On the Possibility of Combining Low Inequality with Growth

An Inquiry into the Effects of Income Inequality and Redistribution on Economic Growth in Affluent Democracies

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AN INQUIRY INTO THE EFFECTS OF INCOME INEQUALITY AND REDISTRIBUTION ON ECONOMIC GROWTH IN AFFLUENT DEMOCRACIES

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Abstract

This study addresses the central question in political economy how growth and distribution of income are related to each other. Even though many studies have empirically investigated this relationship, few studies investigate whether the income distribution as such, or the redistributing public interventions put in place to equalise incomes affect economic growth. With a quantitative panel design covering 30 OECD countries between 1970 and 2009, this study aims to fill this gap.

This study does not find unequivocal evidence that income inequality affects economic growth. Nevertheless, under a number of restrictions, a robust positive relationship between income inequality and subsequent economic growth can be found. Yet, keeping in mind the data limitations, further analysis suggests that it is not so much the degree of income inequality, but the amount of redistribution that affects economic growth. A small but statistically significant and robust negative effect of redistribution is found, which provides evidence for the trade-off theory holding that redistribution can limit the financial incentives to gain wealth, leading to (marginally) lower output growth. Different types of social spending are not found to have a statistically significant effect on growth, which could point to the importance of tax systems or of other social policy fields, but analysis of their effects on growth are beyond the purview of the analysis here. This finding implies that developed societies have to prioritise values or aim for a certain balance between reaching economic growth and limiting income disparities.

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I look forward to future challenges and feel confident that with my research master I am capable of further contributing to research and policy making in the field of social and economic policies.

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List of Abbreviations

3SLS	Three stages least squares estimation
A&B	Arellano-Bond estimation
ALMP	Active labour market policy
EU	European Union
FD	First difference estimation
FE	Fixed effects estimation
GDP	Gross domestic product
IMF	International Monetary Fund
MLD	Mean log deviation, inequality measure
MRW	Mankiw, Romer, and Weil (1992)
IV	Instrumental variables
LIS	Luxembourg Income Study
ln	Natural logarithm
N	Number of observations
no.	Number
OECD	Organisation for Economic Co-ordination and Development
OLS	Ordinary least squares estimation
PPP	Purchasing power parity
PPPI	Price level of investment
RE	Random effects estimation
SCV	Standardised coefficient of variation, inequality measure
SOCX	Social Expenditure Database (OECD)
SWIID	Standardised World Income Inequality Database
System-GMM	System generalised methods of moments
VAR	Vector autoregression

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1. Introduction

1.1 The issue of attaining growth whilst limiting inequality

The attainment of welfare and restraining income inequality, particularly by means of fighting poverty, are amongst the most important social-economic objectives for welfare states (Barr, 1993). Economic expansion implies a higher aggregate standard of living and more utility-enhancing consumption possibilities for society as a whole.[1] The goal of limiting income inequality pertains more to ideological concepts of fairness, humanitarianism, and equality of human beings (Anderson, 1999). 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 restricting inequality can be linked to the provision of a certain level of insurance and security, in which a minimum is guaranteed by the state.

The question what the core objectives of society should be is largely an ideological one. Conversely, how the objectives of economic growth and low inequality can be reached is a more technical question – although not less contested. This second issue relates to the *ability* of states to deliver these productive and protective objectives (Le Grand, 1990: 556; Hudson and Kühner, 2009). Essentially, this ability of states is determined by the performance of their policies – or the absence of them. The attainment of economic growth involves that public policies should not have too high costs in terms of foregone output, and that the finance of and spending by public institutions should have minimal adverse effects on incentives beneficial to growth.[2] Limiting income inequality requires that state actions should benefit the poor relatively more in the long run.

Implicitly or explicitly, many discussions on welfare state performance make allusion to the existence of a trade-off between promoting economic growth and limiting income inequality. This would mean that the policies most adequate to lower income inequalities are the ones that are most harmful to growth, and vice versa. The cornerstone of this argument is that public interventions with respect to market outcomes to promote equality negatively affect growth by the very distortion of these market outcomes. Arguably, redistribution lowers marginal benefits of gaining wealth, leading to lower incentives, and consequently, to a lower overall economic output.

However, other people argue that this trade-off between reaching economic growth and restraining inequality does not exist. Most counterarguments rely on the alleged detrimental effects of income inequality on growth. Inequality inhibits people who lack the financial means to fully realise their potential, dampening investment in human capital and overall knowledge-building, thereby reducing economic growth. Seen from this perspective,

[1] In utilitarian accounts, this higher aggregate standard of living is sometimes morally advocated as 'the greatest happiness principle' (Bentham, 1789; Mill, 1906; Friedman, 2006). See Tobin (1964) for an extensive discussion of economic growth as an objective of public policies.

[2] Incentives related to for instance employment, savings, and physical investment.

redistribution of wealth is an investment in people that suffer from lower opportunities due to financial constraints (*e.g.* Aghion *et al.*, 1999).

1.2 Untying the knot

The last sub-section paints a complex picture of linkages between the objectives of economic growth and the distribution of wealth, in which it might well be the case that economic growth is affected by both the distribution of welfare as such and by public interventions designed to alleviate inequalities. Nevertheless, few studies pay attention to the effects of both inequality as such and redistribution. Whilst studies on the effects of inequality on growth often do not look at differences in redistributive levels across countries (*e.g.* Aghion *et al.*, 1999; Banerjee and Duflo, 2003; Barro, 2008, but Bourguignon, 2004), studies addressing the effects of alleviating policies generally do not incorporate effects of income inequalities (*e.g.* Midgley, 1999).

The debate on the existence of a trade-off is further complicated by the fact that economic growth itself might well affect the distribution of income and the amount of redistribution, which makes the question methodologically challenging. Growth might 'trickle down' to the poor as it can result in higher demands for goods produced by low-income people and in higher tax revenues (*e.g.* Dollar and Kraay, 2002). Conversely, when economic growth primarily benefits the rich, inequalities will increase. Growth might also have an effect on the amount of redistribution, by shaping financial possibilities or by affecting demand for certain policies (*e.g.* Kolluri *et al.*, 2000). For example, in times of economic turmoil, the demand for unemployment benefits will increase. Furthermore, redistribution alleviates income inequality (OECD, 2008; Kenworthy, forthcoming), but income inequality might affect the need and demand for redistribution as well (*e.g.* Alesina and Giuliano, 2009).

Furthermore, redistribution itself can be achieved in different ways. Income can be mitigated through progressive spending (the policy side) and progressive financing (the tax side). Moreover, it is likely that different types of policies, for instance spending on health care or on unemployment benefits, have different effects on economic growth. The same applies to the composition of taxes (*e.g.* Johansson *et al.*, 2008). Preferably, both the effects of the amount of total redistribution and the effects of the composition of taxes and transfers through which income is redistributed should be investigated.

1.3 Aims and structure

This paper aims to clarify the question whether states are able to achieve economic growth whilst actively limiting income inequality. The study investigates both the association between income inequality as such and economic growth, and the effects of redistribution on overall output. Following Arjona *et al.* (2001), it further reflects on the effects of different public social policies on economic growth. The study focuses on social expenditures, as the question of the existence of a fundamental trade-off most notably pertains to the consequences of redistribution on work incentives and employment. In addition, in current capitalist welfare states, most income is earned within labour market relations. Social policies are the main instruments of the government to influence labour market relations

(Scharpf and Schmidt, 2000). For comparability and data reasons, this study focuses on affluent democracies.

The following question guides the investigation:

> *In what way is economic growth affected by the distribution of income and by the public redistribution of income, in particular through different types of public social policies, in current affluent democracies?*

As noted before, the composition of the tax system might also be important in investigating the effects of redistribution on growth, as different taxes might have dissimilar effects on economic growth. In addition, it might be that public policies in other policy fields, such as in housing or education, are relevant for investigating the relationship between income inequality and economic growth. Yet, the analyses of the effects of the tax system and spending outside the social policy field are beyond the purview of the analysis presented here.

