growth rate is an inverted U-shape function of net changes in inequality'. According to them, changes in inequality in any direction are associated with lower growth. Based on a political economy model, they argue that 'planned changes in inequality' or 'hold-ups' are more common in situations of extreme equality and extreme inequality. In addition, in the case that measurement errors in inequality data are higher during times of economic turmoil, changes in inequality will be associated with lower growth rates.

3. Methodology

3.1 Estimation methods

The inequality to growth literature from the 1990s generally connects a country's income distribution at the beginning of a long time period, usually around thirty years, to the average growth rate during that period (Perotti 1996; Persson and Tabellini 1994; Rodrik and Alesina 1994). The regressions are estimated by OLS. By and large, the estimations report negative associations, leaving Benabou (1996) to argue that '[t]hese regressions, run over a variety of data sets and periods with many different measures of income distribution, deliver a consistent message: initial inequality is detrimental to long-run growth'.

Yet, OLS yields biased estimates when unobserved time invariant country effects are correlated with the included explanatory variables. In growth equations there are likely to be many unobserved variables, as economic growth is ultimately the final outcome of innumerable market economy transactions (Sala-I-Martin 1997). Persistent differences in adopted technological levels, cultures and institutions might well affect the growth rate as well as the level of inequality. Therefore, later studies turn to panel data to examine how changes in income distribution affected the growth rate in the subsequent five or ten year period, mostly by using fixed effects estimation (Arjona, Ladaique and Pearson 2002; Castelló-Climent 2004; Forbes 2000). Generally, the negative coefficient disappears – Forbes even reports a significant positive association.

Even though fixed effects estimation is unaffected by heterogeneity bias, it is more sensitive to measurement error than OLS for relatively time invariant stock variables. Monte Carlo studies indicate underestimation of the effects of physical and human capital in growth regressions (Hauk and Wacziarg 2009). As the levels of income inequality and redistribution are also relatively stable over time, fixed effects estimation might underreport those factors as well. A number of authors cope with these problems by using 3SLS (Barro 1999) or System-GMM (Castelló-Climent 2004). Yet, GMM has disadvantages as well. The procedure of first-differencing and using lags as instruments involves a loss of at least three periods of

data. In addition, its first-differenced nature does not allow for inclusion of the level of income as a control variable to account for conditional convergence (see sub section 3.3).

3.2 Inequality and redistribution indicators

An important concern in research on inequality is the availability and quality of data, especially for the income distribution before taxes and transfers. The larger income inequality databases that include observations for developing countries suffer from measurement error, low comparability between countries, and heterogeneity in survey design (Atkinson and Brandolini 2001). Many studies, as can be seen in the Appendix, rely on the Deininger and Squire income distribution database (1996). Unfortunately, this database does not consistently distinguish between the income distribution before and after taxes and transfers (Banerjee and Duflo 2003: 284).

This study uses the OECD database on income distribution and poverty, which contains comparable country level data based on similar definitions and equivalence scales (OECD 2008). At most four continuous decades of data per country are available (1970-1979, 1980-1989, 1990-1999, 2000-2009). Data are available for 30 OECD member states.[1] The panel is unbalanced mainly due to missing observations for Eastern European countries. The database includes data for multiple distribution indicators after taxes and transfers, both for entire and working age population. For distribution *before* taxes and transfers, only the Gini for the entire population has a sufficient number of observations. As noted in the theoretical section, a number of theories predict effects of inequality in the lower part of the income distribution. For this the percentage of the population with an income below 50 per cent of the current median income is used, as too few observations are available at other thresholds. This variable is referred to as the poverty rate. Box 1 summarises the characteristics of the indicators.

Box 1. Inequality indicators

Income is adjusted to household size, assuming an equivalence scale of 0.5 (OECD 2008). For all inequality indicators a lower number indicates a more equal income distribution.

- Gini coefficient: the ratio of the area between a 45 degrees line and the proportion of total national income cumulatively earned from lowest to highest incomes. It varies between 0 and 100, where 0 indicates that everyone enjoys the same income, whilst 100 pertains to one person earning all;
- Mean log deviation (MLD): average log deviation between the mean and disposable income of each household member. Complete equality yields 0, whereas its maximum is (1+ln(100))ln(*mean*);
- Squared coefficient of variation (SCV): squared ratio from the standard deviation to its mean per equivalent household member. Its minimum is 0, its maximum is infinity;
- Poverty rate: the percentage households with an income below 50 per cent of the current median income.

Redistribution is measured both in an absolute and relative manner. Absolute redistribution is calculated as the difference between the Gini before and after taxes and transfers for the entire population. Relative redistribution is defined as the absolute redistribution divided by the Gini before taxes and transfers for the entire population. Due to the low number of observations for inequality before taxes and transfers, only 60 observations are available for the redistribution indicators.

Following the literature, the inequality and redistribution indicators are put in natural logarithm. As economic growth is also expressed as natural logarithm (see next sub section), the coefficients should be interpreted as elasticities.

[1] Australia (AUS), Austria (AUT), Belgium (BEL), Canada (CAN), Czech Republic (CZE), Denmark (DNK), Finland (FIN), France (FRA), Germany (DEU), Greece (GRC), Hungary (HUN), Iceland (ISL), Ireland (IRL), Italy (ITA), Japan (JPN), South Korea (KOR), Luxembourg (LUX), Mexico (MEX), the Netherlands (NLD), New Zealand (NZL), Norway (NOR), Poland (POL), Portugal (PRT), Slovak Republic (SVK), Spain (ESP), Sweden (SWE), Switzerland (CHE), Turkey (TUR), United Kingdom (GBR), and the United States (USA).

3.3 The MRW framework

Three specifications are widely used in the macroeconomic literature on the relationship between income inequality and economic growth (Barro 2000; Mankiw, Romer and Weil 1992; Perotti 1996). The Perotti framework excludes most variables through which the effect of inequality on growth might be channelled, such as the level of investment. The Barro specification, on the other hand, includes terms of trade, government consumption, education, investment share, and a number of variables tailored towards developing countries (fertility, indices of rule of law and democracy, and colonial history).