Societal and scientific relevance

The alleged trade-off between attaining equality and growth is considered to be the primary problem for the contemporary welfare state by many politicians and applied researchers (*e.g.* Pierson and Castles, 2000; Sapir, 2006). Okun (1975: 2) coins the relation 'the big trade-off', because it '[…] plagues us in dozens of dimensions of social policy'. This study provides information whether redistributive policies indeed impede economic growth, or whether redistribution might well be efficient as income inequality itself negatively affects economic output. In addition, this study investigates the effects of different types of social policies on growth, which can provide information which programmes do not hinder economic growth. Lastly, it is helpful to investigate if there is indeed evidence for a trade-off between the values of growth and equality from an ethical perspective. When redistribution negatively affects growth, societies will have to prioritise values, whereas no or even a positive relationship would imply that attaining more equality by means of redistribution does not exclude achieving growth per se.

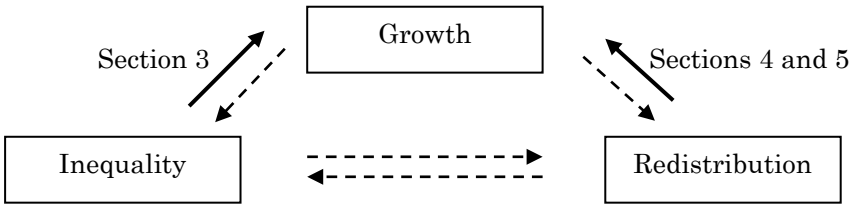
The relationship between income inequality, redistribution, and economic growth has also gained widespread attention in social science. It can be seen as the question in which political science, generally occupied with questions related to distribution and redistribution of power and income, and economics, in which economic growth plays a central role, collide (Alesina and Rodrik, 1994: 465). This study combines political questions and theories with economic reasoning and econometric methods. The study departs from a growth model derived from economic literature and uses panel data estimation methods to better cope with methodological problems, such as feedback loops and omitted variable bias. As noted before, current literature lacks a design in which the effects of inequality, redistribution, and different types of social policies on growth are analysed using a similar framework. Furthermore, this study also devotes attention to possible indirect effects of inequality and social spending on growth by affecting levels of physical and human investment, which is a

new and therefore explorative undertaking in scientific literature. Finally, this study employs more recent and better data up to and including 2009.

Reader's guide

The next section describes the methodological approach. Section three turns to the association between income inequality and economic growth, using multiple inequality indicators.

Figure 1.1: The structure of this study



Subsequently, the effects of income redistribution are investigated in sections 4 and 5. Section 4 focuses on the effects of total income redistribution, as well as the effects of aggregate amounts of public social spending. Section 5 scrutinises the associations between public social policies and economic growth in more detail by differentiating between active and passive labour market programmes. Section 6 discusses the findings and concludes.

Each substantive chapter opens with a short summary of results in italics. To improve readability, additional information is put in the appendices. Appendix 1 contains a further review of the growth model that serves as baseline for the empirical estimations. As the methodological section is rather technical, appendix 2 provides a glossary of statistical terms and a further explanation of the estimation methods used and referred to in this study. Appendix 3 summarises the main descriptive values of the 30 countries incorporated in this study, whilst appendix 4 gives an overview of the empirical literature on inequality, redistribution, and growth. Lastly, appendices 5 and 6 contain additional information on data and estimations for inequality and social spending.

2. The Approach and Methodological Framework

This study departs from a common economic growth model to which indicators of income inequality and redistribution are added. Methodologically, this study employs a panel design for 30 OECD countries with five year periods to investigate the effects of inequality and redistribution on long-term economic growth. The equations are estimated with country fixed effects and time dummies, controlling for unobserved country and time effects. In this way, the effects of changes in levels of inequality and redistribution at the beginning of the period on changes in average economic growth during the subsequent period are investigated. This methodological section is rather technical; concepts in italics are explained in the glossary of statistical terms in appendix 2. The same appendix provides a further description of estimation techniques used and referred to in this study.

2.1 Studying the determinants of economic growth

Generally, studies that estimate the effects of inequality and social expenditure on economic growth follow two paths. One approach builds on literature on determinants of economic growth and adds indicators of inequality or social spending (*e.g.* Barro, 2000; Forbes, 2000; De la Croix and Doepke, 2003; Voitchovsky, 2005; Afonso and Furceri, 2010; Rooth and Stenberg, 2011). A second approach models the behaviour of agents in an (unequal) economy and derives hypotheses from these *structural equations* (*e.g.* Aghion *et al*., 1999; Banerjee and Duflo, 2003). Regardless of the approach, the equations that are estimated are reasonably similar, as variables from growth models are added as *control variables* in the second approach as well.

Since there are many theories developed, this study does not derive a *structural model* with formal equations. Rather, the growth model from Mankiw, Romer, and Weil (MRW, 1992) is taken as a starting point. This model has become a benchmark in studies investigating the determinants of long-term economic growth (Hauk and Wacziarg, 2009). The MRW model was originally constructed to measure conditional convergence between countries. The model postulates the expectation that growth and level of income are inversely related. This denotes that countries with a lower level of income catch up by growing relatively faster, conditional on a number of added explanatory variables. In this study, the *explanatory variables* of the MRW framework are used as control variables for other possible determinants of economic growth. Appendix 1 provides a more extensive discussion of the model and empirical baseline tests.

As the main interest lies in long-term economic growth, period averages are taken to even out business fluctuations. A longer time span, however, entails discarding more information. In addition, a longer time span is likely to be more sensitive to *reverse causality*, as more time has passed by for growth to trickle down, or for a country to respond to growth by changing its policies (Afonso and Furceri, 2010: 520-521). Therefore, five year periods are used as a compromise between filtering business fluctuations and not losing too much information. For a number of estimations, however, data are only available on a ten year time span.

2.2 The growth model specification

2.2.1 Reduced-form model specification

In the MRW model the *dependent variable* is defined as real GDP growth per working age person. This is defined as the average of annual real GDP growth per working age person within the time period. The expression per working age person instead of per capita makes the dependent variable less sensitive to demographic changes, such as an increase in the number of children or retired people.

The four explanatory variables are the initial values of level of GDP per working age person (y_{it}), working age population growth (n_{it}), the average annual stock of physical capital ($1/n \sum_{t=1}^{n}(\ln(s_{it}))$), and the initial stock of human capital (h_{it}), see Box 2.1 for the definitions. For the stock of physical capital a period average is used instead of the initial value, as its expression in percentage of GDP makes it sensitive to business fluctuations.

The MRW model predicts the following relationships. Due to convergence, the level of income is thought to have a negative effect on subsequent growth levels. Working age population growth is supposed to have a negative effect on 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 *et al.*, 1992: 418). Thus, working age population growth lowers growth unless the levels of human and physical capital rise accordingly. The stocks of physical and human capital are thought to have positive effects on economic growth, as they are investments in physical capital or in people.

This leads to the following *baseline equation*, with GDP growth per working age person as dependent variable, and the four explanatory variables plus an *error term* (v_{it}) as right-hand side variables. Subscript n notes the total period length (five or ten years), whilst subscripts t and i refer to the years within the period and the country. Logarithmic expressions are used to allow for interpretation in percentages or *elasticities* (see appendix 2).

$$\frac{1}{n}\sum_{t=1}^{n}(\ln(y_{it+1}) - \ln(y_{it})) = \beta_0 + \beta_1 \ln(y_{it}) + \beta_2 \ln(n_{it}) + \beta_3 \frac{1}{n}\sum_{t=1}^{n}(\ln(s_{it})) + \beta_4 \ln(h_{it}) + v_{it} \quad (2.1)$$

Box 2.1: List of growth model variables

Dependent variable:

- Economic growth: average of annual real GDP growth per working age person (see below), expressed in constant prices and purchasing power parities (2000 PPP in US dollar).

Explanatory variables:

- Initial level of income: level of GDP per working age person at the beginning of the period, expressed in constant prices and purchasing power parities (2000 PPP) per 1,000 US dollar;
- Working age population growth: average growth of the working age population (total population between 15 and 64) at the beginning of the period;
- Stock of physical capital: average of annual total gross fixed capital formation in % of real GDP;
- Stock of human capital: average years of total schooling for the total population aged 25 at the beginning of the period.

2.2.2 Channels

With the MRW model as a set of control variables, this study corrects for effects of the stock of physical and human capital on economic growth when investigating the effects of inequality and redistribution. It might be the case, however, that inequality and redistribution have indirect effects on growth by affecting investments in physical or human capital. As an example, a higher inequality might lower the average years of schooling within a country as fewer people are able to invest in themselves, leading to a lower growth. From this perspective, the effects through the stock of physical and human capital are channels through which inequality or redistribution can affect growth. For that reason, the empirical sections estimate additional equations with the stock of physical and human capital as dependent variables.

The indirect tests are explorative and should be interpreted with caution for two reasons. First, the same set of control variables is used, which might not be fully adequate. Second, the average years of schooling within a country, which is the stock of human capital indicator, shows a persistent rising *trend* over time (a *unit root*), as is shown in appendix 1. This persistent trend over time in a variable makes regressions more sensitive to *spurious findings*. Another variable with a comparable trend over time is likely to be significant, which might have no economic meaning (Granger and Newbold, 1974).

2.3 Methodological choices

Methodologically, this study employs a panel design. A panel data set is characterised by both a temporal and a spatial dimension, as the same unit is repeatedly observed over time. A panel design enables the researcher to investigate whether a change in inequality or redistribution has led to a subsequently altered economic growth pattern within a country. This has two important advantages. First, a panel design is better equipped in determining the causal order of relationship. Second, a panel design allows for better revealing the long-term relationship between inequality, redistribution, and growth, as persistent differences between countries and accidental temporal effects can be filtered out. Yet, a disadvantage is that the used panel estimation technique, fixed effects estimation, is likely to bias downwards the coefficients of the variables of interest, as is explained below.

2.3.1 Simultaneity issues

As noted in the first section, inequality and redistribution might (partially) be a consequence of economic growth, which is called *simultaneity* or the presence of feedback loops. For example, social expenditures on unemployment benefits are likely to increase during a recession. Without correction, this can cause the estimations to be *biased* (see Wooldridge, 2009 for mathematical proof). The temporal dimension of panel data allows for a certain ad hoc correction of simultaneity. As Aron (2000: 114) states, reviewing empirical studies on the effects of institutions on growth: 'Ideally, to reduce *endogeneity* problems [here, problems of simultaneity, ST], institutional quality should be measured at the beginning of the period on which the research is concentrating'. This is the approach followed here. Subsequent levels of economic growth are regressed on initial values of the explanatory variables to

theoretically exclude the possibility that the variation in growth causes the variation in the explanatory variables measured earlier.

Nevertheless, the correction of simultaneity using the time difference between the dependent and explanatory variables is an ad hoc solution that might not be fully adequate. First, people can show behaviour to anticipate for a certain event.[3] For instance, it might be that people advocate higher levels of social spending in anticipation of a possible recession later. This counterargument does not seem to be very strong in this study, as the time period (at least five years) and therefore the time difference between measured cause and effect seems to be long enough to offset any predictive behaviour.

More fundamentally, it might be that the levels of inequality or social expenditure measured at the beginning of the period were already the consequence of economic growth before that period. This chicken or the egg problem is hard to fully overcome. One possible way is to employ *instrumental variables* (IVs) that are related to one of the two variables but not to the error term (they have to be *exogenous* themselves). Yet, it is complex to find IVs that satisfy this criterion. Alesina and Rodrik (1994) instrument inequality with literacy rates and infant mortality. Lundberg and Squire (2003) adopt finance and trade variables to instrument growth, whilst using instruments related to civil liberties for inequality. Yet, it can be questioned whether these variables are not simultaneously determined themselves, and furthermore, most of these instruments do not seem to be applicable in a context of developed countries. In addition, there is a loss of precision as an instrument instead of the actual variable is used, which can lead to even worse outcomes than with the original variables (Bound *et al.*, 1993; Deaton, 2010).

2.3.2 Omitted variables and heterogeneity bias

Second, a panel design is better capable of investigating the long-term relationship between inequality, redistribution, and growth, as persistent differences between countries and accidental temporal effects can be filtered out. In technical terms, a panel design allows to exclude variation that is time specific or country specific, which are caused by *omitted variables* – variables not included as explanatory variables in the estimation.

Unobserved or omitted variables are captured by the error term. A panel design allows for a differentiation of the error term into three parts. One part consists of a 'normal' *idiosyncratic error term* that varies both over time and between countries, which is assumed to be independent and identically distributed (u_{it}). A second part differs per country but is constant over time (a_i), which contains the constant *country effects*. The third part is similar to all countries but differs per time period, called time effects (η_t).

$$v_{it} = u_{it} + a_i + \eta_t \tag{2.2}$$

In growth equations there are likely to be many unobserved variables, as economic growth is the final outcome of the myriad of market economy transactions (Sala-i-Martin, 1997; Arjona

[3] An often used example is the purchase of Christmas cards which occurs before the actual causing event, Christmas, takes place (Atukeren, 2008).

et al., 2001: 4). A country's economic growth rate might well be affected by unobservable characteristics that vary little over time captured by the country-specific error term (a_i), such as persistent differences in adopted technological levels or in cultures and institutions (Banerjee and Duflo, 2003; Verbeek, 2008). These persistent country effects are also likely to be correlated with the explanatory variables, for instance with the stock of physical capital or with income inequality. If this is the case, an estimation that does not eliminate the country effects will lead to biased estimators. This problem is called *heterogeneity bias*.

With a panel design estimation techniques can be applied that eliminate persistent country effects. The panel estimation technique employed here is *fixed effects estimation*, which relies on the variation within a country over time. Basically, in this fashion, the effects of fluctuations in the explanatory variables on fluctuations in the dependent variable are measured. Intuitively this procedure makes sense; only when a fluctuation in an explanatory variable is followed by a change in the dependent variable a (causal) relationship exists. A mere high *correlation*, *e.g.*, between physical investment and economic growth is no proof of causality; it might be spurious (for instance due to an omitted variable, leading to heterogeneity bias).

In technical terms, the country average over time is subtracted from each country observation for every variable. In this way, the constant part of the variation of the variables within a country is filtered out. As persistent differences between countries captured by the country effects (a_i) are constant over time, they are swept away, making fixed effects unaffected by heterogeneity bias (Hsiao, 2006). Appendix 2 further explains fixed effects estimation.

Time effects are fluctuations in the dependent variable within a certain time period but common to all countries (η_t). Basically, these time effects point to unobserved accidental macro-economic shocks that affect all countries, for instance the oil crises between 1970 and 1975, and the current financial crisis (Acemoglu *et al.*, 2005a: 48). These accidental shocks are not of interest here; this study focuses on the long-term association between inequality, redistribution, and growth. The time effects can be absorbed by including *time dummies*. Yet, a disadvantage of the inclusion of time dummies is that they are difficult to interpret as they represent unobserved variables. Therefore, when the inclusion of time dummies makes a significant difference, this is discussed in the text.

2.3.3 Predictive power

Even though fixed effects estimation is preferred as it is corrects for persistent country differences, the transformation has consequences for the predictive power of the estimation, especially in the presence of *measurement error*. When variables are highly persistent, that is, when they hardly fluctuate over time within a country, the fixed part that is swept away by the fixed effects procedure is substantial relative to the part that varies over time within a country. Measurement error that varies over time, however, remains, and is significantly exacerbated after this transformation (Pritchett, 2000: 240). This can lead to substantial underestimation of the effects of highly persistent variables, called *attenuation bias*.

Hauk and Wacziarg (2009) show that fixed effects estimation biases downwards the slopes of the highly persistent stocks of physical and human capital in growth regressions, whilst the initial level of income variable is overestimated. Indeed, in this study the stocks of

physical and human capital are generally found to be insignificant in the estimations. Although Hauk and Wacziarg (2009) do not investigate the predictive power for added indicators to the MRW framework, it is likely that fixed effects estimation biases them downwards as well. The levels of inequality, redistribution, and social spending are also relatively stable within countries across time. The found coefficients are therefore likely to be the lower limits.