The Mankiw *et al*. framework (MRW), designed to explain convergence between countries, is an adequate compromise between the two frameworks. The design was originally constructed to estimate the rate of income convergence between countries, but is also often used in the inequality to growth literature (Arjona, Ladaique and Pearson 2002; Rooth and Stenberg 2011; Voitchovsky 2005). Real GDP growth per person is regressed on the level of real GDP, population growth, and the stocks of human and physical capital. Due to convergence, the initial level of income is thought to have a negative effect on subsequent growth. The same holds for population growth, as '[…] high population growth lowers income per capita because the amounts of both physical and human capital must be spread more thinly over the population' (Mankiw, Romer and Weil 1992). The stocks of physical and human capital are expected to have positive effects on subsequent economic growth. Yet, these last two variables are also channels through which inequality or redistribution might affect growth, as discussed in the theoretical section. Therefore, the empirical analyses are conducted both with and without the stock of physical and human capital.

The MRW framework can be written in the following way as a fixed effects model, with y_{it} as the level of real GDP per person for country i at time t, x_{it} as the vector of the other control variables, g_{it} as the independent variable of interest, that is, inequality, redistribution, or both, and a set of a_i country and η_t time dummies, with idiosyncratic error term u_{it}, clustered on country level to account for autocorrelation and heterogeneity:

$$(\ln(y_{it+9}) - \ln(y_{it+1}))/8 = \beta_1 \ln(y_{it}) + \gamma \ln(g_{it}) + \ln(x_{it})\beta + u_{it} + a_i + \eta_t \qquad (1)$$

To prevent endogeneity problems, economic growth is measured as the difference between the level of welfare at the end of the period and at the beginning of the period plus one year, as the level of welfare at the beginning of period is already present as an explanatory variable. As ten year periods are taken, excluding the first year of growth, the growth rate is divided by 8 to end up with having an average annual growth rate.[2]

As Islam (1995) remarks, the β_1 coefficient in a fixed effects framework cannot be interpreted as the convergence rate in a 'classic' sense, that is, the rate in which countries approach the same welfare level. This is so because in the panel specification the level of income differs per period and country, instead of being held constant at the beginning of the period.

Two baseline equations are formulated. When the income distribution indicator refers to the entire population, economic growth, level of income, and population growth also are expressed per capita. For the indicators focusing on working age population, the growth model variables are expressed per working age person as well. As is common in growth literature, all variables are expressed in natural logarithm (Islam 1995).

Economic growth and level of income are expressed as real GDP growth per person, 2000 PPP in US dollars. Population growth is defined as the growth of the total population between 15-64 at the beginning of the period. The stock of physical capital is measured as the average annual total gross fixed capital formulation in percentage of real GDP; for the

[2] For the period 1979-1970 for instance, economic growth is measured as the difference in log welfare per person in 1979 and 1971, whilst initial level of income is defined as log welfare per person in 1970. Other ways of dealing with this essentially lagged dependent variable endogeneity, such as Chamberlain's Π-matrix or GMM, require more data points (see Dowrick, S., and M. Rogers. 2002. "Classical and technological convergence: beyond the Solow-Swan growth model." *Oxford Economic Papers* 54(3):369-85.).

stock of human capital the average years of total schooling for the total population aged 25 and over is used. All data come from OECD National Accounts and Economic Outlook no. 88, except for the human capital indicator (Barro and Lee 2010).

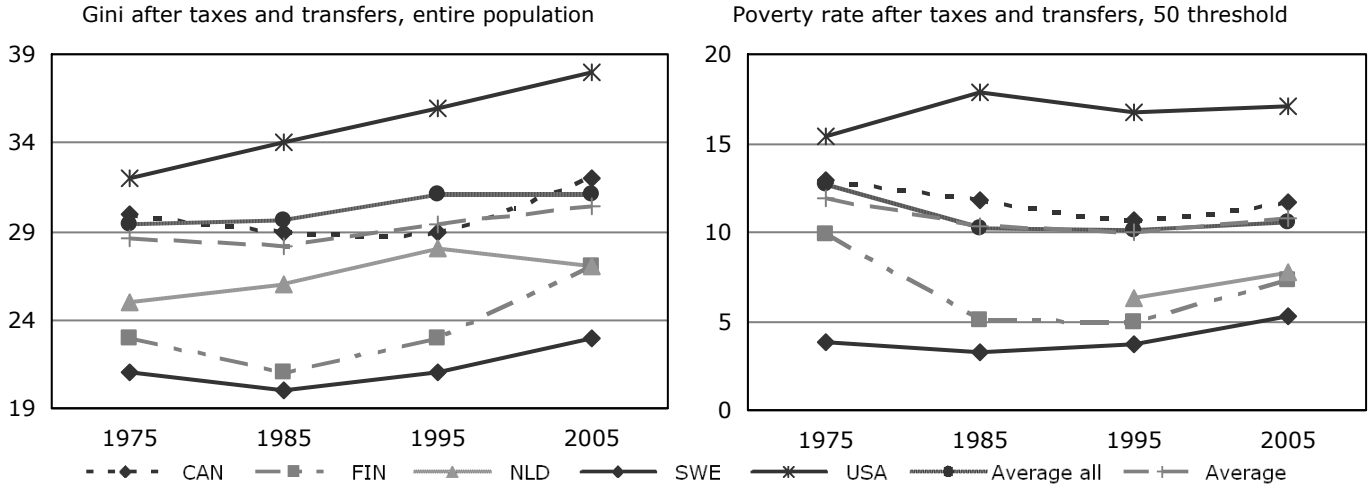
4. Empirical analyses

4.1 Data description and trends

The inequality indicators reveal a moderate trend towards increasing income inequality within the OECD area, as documented elsewhere and graphically displayed here in Figure 2 (OECD 2008; OECD 2011). In the data set used here, the average Gini after taxes and transfers for the entire population increased from 29.4 to 31.1 between 1975 and 2005, which is the same rise reported in OECD (2008). For the seven countries for which data are available for all periods, the average Gini rose from 28.6 to 30.4. Spain, France, and Greece are the only countries with a decrease in inequality over time. The Scandinavian countries report the lowest inequality after taxes and transfers levels, whilst high values are reported in Mexico, Turkey, and to a lesser extent in Southern European countries, the US, and the UK.

The poverty rate after taxes and transfers shows a more stable pattern, where highest average values are reported in the first period. On average, poverty has increased in the last period compared to the second and third one. Highest poverty rates after taxes and transfers are reported in Mexico (although decreasing), Turkey, and the US (and increasing).

Figure 2. Gradual and widespread rise in income inequality within the OECD area



Source: OECD (2008) and own calculations.

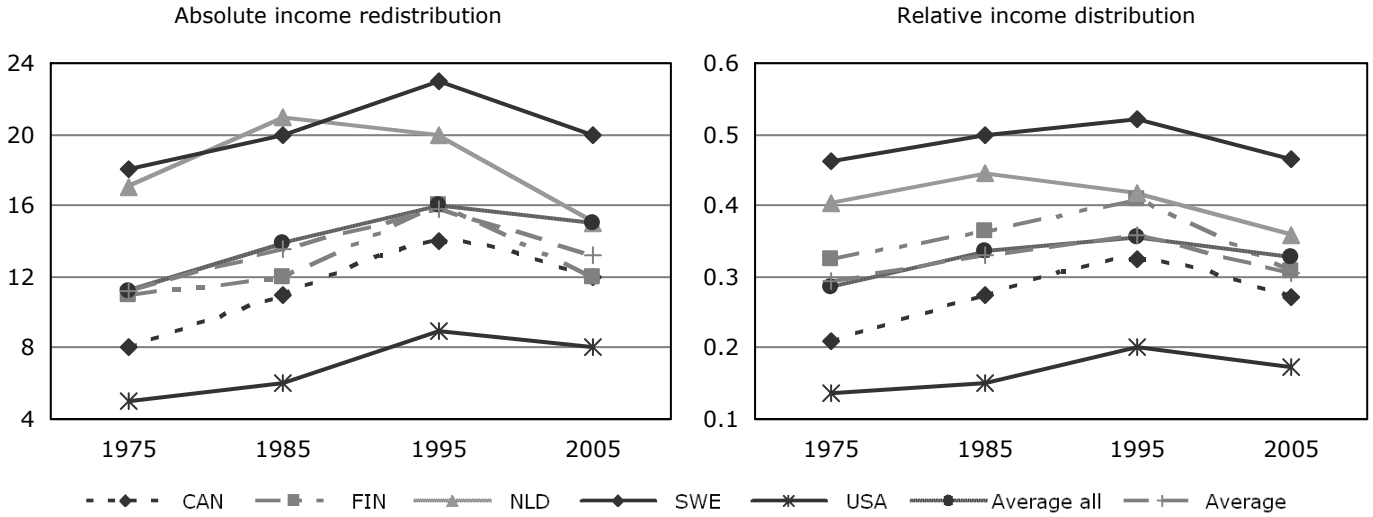
The Gini before taxes and transfers for the entire population has an even stronger increase over time between 1975 and 2005 (from 38.9 to 45.0 for all countries, from 37.7 to 43.4 for the six countries without missing values). In general, the income distribution before taxes and transfers shows less variation between countries. Its standard deviation of 5.4 is roughly twenty per cent lower than its counterpart after taxes and transfers. This implies that the distribution of market outcomes are more similar across countries than the income distribution after public intervention, pointing to an important impact of the welfare state on the income distribution. Italy, Poland, Portugal, but also Germany show high levels of inequality before redistribution, although this is probably partly due to the lack of data for Turkey and Mexico. Again, the Scandinavian countries show the most equal income distributions.

The poverty rate before taxes and transfers shows a pattern comparable to the Gini, before taxes and transfers. It increases quite strongly over time (from 21.1 to 25.5 for all, and from 22.1 to 26.5 for the five countries without missing values). Spain, Finland, and South Korea show the lowest poverty rates before taxes and transfers (around 18 in 2005).

As was the case for the inequality before taxes and transfers, high values are reported in Italy, Poland, but also Belgium and Germany. The most rapid increase in poverty before taxes took place in Japan (from 12.5 to 26.9 between 1985 and 2005).

The level of absolute income redistribution has increased over time (from 11.1 to 15.0 for all countries and from 11.2 to 13.2 for the six countries without missing values), although the highest values are reported in 1995, as can be seen in Figure 3. Sweden and continental Europe have high redistributive values (around 20); whilst Norway and Finland redistribute less income (between 11 and 16). South Korea and the US have the least redistributive welfare states. Figure also 3 shows that the amount of relative income redistribution, which is the amount of absolute redistribution divided by the Gini before taxes and transfers, follows a comparable pattern over time. Again, Sweden has the highest values, whereas less income is redistributed in the US.[3]

Figure 3. Large variation in amount of redistribution between the OECD area



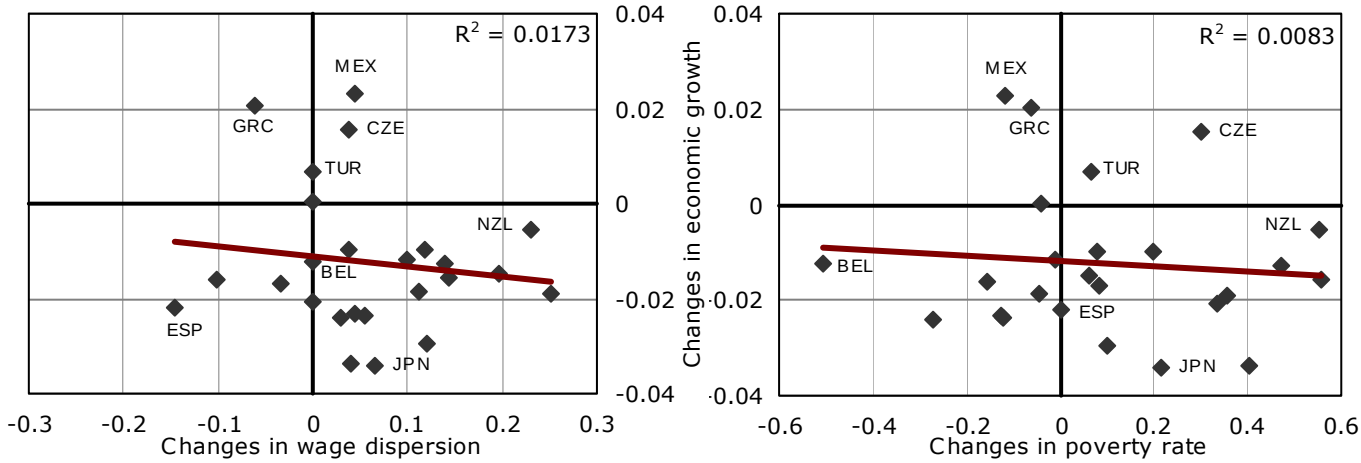
Source: OECD (2008) and own calculations.

4.2 Associations between inequality and growth

As noted previously, OLS estimations usually produce statistically significant negative effects of inequality on growth (Perotti 1996; Persson and Tabellini 1994; Rodrik and Alesina 1994). Simple associations between changes in income distribution or the poverty rate and changes in economic growth summarised in Figure 4 reveal an inconclusive picture here. The trend lines in Figure 4 show a low *R*-squared value.