Hauk and Wacziarg advocate a number of other estimation methods that have fewer problems due to measurement error. However, these solutions are not fully satisfactory either. First, they suggest to drop the panel design and use both within and between variation; thus, using ordinary least squares (*OLS*). Yet, in the presence of fixed country effects (a_i), this biases the estimations as explained before (heterogeneity bias). Whether there are significant country effects can be tested by means of an *F test* that all (a_i) are zero. If this *F* test is not rejected, the more efficient pooled OLS can be used, but in this study, *F* tests are rejected for every model specification. Another way would be to drop the whole panel design and take one average across the whole period per country for every variable. Yet, this also does not solve the heterogeneity bias, it introduces problems due to simultaneity, and it involves a substantial loss of data problems.

Their second suggestion is quite technical; it involves the use of an elaborate estimation technique called system generalised methods of moments estimator (*System-GMM*; Blundell and Bond, 1998). System-GMM also eliminates country effects and is according to Hauk and Wacziarg (2009) more powerful in growth regressions. Yet, its procedure involves a loss of at least three periods of data which makes results in this study unstable because of limited number of observations. Therefore, for this study, this remedy seems to be worse than the cure. Appendix 2 provides more information on OLS and System-GMM.

Panel estimation techniques also put higher demands on the *standard errors*. *Heteroskedasticity*, when the variance of the error term depends on the explanatory variables, and *autocorrelation*, when the error terms in consecutive periods are correlated, lead to incorrect standard errors, and therefore to incorrect *t-tests* for statistical significance. Baseline tests indicate that autocorrelation is not a serious problem (*Breusch-Godfrey test*; Breusch and Godfrey, 1981), whereas there is presence of heteroskedasticity (*Breusch-Pagan test*; Breusch and Pagan, 1980). This study always uses *clustered standard errors* on country level that allow for general forms of heteroskedasticity and autocorrelation within countries, by imposing alternative assumptions on the covariance matrix structure (Verbeek, 2008: 372).

2.4 Countries, time period, and data

The panel used for this study covers the years 1970-2009 for all OECD countries except for the recent member states Chile, Estonia, Israel, and Slovenia. The 30 included countries and their main descriptive values are listed in appendix 3. The panel is *unbalanced* as earlier observations are missing for East-European countries, Germany, Mexico, and Turkey. The study focuses on these developed OECD countries for two reasons. First, their social-

economic problems are more comparable.[4] In addition, it allows for reliance on OECD data which are likely to have substantially lower measurement error (*e.g.* Krueger and Lindahl, 2001; Banerjee and Duflo, 2003; Siegel, 2007). As noted in the previous sub-section, measurement error is an important issue when using fixed effects estimation.

For economic growth and the initial level of income, data come from National Accounts (OECD). The GDP is calculated using an expenditure approach, and is expressed in constant prices and 2000 purchasing power parity (PPP) in US dollars. Data for the year 2010 are calculated using the trend of the GDP volume at 2005 PPP in US dollars from Economic Outlook no. 88 (OECD). Total volume of gross fixed capital formation and GDP volume in market prices are drawn from this last data source as well. Data on working age population are taken from the Economic Outlook no. 88 (OECD), complemented by data from National Accounts (OECD) for Czech Republic, Mexico, and Slovak Republic. Data for the human capital variable are drawn from the Barro and Lee (2010) database. This database has a long time span and it includes estimations on a five year base of average number of years of schooling of the population between 15 and 64.

Baseline tests for the MRW growth model are presented in appendix 1 for five and ten year time spans. Fixed effects estimation yields significant coefficients for initial GDP and working age population growth, whereas coefficients for the stocks of physical and human capital are insignificant. As explained in the previous sub-section, the consistently reported insignificance of the time-persistent stocks of physical and human capital is likely to be at least partly a consequence of the use of fixed effects estimation.

In the next section the methodological framework constructed in this section is applied to the question whether income inequality affects subsequent economic growth rates in affluent democracies.

[4] Malnutrition, HIV, and fertility for instance might well be important factors affecting both growth and inequality in developing countries, whereas these problems seems to be less relevant for developed countries.

3. Inequality and Growth

This first empirical section addresses the relationship between income inequality and economic growth with the MRW growth model introduced in the previous section as a set of control variables. Seven inequality indicators are distinguished. OECD data for the Gini on final income for entire population is complemented using the trends in databases with a similar inequality definition. This indicator yields a robust positive relationship between inequality and economic growth in the subsequent period. The relationship is significant when outlier Ireland is excluded or when the time dummies are left out of the model. Further explorative inspection suggests that inequality has a negative association with the stock of human capital, although a causal inspection requires further research.

3.1 Literature on effects of inequality on growth

There is a large body of literature on the effects of inequality on growth. The next two sub-sections summarise the main theories and empirical findings. Appendix 4 presents an overview of main studies on the relationship between inequality and growth from approximately 2000 onwards; an overview of older studies can be found in Arjona *et al.* (2001: 46-53).

3.1.1 Positive effects of inequality on growth

A first reason why inequality might enhance growth is that high income classes have higher marginal propensities to save (Li and Zou, 1998; Castelló-Climent, 2010: 296). As the rates of savings and investment are positively related, more unequal societies will have higher investment rates in physical capital, and therefore a higher growth. Also, it could be that a concentration of capital is crucial for the construction of new activities with high set-up costs (Galor and Tsiddon, 1997; Dominicis *et al.*, 2008). This first class of arguments predicts a positive effect of inequality on the stock of physical capital, leading to a higher economic growth. With the internationalisation of the capital market, this argument might have lost strength. Countries with lower saving rates can rely on the savings of other countries to finance their investment.

Hypothesis 3a: Inequality has a positive effect on the stock of physical capital, leading to higher economic growth

A second argument focuses on the incentives of people. Higher dispersion incites people to put forth additional effort, as the rewards of this additional effort are higher (*e.g.* Mirrlees, 1971). As people will make more efforts, economic growth will increase. This has been called the 'tournament model' (Lazear and Rosen, 1981). From experimental economics there is evidence that relative incomes are important for perceived welfare or well-being (Gruen and Klasen, 2007: 217-218). Comparing 72 Swedish regions, Rooth and Stenberg (2011) find that higher inequality in the home region stimulates workers to find work in other regions,

leading to a higher overall economic growth. Mahy *et al.* (2011) show that intra-firm wage dispersion in Belgium has a positive impact on firm productivity. This group of arguments hypothesises a positive effect of inequality on economic growth through the (unobserved) incentives channel.

Hypothesis 3b: Inequality has a positive effect on economic growth

3.1.2 Negative effects of inequality on growth

Three negative effects of inequality are regularly put forward in economic and political literature. First, from development literature there is evidence that more equal societies are more socio-politically stable, which positively affects growth (Alesina and Perotti, 1996; Perotti, 1996; Keefer and Knack, 2002). Unequal countries experience more violent protests and coups as inequality lowers costs of participating in disruptive actions.[5] Keefer and Knack (2002) argue that inequality, ethnic tensions, and social polarisation reduce security of property and contract rights, and consequently lower growth. These factors may play a less important role in developed countries as property rights are relatively well-secured (Barro, 2008; Castelló-Climent, 2010).

Hypothesis 3c: Inequality has a negative effect on economic growth

A second argument pertains to the alleged detrimental 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 growth (Galor and Zeira, 1993; Persson and Tabellini, 1994; Aghion *et al.*, 1999: 1621; Bourguignon *et al.*, 2007). This tenacious underdevelopment of poor people might lead to poverty or inequality traps, which are '[…] persistent differences in power, wealth and status between socio-economic groups, that are sustained over time by economic, political and socio-cultural mechanisms and institutions' (Bourguignon *et al.*, 2007: 236). 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 economies, this negative effect of inequality through the human capital channel might have become more imperative (Galor and Moav, 2004).

Hypothesis 3d: Inequality has a negative effect on the stock of human capital, leading to lower economic growth

A third group of arguments focuses on the redistribution channel. From a median voter model, the majority will favour redistribution when the mean income exceeds the median income (Persson and Tabellini, 1991; Alesina and Rodrik, 1994; Rodrik, 1998; Lübker, 2007; Alesina and Giuliano, 2009). As in a more unequal society the difference between mean and median income is larger, this will lead to greater need or higher demand for redistribution.

[5] Tentatively, the high income inequality might have been one of the factors leading to the Arab spring in 2011.

Redistribution by public interference distorts incentives to work more as marginal benefits decline, a line of reasoning that will be further explained in section 4.1.