[3] The amount of poverty reduction, defined as the difference between the poverty rate before and after taxes and transfers at 50 per cent of the current median income, has a pattern equivalent to the development of income redistribution over time. It shows an increasing trend over time (from 9.4 to 16.2 for all countries, and from 9.1 to 14.7 for the six countries without missing values), with highest values reported in 1995.

Figure 4. No clear association between trends in inequality, poverty, and economic growth



Note: Indicators defined as changes between log values at fourth and second period; fourth and third period for CZE, HUN, and POL. Economic growth: real GDP per capita. Wage dispersion: Gini after taxes and transfers, entire population. Poverty rate: poverty rate after taxes and transfers, 50 per cent of current median income. For inequality CHE, and for poverty AUS, GBR, NLD, and PRT are calculated as the difference between fourth and third period.

Source: OECD (2008) and own calculations.

Nevertheless, OLS results are biased in the presence of heterogeneity bias. Tests indicate that there are indeed significant correlations between country effects and the explanatory variables. Therefore, Table 1 presents fixed effects panel estimation results which control for unobserved heterogeneity.

Table 1. No clear association between inequality after taxes and transfers and economic growth

Dependent variable: log real GDP growth per capita (columns 2-4), per working age person (columns 5-7)

	Baseline	Entire population			Working age population		
		Gini	Squared coefficient of variation	Mean log deviation	Gini	Squared coefficient of variation	Mean log deviation
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Inequality measure		.006 (.017)	.003 (.003)	-.002 (.009)	-.003 (.014)	.001 (.002)	-.002 (.008)
Level of income	-.059 (.014) ***	-.059 (.014) ***	-.050 (.017) ***	-.052 (.017) ***	-.063 (.010) ***	-.060 (.014) ***	-.061 (.012) ***
Population growth	-.316 (.299)	-.312 (.301)	-.557 (.393)	-.599 (.444)	-.394 (.306)	-.330 (.286)	-.334 (.323)
Physical capital	-.010 (.014)	-.010 (.013)	-.008 (.012)	-.009 (.013)	-.015 (.009)	-.013 (.012)	-.013 (.011)
Human capital	.020 (.009) **	.021 (.009) **	.023 (.009) **	.017 (.010) *	.010 (.007)	.010 (.016)	.005 (.016)
Constant	.173 (.028) ***	.151 (.064) **	.131 (.032) ***	.167 (.042) ***	.254 (.051) ***	.223 (.069) ***	.247 (.072) ***
Observ	80	80	71	71	78	67	67
Countries	30	30	28	28	30	28	28
R-squared	.665	.666	.719	.714	.707	.718	.718
F test	46.82 ***	40.28 ***	64.89 ***	64.64 ***	73.87 ***	67.45 ***	66.01 ***

Note: Country fixed effects, 1970-2009, ten year periods with time dummies, clustered standard errors between brackets. Significance levels are noted by *** (1 per cent), ** (5 per cent), or * (10 per cent). All variables in logs. Columns 1-4: per capita sample. Columns 5-7: working age population sample. All inequality indicators are measured after taxes and transfers. See Box 1 for their definition.

Source: OECD (2008) and own calculations.

The results reported in Table 1 consistently indicate that inequality after taxes and transfers does not have a clear association with economic growth. The coefficients of the inequality measures are robust to the exclusion of countries.[4] Exclusion of the human capital indicator as an explanatory variable, to allow for negative associations between inequality and growth through a lower stock of human knowledge, makes the inequality indicator coefficients more negative or less positive, but still (strongly) insignificant. The exclusion of the stock of physical capital to consider possible effects of inequality through the savings channel does not affect the inequality coefficients in any systematic way.

Further evidence that there is no evident relationship between income inequality and economic growth for affluent countries comes from Table 2. Here, the Gini before taxes and transfers and the poverty gap before and after taxes and transfers are employed as income distribution indicators (columns 2-4). The results are again robust to the exclusion of countries and variables, especially when taking into account the strong influence of Italy and Japan due to their high inequality and poverty before taxes and transfers.[5]

Table 2. Also no association for other distribution indicators and specifications

Dependent variable: log real GDP growth per capita

	Baseline	Gini before taxes and transfers	Poverty rate before taxes and transfers	Poverty rate after taxes and transfers	Squared Gini growth, full sample	Squared Gini growth, excluding New Zealand
	(1)	(2)	(3)	(4)	(5)	(6)
Inequality measure		-.023 (.016)	-.016 (.011)	.002 (.004)	.000 (.000) **	.000 (.000)
Level of income	-.079 (.018) ***	-.078 (.018) ***	-.091 (.015) ***	-.059 (.014) ***	-.090 (.016) ***	-.080 (.016) ***
Population growth	.276 (.144)	.313 (.142) **	-.077 (.243)	-.309 (.293)	-.456 (.229) *	-.829 (.469)
Physical capital	-.011 (.008)	-.014 (.008)	-.006 (.017)	-.012 (.014)	-.004 (.017)	-.001 (.017)
Human capital	.000 (.011)	-.005 (.012)	.015 (.009)	.023 (.004) **	.039 (.019) *	.031 (.018)
Constant	.264 (.051) ***	.363 (.086) ***	.297 (.092) ***	.166 (.028) ***	.204 (.056) ***	.189 (.059) ***
Observ	60	60	65	76	52	50
Countries	25	25	29	30	25	24
R-squared	.879	.892	.800	.670	.836	.858
F test	115.6 ***	146.5 ***	47.48 ***	45.25 ***	30.88 ***	39.40 ***

Note: Country fixed effects, 1970-2009, ten year periods with time dummies, clustered standard errors between brackets. Significance levels are noted by *** (1 per cent), ** (5 per cent), or * (10 per cent). All variables in logs, except the inequality indicator in columns 5-6. Per capita sample. Gini: entire population. Poverty rates: 50 per cent of current median income threshold. Banerjee and Duflo equations: squared Gini growth is used as inequality measure, defined as the difference between Gini after taxes and transfers, entire population, at beginning and end of period squared.

Source: OECD (2008) and own calculations.

[4] The exclusion of a country does not yield a significant coefficient for any inequality indicator, apart from the standard coefficient of variation (SCV) for the entire population. Here, excluding Greece leads to a positive coefficient that is borderline significant (*p* value of .097). Yet, excluding other countries (Canada, Japan, Mexico) yields a much lower and insignificant inequality coefficient.

[5] When excluding Norway the Gini before taxes and transfers becomes significant (*p* value of 0.033), but this result is fully driven by Japan and Italy. The poverty rate before taxes and transfers becomes significant without human capital (*p* value of 0.067), but further analysis points out that this is again due to the strong influence of Japan and Italy. The poverty rate after taxes and transfers is fully robust to dropping indicators and countries. Excluding the investment indicator does not affect the results in any significant way.

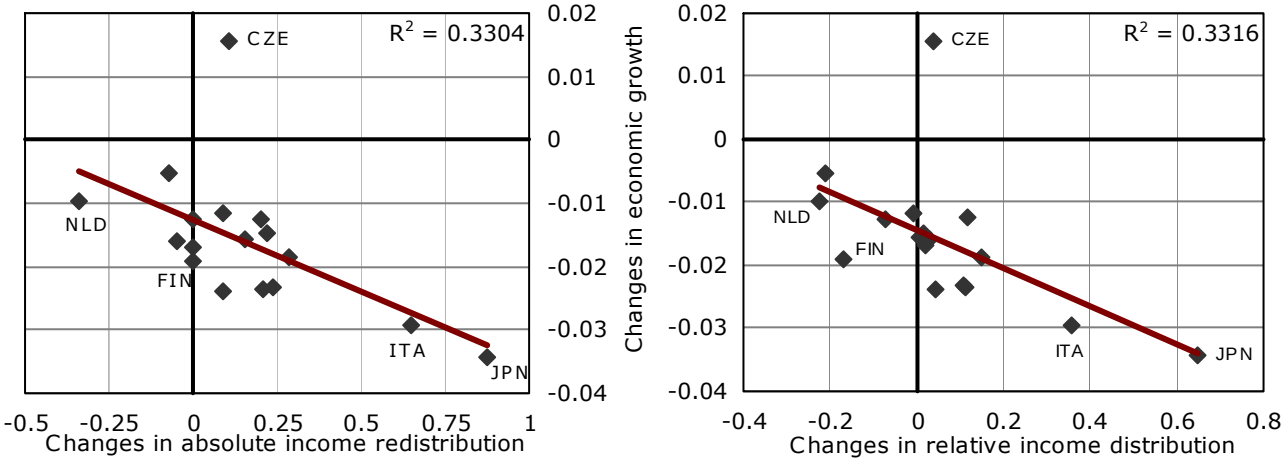
Columns 5 and 6 of Table 2 present the results for the estimations of nonlinear relations between income inequality and economic growth, as proposed by Banerjee and Duflo (2003: 267) for reasons discussed in sub section 2.3. According to them, changes in inequality in any direction, captured by the squared inequality growth rate, lead to lower growth. Indeed, in their analyses it is this squared inequality growth rate, measured as the difference between logs of Gini at the end and beginning of the period, that is significant. Unfortunately, the procedure of calculating (squared) changes in inequality leads to a further decrease of the available data. This would even be more so when the variable would be put in natural logarithm; a stable inequality over time would yield an undefined log. Therefore no log transformation is used for this variable.

Nevertheless, column 5 denotes a *positive* significant effect of changes in inequality, albeit this coefficient is very low (0.0002 with a *p* value of 0.03). Further analysis reveals that this result is driven by the inclusion of New Zealand – its exclusion decreases the size of the coefficient by almost a factor 4, yielding an insignificant coefficient (0.00005 with a *p* value of 0.52). It is likely that the (somewhat) larger country sample, which includes a number of developing countries, can explain the difference in results of this study and the results presented by Banerjee and Duflo.[6]

4.3 Associations between redistribution and growth

This sub section addresses the relationship between income redistribution and economic growth. Simple OLS associations reveal a negative association between changes in income redistribution and economic growth, as shown in Figure 5. Czech Republic is the only country in the right top corner of the figure, indicating positive adjustments both in income redistribution and economic growth. Two countries combine a relatively high increase in redistribution with a high decrease in growth, namely Italy and Japan. Absolute and relative income redistribution show equivalent developments over time.

Figure 5. Negative OLS association between income redistribution and economic growth



Note: Indicators defined as changes between log values at fourth and second period. Economic growth: real GDP per capita. Income redistribution: Gini, entire population. For AUS, CZE, and PRT the difference between fourth and third period is used.

Source: OECD (2008) and own calculations.

[6] Other differences – a slightly different set of control variables which includes fertility, government consumption, and a number of dummies related to developing countries, and the use of a random effects estimator – cannot explain the differences, as further inspection (results not shown here) reveals.

The panel estimations, reported in Table 3, provide more insight, although the number of observations are low due to limited data availability. The analysis indicates a consistently negative significant association between income redistribution and economic growth. The magnitude and significance of the coefficient does not differ much for absolute or relative income redistribution.[7] This indicates that the reallocation of income by public interventions is associated with lower growth regardless of the initial level of inequality before redistribution.

Furthermore, the results do not change in any significant way when income inequality is included as an explanatory variable as shown in columns 3 and 5.[8] The redistribution indicator remains significant, as opposed to the income inequality coefficient. This also indicates that the significance of the income redistribution coefficient is not likely to be a consequence of multicollinearity between inequality and redistribution.

Table 3. Income redistribution is associated with lower economic growth
Dependent variable: log real GDP growth per capita

	Baseline	Absolute redistribution		Relative redistribution	
	(1)	(2)	(3)	(4)	(5)
Income redistribution		-.012 (.004) ***	-.012 (.004) ***	-.016 (.006) ***	-.016 (.006) **
Income inequality			.008 (.014)		-.002 (.015)
Level of income	-.079 (.018) ***	-.073 (.017) ***	-.074 (.018) ***	-.073 (.018) ***	-.073 (.018) ***
Population growth	.276 (.145) *	.244 (.112) **	.223 (.129) *	.207 (.113) *	.211 (.125)
Physical capital	-.011 (.008)	-.013 (.009)	-.013 (.009)	-.012 (.009)	-.012 (.009)
Human capital	.000 (.011)	-.001 (.010)	.002 (.010)	.002 (.010)	.002 (.011)
Constant	.264 (.051) ***	.286 (.059) ***	.254 (.014) ***	.300 (.059) ***	.308 (.097) ***
Observ	60	60	60	60	60
Countries	25	25	25	25	25
R-squared	.879	.906	.907	.907	.907
F test	115.6 ***	100.6 ***	82.19 ***	86.43 ***	86.46 ***

Note: Country fixed effects, 1970-2009, ten year periods with time dummies, clustered standard errors between brackets. Significance levels are noted by *** (1 per cent), ** (5 per cent), or * (10 per cent). All variables in logs. Per capita sample. Absolute redistribution: difference Gini before and after taxes and transfers, entire population. Relative redistribution: absolute redistribution divided by Gini before taxes and transfers, entire population. Level of inequality: Gini after taxes and transfers, entire population.
Source: OECD (2008) and own calculations.