It is not entirely certain how this theory should be tested. The theory predicts that higher inequality will lead to higher redistribution, and subsequently, to lower growth. Yet, redistribution will also lead to lower inequality, causing a complex feedback. The theory is tested by regressing growth on market income distribution, which summarises the amount of inequality *before* redistribution. The reasoning then is that a higher market income distribution will lead to lower economic growth by leading to higher redistribution, although this last allegation through redistribution is not tested here.

Hypothesis 3e: Market income inequality has a negative effect on economic growth

Obviously, the median voter theory can also be turned around if the postulation is that redistribution, *e.g.*, in the form of public education, has positive effects on economic growth (see sub-section 4.1; Saint-Paul and Verdier, 1993).

Banerjee and Duflo (2003) argue that fluctuations in inequality in general, thus both a lower and higher inequality, lead to lower economic growth in the subsequent period. More inequality will lead to more redistribution, whereas less inequality will lead to lower incentives. When changes in inequality, measured by squared growth of inequality, are added to the equation, the level of inequality loses its significance in their analyses.

Hypothesis 3f: Changes in inequality have a negative effect on economic growth

3.1.3 The effects of growth on inequality

Unless all people benefit equiproportionally from growth, growth itself also affects the distribution of incomes. Dollar and Kraay (2002) controversially find evidence that growth has an equalising effect for developing countries. Growth 'trickles down' to the poor as it leads to higher tax revenues and an increase in demand for goods produced by low-income groups. Heinrich (2003), however, argues that growth leads to greater inequality for developed countries using LIS data.

Most famously, Kuznets (1955) argues that the effect of growth on inequality is not linear but shows an inverted U-shape pattern. The initial phases of development disproportionally benefit the rich, but when a certain level of development is reached, growth trickles down and inequality decreases. Barro (2000; 2008) also finds evidence for the existence of this inverted U-shape pattern. He argues that economic developments, for instance the current shift to a knowledge economy, initially benefit a minority but gains are spread more widely after some time. In this sense, economic growth is the forerunner of income equality.

As explained in the sub-section 2.3, the temporal dimension in the panel study allows for an ad hoc solution to feedback problems. The income inequality indicators are generally measured at the beginning of the period, whilst economic growth is measured as an average during the period.

3.2 Operationalisation and extension of the growth model

The growth model that was introduced in section 2 and appendix 1 can be augmented as follows, in which the term ($\ln(\Omega_{it})$) denotes the added inequality indicator:

$$\frac{1}{n}\sum_{t=1}^{n}(\ln(y_{it+1}) - \ln(y_{it})) = \beta_0 + \beta_1 \ln(y_{it}) + \beta_2 \ln(n_{it}) + \beta_3 \frac{1}{n}\sum_{t=1}^{n}(\ln(s_{it})) + \beta_4 \ln(h_{it}) + \beta_5 \ln(\Omega_{it}) + u_{it} + a_i + \eta_t \quad (3.1)$$

The addition of an inequality indicator to a growth model implies that the coefficient measures any additional association between the inequality measure and growth (*e.g.* Deaton, 2010). Hence, the inequality indicator only picks up the partial association with growth, controlling for indirect associations through the stocks of physical and human capital. In sub-section 3.5 possible indirect associations between inequality and growth through the stock of physical and human capital are analysed.

Within the text results are displayed for fixed effects estimation with time dummies and clustered standard errors. *F* tests show that the unobserved country and time effects are always jointly significant.

Inequality indicators

Inequality indicators summarise the income distribution in different ways. Therefore, the choice for an indicator has an effect on the results (*e.g.* Atkinson, 1970: 257). For instance, the Gini coefficient is particularly sensitive to changes in the middle of the distribution, whereas the mean log deviation is sensitive to the lower tail of the income distribution (Cowell, 2009). Also for theoretical reasons it is preferable to employ multiple inequality measures. Theories related to work incentives can best be tested using inequality within the working age population, whereas, *e.g.*, the socio-political stability argument pertains to inequality within the entire population. For that reason, multiple indicators are used. Box 3.1 gives an overview of the inequality measures used in this paper.[6]

Inequality defines poverty as being below a certain threshold, compared with the mean or median in a country. Inequality can therefore be called a relative poverty measure. Poverty can also be defined in an absolute fashion – everyone below a certain income threshold that is assumed to be essential to live a healthy life. Yet, the definition of this absolute poverty line is subjective and data are less comparable across countries. In addition, in the context of developed countries, the extent that people are lagging behind seems to be a more widespread and therefore pressing issue than absolute poverty (see the discussions between Townsend (1985) and Sen (1985); Foster, 1998).

[6] A different way to estimate whether the effect of inequality on growth differs per income group is to use quintile regressions, which estimates effects of means of multiple groups of the distribution (*e.g.* Castelló-Climent, 2010).

Data

The OECD database on income distribution and poverty contains information on all indicators summarised in Box 3.1 for a maximum of six time points per country (mid 70s, mid 80s, around 1990, mid 90s, around 2000, and mid 2000s). The data measured in the middle of decades are used for the analyses on ten year averages. This has one important drawback. The inequality indicators do not refer to the beginning of the period, but to the middle, which is the same period as the dependent variable refers to. This further complicates causal interpretation of the results.

Data at the beginning of the period on a five year time period are created for the Gini on entire population, final income distribution, using multiple data sources. The data from the OECD are complemented using the trend of data from the Luxembourg Income Study (LIS) and the Standardised World Income Inequality Database (SWIID; Solt, 2009). These data sources have the same Gini definition. Data have been complemented when the overlapping years showed a comparable trend. Around 30 per cent of the observations are complemented in this fashion. Appendix 5 presents an overview of this variable, indicating which missing data are complemented.[7] Although the complementation leads to a larger number of observations, it adds an unknown amount of measurement error and subjectivity.

Income inequality data are derived from income surveys. For that reason, typical survey problems, such as attrition, can affect the quality of the data (Atkinson and Brandolini, 2001; Banerjee and Duflo, 2003). This can have consequences or the quality of the data. The OECD and LIS data are widely regarded to be among the most reliable (ibid).

Box 3.1: List of inequality indicators

All inequality indicators come from the OECD. Income is adjusted to household size, assuming an equivalence scale of 0.5 (OECD, 2008). For the estimations, all variables are multiplied by 100 and logarithms are taken. For all inequality indicators a lower number indicates a more equal income distribution.

- Gini coefficient: the difference between the proportion of total national income cumulatively earned from lowest to highest incomes (Lorenz curve) and a 45 degrees line representing perfect equality. It varies between 0 and 1, where 0 resembles the situation in which everyone enjoys the same income, whereas 1 pertains to one person earning all;
- Mean log deviation (MLD): average logged deviation between the arithmetic mean and disposable income of each household member. Complete equality yields a score of 0, whereas its maximum is $1 + \ln(100))\ln(\mu))$;
- Squared coefficient of variation (SCV): squared ratio from the standard deviation to its mean per equivalent household member. Its minimum is 0 whereas its maximum is infinity.

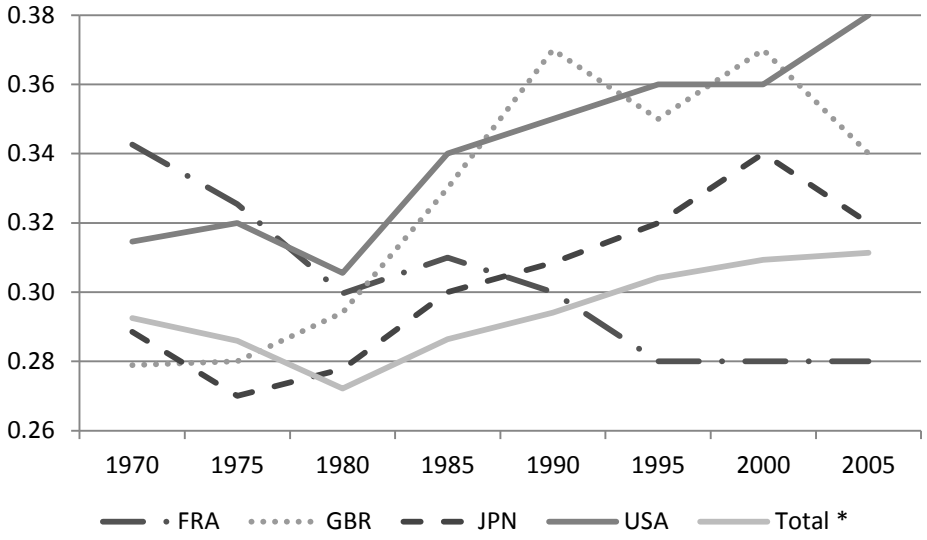
For the Gini indicator, both market and final income distribution indicators are available. Market income distribution pertains to the income distribution *before* taxes and transfers (gross income), whereas final income distribution is the income distribution taking *after* taxes and transfers (net income).