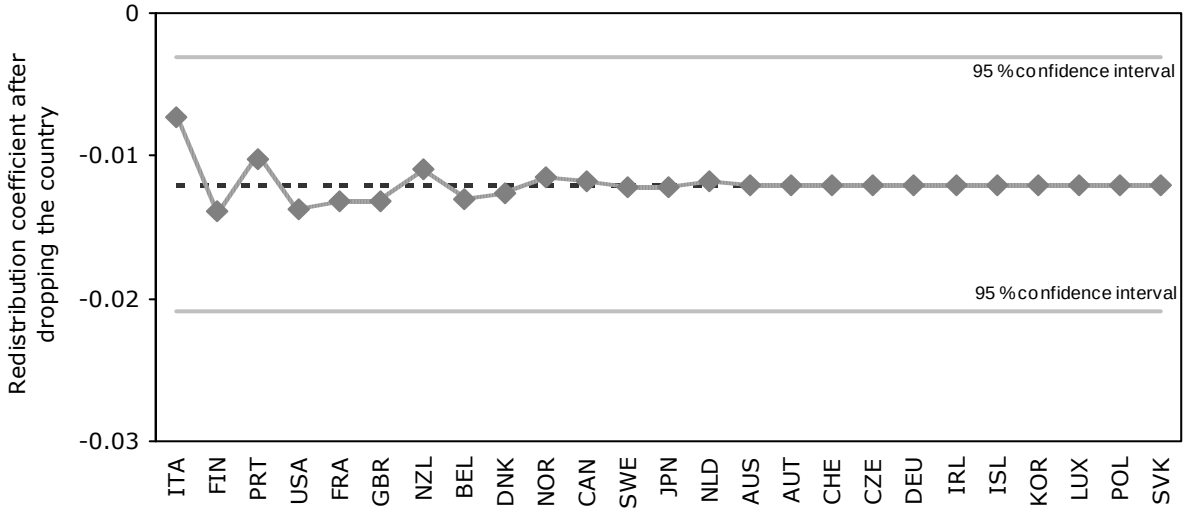
The coefficient of the redistribution indicator varies between -0.01 and -0.02 in log specification. It implies that for a given country, an increase in income redistribution of 1 per cent across time is associated with an on average 0.01 per cent annual lower economic growth during that ten year period, holding the control variables, including the level of inequality, constant. This is quite a low association. For the countries without missing values, the level of absolute redistribution grew between 1975 and 2005 by almost 18 per cent (from 11.2 to

[7] In addition, fixed effects regressions yield negative coefficients for absolute and relative poverty reduction that are significant at the 1 per cent level. The indicators are defined in the same fashion as income redistribution, using poverty rate before and after taxes and transfers, with 50 per cent of the current median income as threshold. The coefficients lie between -0.005 and -0.007 and remain firm when the level of poverty rate is held constant.
[8] Without redistribution, income inequality is not significant for the set of countries and periods used in Table 3.

13.2, see sub section 4.1). Thus, according to the estimates, we should expect an associated 0.18 per cent decrease of economic growth between that same period.[9]

Even though the redistribution coefficient is weak, it remains significant when countries or variables are excluded, whilst the inequality indicator never reaches significance. Figure 6 shows this for the level of absolute redistribution, holding constant the level of inequality (column 3 in Table 3). The black line in small dashes just below -0.01 shows the absolute redistribution coefficient for the full sample, and the light grey lines indicate the 95 per cent confidence interval for this coefficient. The diamond shaped markers signify the effects of dropping the country displayed at the bottom of the figure. As is evident from Figure 6, the coefficient is not significantly changed when a country is left out of the sample. All specifications remain well within the 95 per cent confidence intervals.

Figure 6. Income redistribution is robustly associated with lower growth



Note: Per capita sample. Income redistribution: log difference Gini before and after taxes and transfers, entire population. See footnote 1 for country abbreviations.
Source: OECD (2008) and own calculations (Table 3 column 3).

5. Discussion and conclusion

This study addresses the central question in political economy how the socio-economic objectives of attaining welfare and restricting income inequality are related to each other. From the literature we can derive reasons why the income distribution might affect growth, but also why public redistribution to equalise incomes can influence economic output. The empirical analyses presented here using a macro panel design of 30 OECD countries seem to suggest that it is not so much the level of income inequality, but rather the level of income redistribution that is associated with (lower) economic growth.

The empirical results indicate that all inequality indicators, both for entire and working age population, after and before taxes and transfers, are not associated with economic growth in any systematic fashion. The same holds for the poverty level before and after taxes and transfers. Therefore, no evidence is found both for theories predicting a positive effect of inequality on growth, through the savings or incentives channel, or for theories suggesting a negative effect of inequality, by affecting stability or the attainment of human capital. This finding corresponds to other studies employing a panel design to investigate the effects of inequality on growth (Arjona, Ladaique and Pearson 2002; Castelló-Climent 2004; Forbes 2000). It might be that other studies that do report effects of inequality on growth report spu-

[9] Of course, the coefficient is calculated using all the fluctuations in redistribution and economic growth in all four decades and all countries, controlling for country and time effects, whereas the calculation above only takes into account the difference in redistribution and growth between the first and last decade.

rious findings, as the studies generally do not control for the amount of income redistribution. In addition, most studies that present evidence that inequality harms long-term growth rely on OLS estimations that are sensitive to unobserved heterogeneity across countries.

Income redistribution, however, has a significant negative association with economic growth. The coefficient does not differ much between redistribution defined in an absolute and a relative way. This seems to indicate that the reallocation of income by public interventions is associated with lower growth regardless of the initial level of inequality before public intervention. The finding that it is redistribution rather than the level of income inequality that is associated with lower growth is in line with the trade-off argument holding that public actions to equalise incomes come at the cost of lower output growth, although the analyses cannot offer any causal evidence. Yet, the found coefficient suggests only a marginal association between redistribution and growth, which seems to suggest that it might be a minor trade-off rather than a 'big trade-off' (Okun 1975).