[7] This procedure of combining is preferred over choosing LIS or SWIID. The LIS database also suffers from data scarcity, whereas the SWIID differs more from the other two data sources and therefore is considered to be less reliable.

3.3 Data descriptions and trends

The inequality indicators reveal a moderate trend towards increasing inequality within the OECD area. This corresponds to findings in other literature on increasing inequalities (*e.g.* OECD, 2008; forthcoming). Figure 3.1 summarises this for the Gini on entire population, final income distribution for a number of countries. For the 14 countries for which data are available for all periods, this Gini rose on average from .29 in 1970 to .31 in 2005. This is exactly the average rise reported in a study relying solely on OECD data (OECD, 2008). The change is qualified in this study as a 'moderate, but significant and widespread' rise in income inequalities. Following the interpretation of Blackburn (1989 quoted in OECD, 2008), the rise of 2 Gini points is equal to a transfer of 7 per cent of income of people below the median to the people with an income above the median, whose incomes subsequently rise by almost 3 per cent.

Figure 3.1: Gradual and widespread rise of income inequality within the OECD area



Total covers CAN DEU DNK ESP FRA GBR HUN ITA JPN NOR NZL POL SWE USA

In general, the indicators on final income distribution show low inequalities in the Scandinavian countries, most notably for Sweden. High inequalities on final income distribution are reported for Mexico and Turkey, and for UK and Greece. Slovakia shows the strongest increase in inequalities (from .19 to .27 within fifteen years) whereas inequality in France decreased most substantially (from .34 to .28 over the whole period).

The Gini on market income distribution shows much less variation between countries. For the specification in logs, final income distribution has a standard deviation roughly 50 per cent higher than the standard deviation of market income distribution (.20 and .13, respectively). This implies that market outcomes are more similar across countries than final income levels, after taxes and transfers. Finland consistently reports the lowest inequality levels, but interestingly, also the US and Canada, countries with relatively high levels of final income inequality, show low values in 1970 and 1980. Mexico and Italy show the highest values of market income inequality. As inequality between countries varies

much stronger for final incomes than for market incomes, public interventions apparently play an important role in altering the income distribution. The associations of redistribution and inequality reducing social policies with economic growth are covered in sections 4 and 5.

The logs of the inequality indicators, which are used in the analyses, show low negative correlations with economic growth (between -.08 and -.24), as shown in Table 3.1. The Gini on entire population, final income distribution, shows the lowest correlation with economic growth, although it shows generally stronger correlations with the growth model variables.

Table 3.1: Correlations between inequality indicators and growth model variables

	Economic growth	**Initial level of income**	**Working population growth**	**Stock of physical capital**	**Stock of human capital**
Entire population, Final income distribution					
Gini [1]	-0.08 (0.27)	-0.40 (0.00)	0.47 (0.00)	0.01 (0.90)	-0.41 (0.00)
SCV [2]	-0.23 (0.04)	-0.31 (0.01)	0.28 (0.01)	0.06 (0.64)	-0.27 (0.02)
MLD [2]	-0.19 (0.10)	-0.36 (0.00)	0.32 (0.01)	0.06 (0.61)	-0.32 (0.01)
Working age population, Final income distribution					
Gini [2]	-0.19 (0.08)	-0.44 (0.00)	0.41 (0.00)	-0.00 (0.99)	-0.37 (0.00)
SCV [2]	-0.20 (0.10)	-0.15 (0.22)	0.18 (0.14)	0.05 (0.70)	0.01 (0.95)
MLD [2]	-0.24 (0.05)	-0.33 (0.01)	0.36 (0.00)	0.03 (0.81)	-0.27 (0.02)
Entire population, Market income distribution					
Gini [2]	-0.11 (0.34)	-0.15 (0.22)	-0.08 (0.49)	-0.05 (0.67)	-0.22 (0.06)

[1] Five year data set; [2] Ten year data set. Significance between brackets, all variables in logs.

Regarding the indirect associations, all indicators except for SCV on working age population show moderately strong negative correlations with the stock of human capital as is shown in table 3.1. This could indicate evidence for the human capital theory implying that inequality leads to underinvestment in human capital, which is further tested in sub-section 3.5. The indicators show generally positive correlations with the stock of physical capital as predicted by the marginal savings theory, although the correlations are weak. The moderately strong negative correlations between inequality and level of income suggest that richer countries in general have lower inequalities, although a causal interpretation seems not warranted.[8]

[8] A different design and much longer time span is required to estimate the effects of inequality on level of income, as levels of income are the result of many years of economic growth. In addition,

The inequality indicators generally are highly correlated (around .90, results not shown here), except for SCV on working age population and Gini on entire population, market income distribution (around .50).

3.4 Estimation of the direct relationship

This section tests the association between income inequality and economic growth with the MRW growth model as a set of control variables. All estimations are conducted with clustered standard errors and time dummies.

OLS estimates usually produce statistically significant negative effects of inequality on growth (*e.g.* Alesina and Rodrik, 1994; Persson and Tabellini, 1994; Clarke, 1995; Perotti, 1996; Keefer and Knack, 2002). This coefficient is found to be stable, holding for different inequality indicators, country samples, and time specifications. Because of these consistently negative associations, Bénabou (1996: 13) argues: 'These 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'.

Nevertheless, as explained in sub-section 2.3. and appendix 2, when unobserved time invariant country effects are correlated with the included explanatory variables, OLS yields biased estimates (heterogeneity bias). Tests show that there is indeed presence of country effects within the panel, and therefore OLS results are not shown here.[9] Still, it is interesting to note that the obtained results show little difference between the indicators focusing on entire or working age population, or between indicators on final and market income distribution. Following the literature, OLS yields consistently negative coefficients for inequality which are all significant without time dummies, but generally are not significant – and even change quite radically – when time dummies are included.

Other studies rely on fixed effects estimations (*e.g.* Forbes, 2000; Arjona *et al.*, 2001; Castelló-Climent, 2004). Fixed effects estimation is unaffected by heterogeneity bias, but as noted in sub-section 2.3, in growth equations it can (severely) underestimate the coefficients of stock variables. Generally, the negative association between inequality and growth disappears when the fixed effects estimation is used (Forbes, 2000; De Dominicis *et al.*, 2008).

Table 3.2 presents the results of different income inequality indicators that are available on a ten year data base. The inequality indicators, except for the very insignificant MLD for the working age population, show positive coefficients. The SCV indicators for entire and working age population are significant at respectively the 10 and 5 per cent significance level.

GDPs are slowly rising over time and as inequality is gradually rising too, the correlation might be spurious.

[9] F tests that all (a_i) are zero are rejected at the 5 per cent significance for Gini on market income distribution without time dummies, and at the 1 per cent significance for all other indicators.