An important limitation of this study is the low number of available observations, which warrants caution with the interpretation of the results. It also bounds the possibility for other estimation methods that require more data, such as System-GMM. The fixed effects estimation employed here assists in controlling for unobserved country differences, but it is known to have low predictive power when variables are highly persistent over time, which is the case for the levels of income inequality and redistribution of affluent countries. It might thus be that the reported coefficient underestimates the 'true' association between redistribution and growth. An alternative to increase the number of observations is to employ a regional design. An extra advantage is that with this design the redistributing effects of national policies and institutions is automatically held constant across regions.

A second limitation of the design employed here is that the results cannot offer causal evidence due to the possibility of reverse effects of economic growth on the need and demand for public interference. Future research could focus on the persistent issue to separate the two causal effects, for instance by exploiting an exogenous shock in redistribution, not resulting from a fluctuation in growth, or vice versa. Lastly, this study used an indicator of overall absolute and relative redistribution. An interesting possibility for future research is to compare the effects of different kinds of redistributing instruments on growth, such as means-tested spending, progressive taxing, or a minimum wage.

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Appendix: Empirical literature review

Income inequality and economic growth

Authors	*Period, method, sample, and data sources*	*Dependent variables*	*Independent variables*	*Results*
Banerjee & Duflo (2003)	RE, FE, FD, Arellano-Bond, 5-year span, different types of fitting prior (Kernel and quadratic), Gini from Deininger & Squire	Log GDP growth per capita in 1980 dollars (Summers and Heston)	(Lagged) inequality and (lagged) inequality growth (squared) Controls: Perotti (1996: log of GDP, PPPI, male and female education) or Barro (2000: log lagged GDP and GDP squared, lagged government consumption, secondary and higher education, fertility, difference in terms of trade, lagged investments, number of developing dummies	Changes in inequality in any direction as associated with lower future growth, non-linear relationship between inequality and magnitude of changes in inequality, and negative relationship between growth and inequality lagged one period. When using 'normal' linear growth equation, RE insignificant, FD, FE and A&B positive and significant,
Barro (1999; 2000)	Departs from conditional convergence framework (Barro, 1991; 1997). Three decades data (1965-75, 75-85, 85-95), mostly own and World Bank data. Gini and quintile shares from Deininger & Squire. 3SLS treating country-specific error terms as random, arguing that the differencing implicit in running FE regressions exacerbates the biases due to measurement error.	1. Average growth rate of real per capita GDP over per decade 2. Average ratio of real investment (private plus public) to real GDP per decade	Controls: baseline model for both 1 and 2: Gov consumption/GDP Rule-of-law, democracy index (squared), inflation rate, years of schooling at beginning of period, log total fertility rate, growth rate of terms of trade (if not beginning then period averages) Only for 1: investment/GDP IV's are actual values of schooling and terms-of-trade, lagged values of other ones	Higher inequality lowers growth in poor countries and stimulates it in rich countries, following the Kuznets hypothesis.
Barro (2008)	WIID (2007) and Deininger-Squire for inequality measures, 1960-2000 (5 benchmark years for growth to ineq, 4 for reverse relationship), cross-country growth regressions, OLS, FE, and 3SLS.	1. Growth → Inequality (Kuznet): Gini coefficients, lowest and highest quintile share. 2. Inequality → Growth: annual growth rate of real log per capita GDP	1. Growth → Inequality (Kuznet): Log GDP per capita (squared), dummies for net income/expend, individual, former colony, regional dummies, openness variable 2. Inequality → Growth: Conditional-convergence framework (Barro, 1991): initial log GDP, initial life expectancy from age 1, human capital (initial upper-level school attainment of males), openness, interaction term of Gini and log capita GDP	Growth → Inequality (Kuznet): There is evidence for Kuznet's relationship (positive effect Gini from log per capita GDP abd negative effect square log per capita GDP). Regional dummies are strongly significant. Openness ratio has an increasingly strong inequalising effect, yet it also stimulates growth. Inequality → Growth: Gini added to growth equation is significantly negative. Interaction term Gini and log growth is significant, thus impact of inequality on growth is most negative for poorest countries (eventually inequality is good for growth for richer countries). Ineq has also effects on other growth variables as indicated by interaction terms. Poor countries grow faster (initial GDP). Openness variable has a positive effect on growth.

Authors	*Period, method, sample, and data sources*	*Dependent variables*	*Independent variables*	*Results*
Castelló-Climent (2010)	1960-2000, 102 countries (max), Gini and quintile human capital inequality from Castello & Domenech, Gini from WIID and LIS and percentile ratios. System-GMM	Average annual growth of real GDP per capita	Lagged human or income inequality Controls: time dummies, real GDP per capita, government spending and total trade in % GDP, inflation rate, stock of human capital	Human capital inequality leads to lower growth rates, but only in developing countries. Income inequality leads to lower growth rates in developing countries and higher growth
De La Croix & Doepke (2003)	Introducing fertility, developing countries mostly, following growth equations from Barro (2000) and Perotti (1996). Periods 1960 to 1976 or 1976 to 1992, Penn World Tables, World Fertility Survey and Demographic and Health Surveys on total fertility rates, Deininger & Squire (1996), Barro & Lee (2001), 68 countries leading to N of 83. Generalised Method of Moments (GMM), allowing for autocorrelation and different constants in the two periods	Average annual growth rate of GDP per capita	Difference in the total fertility rate between women with the highest and the lowest education level Controls: GDP per capita, the average ratio of investment to GDP, the average ratio of government expenditure to GDP, the initial income Gini, African dummy, initial total fertility rate To control for endogeneity of investment, government expenditure, Gini and fertility differentials, IVs are used: constant, initial GDP per capita (squared), investment and government spending per GDP, fertility (squared), Africa dummy, tropics and access to sea variables (Sachs & Warner, 1997)	More theoretical approach proposing new channel for inequality on growth by differential fertility. Families with less human capital will have more children and invest less in education. High inequality leads to large fertility differentials, lower education investments, and therefore lower growth.
Forbes (2000)	Gini from Deininger & Squire (1996), World Bank STARS data set, Barro & Lee (1996), Penn World Tables, 1966-1995 (six five-year periods), 45 countries, 180 observations. Fixed and random effects (inconsistent due to presence lagged dependent variable), Chamberlain's π-matrix, Arellano-Bond (1991)	Average annual growth (growth in log of real GNP per capita)	Identical to Perotti (1996), with inclusion of country and period dummies: Initial stocks of inequality (Gini), income (lagged dependent variable), male and female education (average years of schooling), PPPI (market distortions, proxied by price level of investment) Alternative specifications are tested as sensitivity analysis	Inequality is always positive, significant at 5% and strong, no matter what panel estimation method is used (although FE and RE are inconsistent).
Galor & Moav (2004)	Purely theoretical, combining strands of classic approach focusing on savings, and credit market imperfections approach.			The replacement of physical capital accumulation by human capital accumulation as a prime engine of economic growth changed the qualitative impact of inequality on the process of development. During industrial revolution because of need of savings, inequality stimulated growth, now human capital is more important inequality is associated with lower growth due to credit market imperfections.

Authors	*Period, method, sample, and data sources*	*Dependent variables*	*Independent variables*	*Results*
Keefer & Knack (2002)	Deininger & Squire (1996), International Country Risk Guide for property rights, Sullivan (1991) on ethinic data. Long-run observations with 1 observation per country (Persson and Tabellini (1994) and Alesina and Rodrik (1994) approach), period 1970–92, N of 56 or 89, OLS	Annual growth per capita averaged over period 1970–92	Initial GDP per capita, mean years of education, income and land Gini, property rights index	Social polarisation reduces security of property and contract rights, and for that reason also growth. Both relations are estimated using OLS. When the security of property rights is controlled for in OLS on inequality on growth OLS regression, effect of inequality diminishes considerably.
Lundberg & Squire (2003)	Deininger & Squire data, Penn World Tables OLS (SURE), 3SLS, Keane & Runkle 3SLS, 38 countries, five year aggregated periods, 119 observations	Base models: 1. Growth 2. Gini Simultaneous assessment of growth and Gini	1. Education, government, M2/GDP (financial development), inflation, Sachs-Warner openness index (all instrumented because of endogeneity), terms-of-trade changes, initial income, dummy for 1980s and 1990s (Gini later) 2. Education, M2/GDP (financial development), civil liberties (Gastil index), mean land Gini, mean land Gini * LDC (less developed countries) (all instrumented because of endogeneity) (Growth later)	Drawing from both literature on determinants of inequality and of growth, authors come up with a simultaneous examination of variables that cause both growth and inequality. Education, inflation and distribution are correlated with both faster growth and lower income inequality, whereas civil liberties increases equality but decreases growth, and Sachs-Warner openness index increases growth but decreases equality (coefficients and joint significance test). Estimations are on short-run changes and not long-run steady state consequences of policy however.
Panizza (2002)	OLS, FE, GMM-estimator, 10 and 20 years, 1940-1980, 14 states of the US	Annual growth rate of income per capita	Log of income per capita, inequality (Gini or income share of third quintile), Perotti control set (stock of human capital, degree of urbanisation, age structure), time dummies	Whilst pooled OLS leads to a negative and significant relationship, panel estimation methods mostly lead to negative but insignificant associations. The associations are not robust.
Rooth & Stenberg (2011)	72 Swedish regions, 1990-2006 Gini, third quintile, p90/75 and p50/10 (population register data) OLS, FE, System-GMM	Average per capita earnings growth	Gini, third quintile, p90/75 and p50/10. Controls: log per capita income, spatial lag, college graduates, working age fractions, employment proportions	Positive association between inequality between 90th and 75th percentile and economic growth, which disappears when controlling for commuting patterns.
Voitchovsky (2005)	LIS database, System-GMM-estimator (Arellano & Bover, 1995; Blundell & Bond, 1998), 5-year panel data growth model, 21 countries, 1975-2000	Log of real GDP per capita	Inequality ratios, especially 50/10 for bottom and 90/75 for top inequality, Gini Controls: initial average years of schooling, average investment rate, initial level of income Default instruments are delta investments, and delta average years of schooling lagged	Association inequality and growth differs alongside the inequality distribution. Inequality at the top end of the distribution is positively associated with growth, whereas there is a negative association between inequality at the lower end of the distribution and growth. A single inequality indicator will not be able to grasp these differences.

Social expenditures, redistribution, taxes, and growth

Authors	*Period, method, sample, and data sources*	*Dependent variables*	*Independent variables*	*Results*
Afonso & Furceri (2010)	1970-2004, five year periods, EU15 and rest of OECD, OECD economic outlook, Barro & Lee (2001), Penn World Tables, pooled OLS and FE, and IV for simultaneity (share of government spending by lagged values, openness, country size (total population; and volatility by its lagged values, openness). Data detrended using HP6.25 filter, BP filter, first differencing Decomposes size (in % of GDP) and volatility (standard deviation of the cyclical component of the variables)	Growth rate of real GDP per capita	1. Government revenue in % of GDP and its volatility: total expenditure, transfers, subsidies, government investment, government consumption (wage and non-wage) 2. Government expenditure in % GDP and its volatility: total revenue, direct taxes, indirect taxes, social contributions Control variables: Growth model (initial GDP per capita, average total investment share of GDP, initial human capital, average growth rate of population), openness, output volatility (standard deviation of output business cycle), country dummies for Germany and Finland for breaks, year dummy for EMU and EU single market	Paper looks at effects of size and volatility of government revenue and spending on growth. Composition of government expenditures seems to be important, although all effects on growth are negative: - Indirect taxes, social contributions, and government consumption (size and volatility); - Subsidies (size); - Government investment (volatility). Slightly different coefficients for EU15 and rest of OECD
Kneller et al. (19991999)	Following growth model literature, 22 OECD countries, 1970–95, IMF and World Bank data, five year averages, two-way FE	Log annual per capita GDP growth	Policy variables: budget surplus, distortionary and non-distortionary taxes, productive and non-productive expenditures. Controls: initial GDP per capita, investment, labour force growth, lending minus repayments, other revenues	Support for Barro (1990). Distortionary taxes reduce growth whereas non-distortionary taxes do not. Productive government expenditures stimulate growth, whereas non-productive expenditures do not.
Romer & Romer (2010)	'Exogenous' tax policy implementations using narrative records. US tax changes between 1945-2007, quarterly data, VAR model	Real GDP relative to normal	VAR model with annual subsequent growth rates. Robustness tests involving government spending, federal funds rates, anti-inflationary monetary policies, monetary shocks	Exogenous tax rate of 1 percent of GDP leads to continuous lower real GDP of 2.5-3 percent after 12 quarterly periods.

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