Table 3.2: No unequivocal evidence for a relation between inequality and growth using OECD data

		Final income distribution					Market income distribution
		Entire population		Working age population			Entire population
	Baseline	SCV	MLD	Gini	SCV	MLD	Gini
Level of income	-.0550 (.0085) ***	-.0529 (.0086) ***	-.0549 (.0083) ***	-.0589 (.0088) ***	-.0586 (.0108) ***	-.0599 (.0110) ***	-.0712 (.0133) ***
Population growth	-.2267 (.2455)	-.2287 (.2152)	-.2200 (.2234)	-.3170 (.2401)	-.2558 (.2240)	-.2502 (.2559)	-.1503 (.1689)
Physical capital	.0015 (.0102)	.0018 (.0103)	.0015 (.0099)	-.0037 (.0082)	-.0015 (.0110)	-.0003 (.0105)	.0043 (.0107)
Human capital	-.0040 (.0053)	.0001 (.0058)	-.0020 (.0058)	-.0079 (.0056)	-.0116 (.0072)	-.0145 (.0117)	-.0194 (.0193)
Inequality level		.0025 (.0014) *	.0035 (.0055)	.0012 (.0110)	.0017 (.0008) **	-.0006 (.0058)	.0062 (.0175)
Constant	.1943 (.0427) ***	.1702 (.0425) ***	.1804 (.0498) ***	.2254 (.0561) ***	.2246 (.0484) ***	.2381 (.0681) ***	.2440 (.1122) **
Observ	71	71	71	78	68	67	71
Countries	28	28	28	30	28	28	27
R-squared	0.7579	0.7635	0.7601	0.7390	0.7526	0.7453	0.7381
F test	115.98 ***	137.19 ***	118.29 ***	65.95 ***	78.21 ***	83.95 ***	28.93 ***

Country fixed effects, 1970-2009, ten year periods with time dummies, clustered standard errors. Significance levels are noted by *** (1 per cent), ** (5 per cent), or * (10 per cent), standard errors in brackets. All variables in logs. Dependent variable: average growth of real GDP per working age person during the subsequent ten year period in 2000 US dollar PPP. Growth model variables: see Box 2.1. Inequality indicators: see Box 3.1.

Nevertheless, sensitivity analyses show that the estimations with ten year data are not particularly robust. For instance, when period 1970-1979 is excluded, the inequality indicators become negative, although they remain insignificant. The fact that the period 1970-1979 behaves differently is due to the fact that only limited data are available for this period.[10] When the only six countries are excluded that have data for this period, the fixed effects estimations turn negative as well. In addition, results are sensitive to the inclusion of Ireland. Without Ireland, the MLD for the entire population becomes significant at the 5 per cent, whilst significance of the SCV estimations decreases. With an N between 67 and 78 this lack of robustness is likely to be a consequence of the low number of observations. Because of the lack of robustness it does not seem justified to draw general conclusions on the association between inequality and growth using the ten year estimations.

Fortunately, the created database for the Gini indicator on entire population, final income distribution, for which data on a five year time span are available, performs better. Results are shown in table 3.3. Again, when all periods and countries are included, inequality shows

[10] Only for CAN, FIN, GBR, GRC, SWE, and USA

a negative coefficient for OLS and a positive one for fixed effects, corresponding to findings in the literature. Both are insignificant with the normal model specification. When the periods 1970-1974 and/or 1975-1979 are dropped, the fixed effects specification does not change sign as was the case for the inequality indicators in the ten year data set. This is further evidence that the 10 year estimations suffer from data scarcity.

Table 3.3: Under certain restrictions a positive relation between inequality and growth can be found for complemented data

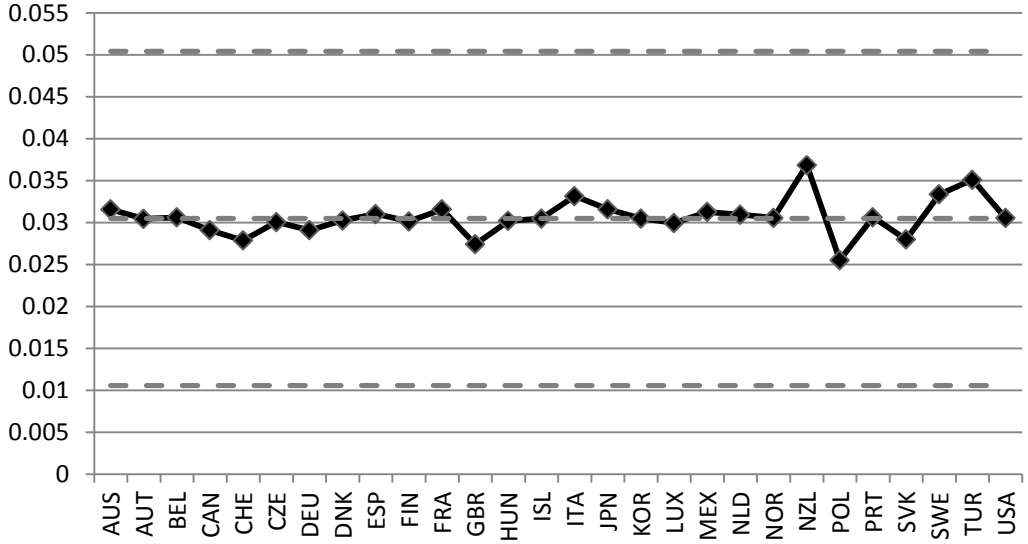
	Baseline	**All countries**	**All countries, no time dummies**	**Without Ireland**
Level of income	-.0518 (.0101) ***	-.0518 (.0106) ***	-.0355 (.0074) ***	-.0603 (.0108) ***
Population growth	-.4198 (.1832) ***	-.4111 (.1709) **	-.7356 (.1705) ***	-.4609 (.1628) ***
Physical capital	-.0003 (.0103)	-.0004 (.0094)	.0045 (.0074)	.0039 (.0088)
Human capital	-.0188 (.0096) *	-.0129 (.0094)	.0030 (.0093)	-.0103 (.0103)
Inequality level		.0209 (.0127)	.0347 (.0121) ***	.0305 (.0097) ***
Constant	.2234 (.0469) ***	.1413 (.0670) *	.0057 (.0497)	.1162 (.0615) *
Observ	182	182	182	176
Countries	30	30	30	29
R-squared	0.5209	0.5300	0.3088	0.5529
F test	29.90 ***	29.52 ***	18.36 ***	47.39

Country fixed effects, 1970-2009, five year periods with time dummies unless stated otherwise, clustered standard errors. Significance levels are noted by *** (1 per cent), ** (5 per cent), or * (10 per cent), standard errors in brackets. All variables in logs. Dependent variable: average growth of real GDP per working age person during the subsequent five year period in 2000 US dollar PPP. Growth model variables: see Box 2.1. Inequality level: Gini, entire population, final income distribution.

With the normal model specification, with all countries and time dummies included, inequality shows a positive but insignificant sign. Without time dummies, the inequality coefficient increases substantially and becomes significant at the 1 per cent. Apparently, time dummies have an important effect, which suggests significant country-invariant time specific variation. The concluding section further reflects on the use of time dummies.

Further inspection of the Gini shows that Ireland is an outsider. If Ireland is excluded from the Gini estimation, the Gini becomes significant at the 1 per cent for fixed effects. Excluding Ireland leads to a stronger and less dispersed coefficient, as the coefficient increases with roughly 50 per cent, whilst the standard error drops with 25 per cent. When additional countries are dropped, the inequality coefficient hardly changes as Figure 3.2 indicates. All coefficients of inequality are well within the 95 per cent confidence interval (between .011 and .050, indicated by the grey dashed line) – and only one country (Switzerland) leads to a coefficient outside the 99 per cent confidence interval.

Figure 3.2: Effects on inequality coefficient of dropping additional countries are negligible



Ireland might be an outsider for a number of reasons. Data for Ireland involve a break in the series because of a change in inequality measurement, from national data definition to the EU-SILC definition in the last decade.[11] Second, Ireland might be considered an outlier in the analysis because of its relatively tempestuous economic growth pattern, with some of the highest (1995-1999) and lowest (2005-2009) economic growth rates, combined with stable income inequality over the whole period. This patterns deviates from patterns recorded for other countries.

3.5 Additional analyses

Sub-section 3.4 analysed the linear association between inequality and growth with the MRW growth model as control variables. This might not be the correct way to analyse the relationship between inequality and growth for two reasons. First, it might be expected that not the level but the growth rate of inequality has an association with economic growth (Hypothesis 3f). Second, inequality might affect the attainment of physical and human capital, leading to indirect associations with growth (Hypotheses 3a and 3d).

This sub-section only employs the Gini indicator for the entire population, final income distribution. This indicator is available on a five year basis and the last sub-section suggests that it performs more robustly. As the inequality indicators are highly correlated with each other, applying only one inequality indicator might be less of a problem.

Growth of inequality

Banerjee and Duflo (2003: 267) argue that the 'growth rate is an inverted U-shape function of net changes in inequality'. Redistribution or 'planned changes in inequality' will be higher when inequality increases, whereas incentives decrease when equality increases, both

[11] As did Austria, Spain, Belgium, and Portugal.

leading to lower economic growth (ibid: 274). Changes in inequality in any direction, measured by the squared growth rate of inequality, lead to lower growth. Indeed, in their analyses the significance of the level of inequality disappears when the growth rate of inequality is added to the equation. Following Banerjee and Duflo, growth of inequality is measured as the difference between logs of Gini at the end and the beginning of the period. Hence, the measure relates to the same period as economic growth, which further complicates causal interpretation. Results are shown for fixed effects.[12]

Table 3.4: No evidence for effects of changes in inequality on growth

	All countries	**Without Ireland**
Level of income	-.0679 (.0137) ***	-.0783 (.0149) ***
Population growth	-.4889 (.2956)	-.6761 (.2808) **
Physical capital	.0062 (.0093)	.0057 (.0095)
Human capital	.0059 (.0110)	.0067 (.0139)
Inequality level	.0371 (.0142) **	.0470 (.0124) ***
Inequality growth	-.0086 (.0122)	-.0086 (.0127)
Inequality growth^2	-.1524 (.1899)	-.1521 (.1789)
Constant	.0809 (.0866)	.0811 (.0871)
Observ	156	151
Countries	28	27
R-squared	0.5926	0.6064
F test	34.99 ***	33.38 ***

Country fixed effects, 1970-2009, five year periods with time dummies, clustered standard errors. Significance levels are noted by *** (1 per cent), ** (5 per cent), or * (10 per cent), standard errors in brackets. All variables in logs. Dependent variable: average growth of real GDP per working age person during the subsequent five year period in 2000 US dollar PPP. Growth model variables: see Box 2.1. Inequality variables: Gini, entire population, final income distribution.

Interestingly, whereas Banerjee and Duflo show in their study that the level of inequality loses significance when growth rate and growth rate squared are added, the opposite happens here. The level of inequality becomes significant at the 5 per cent, even when Ireland is not excluded. The signs of the coefficients do correspond with the findings reported by Banerjee and Duflo (ibid: 285), but the significant one is the level, and not the squared growth rate of inequality. Therefore, this study does not find evidence for Hypothesis 3f, which entails that changes in inequality have a negative effect on economic growth.

[12] The *F* test that all (a_i) are zero is rejected at the 1 per cent both with and without time dummies.

Banerjee and Duflo (2003) use a slightly different set of control variables, taken from Barro (2000). In addition to the growth model variables used in this study, they use initial GDP squared, government consumption, fertility, terms of trade, and a number of dummies related to developing countries. Nevertheless, it does not seem likely that an additional set of control variables would boost the significance of their inequality indicator. Another reason might be that they estimate the equation with random effects, see appendix 2 for an explanation. Random effects estimation does not change the outcomes in this study, and random effects are biased in this study as shown by a Hausman test which rejects similarity of results at the 1 per cent significance. More likely, the inclusion of a number of developing countries in their panel explains the difference in results.

Channels of inequality and growth

A number of theories specifically focus on indirect effects of inequality by affecting the attainment of physical and human capital, thereby lowering consecutive economic growth. As the stocks of physical and human capital are included as control variables, these effects do not show up in the estimations. In table 3.5, the stocks of physical and human capital are used as dependent variable, with the MRW model as a set of control variables. As this set of control variables might not fully be appropriate, these tests are quite exploratory.[13]

Table 3.5: Explorative evidence for importance of human capital channel

	Physical capital	**Human capital**
Level of income	-.1471 .1202)	-.0740 .1774)
Population growth	-.9394 2.598)	-2.305 1.927)
Physical capital		-.0883 .1229)
Human capital	-.0958 (.1899)	
Inequality level	.0115 (.1873)	-.4181 (.1588) **
Constant	3.689 (1.084) ***	3.889 (.8510) ***
Observ	182	182
Countries	30	30
R-squared	0.2380	0.7402
F test	4.94 ***	22.97 ***

Country fixed effects, 1970-2009, five year periods with time dummies, clustered standard errors. Significance levels are noted by *** (1 per cent), ** (5 per cent), or * (10 per cent), standard errors in brackets. All variables in logs. Dependent variable second column: average stock of physical capital in percentage of GDP. Dependent variable third column: stock of human capital defined as value between two consecutive periods using linear interpolation. Growth model variables: see Box 2.1. Inequality level: Gini, entire population, final income distribution.

[13] Again, OLS is biased due to existence of country fixed effects at the 1 per cent.

Income inequality is not found to systematically affect the stock of physical capital. Even though the specification might be poor as shown by the insignificance of all slope coefficients and the low *R*-squared value, this comes as no surprise as the correlation between inequality and the stock of physical capital is almost zero (see Table 3.1).[14] Thus, no evidence is found for the reasoning that wage dispersion will lead to higher physical investment (Hypothesis 3a).

In the equation with the stock of human capital as dependent variable, the level of inequality shows a statistically significant coefficient at the 5 per cent. This indicates a negative association between initial levels of inequality and average years of schooling in the subsequent period. Whether this can be interpreted as a causal relationship is difficult to assess. From the credit market imperfection theory, a lack of financial means inhibits people to fully invest in themselves (Hypothesis 3d).

On the other hand, it is also likely that a higher average years of education will lead to more income equality. Higher educational degrees are preconditions for higher-paid word in developed countries; a higher average years of schooling in a country thus likely implies a bigger pool of people eligible for better paid work (*e.g.* Muller, 2002). In addition, with a larger pool of higher educated people, the premium of reduces which further decreases income inequality (Knight and Sabot, 1983; De Gregorio and Lee, 2002).[15] Furthermore, the average years of schooling is not a variable that fluctuates without restraint, as the OECD countries have legally binding minimum years of education for youth. The steady growth of educational levels is even found to be the strongest equality-enhancing factor within the OECD (OECD, forthcoming).[16] When inequality is regressed on the stock of human capital and the MRW model variables, the stock of human capital is indeed significant as well.

3.6 Conclusions

This section empirically estimates the relationship between inequality and economic growth. For theoretical reasons it is preferable to distinguish between inequality in final and in market income distribution, and between inequality within the entire and working age population. Although OECD data allow for these distinctions, due to data scarcity the results are not particularly robust. A more extensive dataset for the Gini on entire population, final income distribution, in which data from the OECD are complemented by data from the Luxembourg Income Study (LIS) and the Standardised World Income Inequality Database (SWIID), facilitates generating more robust results. Nevertheless, this complementation of

[14] Barro (2000) follows a similar approach by using the same control variables when regressing investment and growth on inequality. Next to the growth model variables, he incorporates initial level of GDP squared, government consumption per GDP, inflation rate, fertility rate, growth rate of terms of trade, and a number of dummies designed for developing countries. Perotti (1996) only adds initial income, schooling, fertility, and developing country dummies for his estimation of the association between inequality and investment.

[15] Yet, as these authors argue, not only total educational attainment but also inequality in educational attainment is important in decreasing income dispersion.

[16] The approach of this study is comparable to this study, but then reverse: inequality is regressed on the average years of schooling.

data is by no means perfect as it incorporates breaks in the series and it adds a certain amount of subjectivity. Results should therefore be interpreted with caution.

The indicators show a moderate but widespread trend towards increasing income inequality within the OECD region. Following the findings normally reported in the literature, all OLS estimations of the association between inequality and economic growth yield negative coefficients, whereas the fixed effects estimations of inequality on growth are generally positive. The fixed effects estimations are preferred due to the existence of unobserved country effects that bias the OLS results (heterogeneity bias, see sub-section 2.3.2). Yet, the fixed effects estimations do not provide unequivocal evidence that income inequality affects economic growth. The fixed effects estimations are only robust for the complemented dataset. Inequality is found to be negative, but this relationship is only significant when time dummies are excluded or when Ireland is left out of the sample. Ireland might well be an outlier due to its relatively tempestuous growth rate in combination with a relatively stable income inequality level, although the outlying position could also be a consequence of data breaks.

Additional analyses do not find evidence for a relationship between squared differences in growth in inequality and economic growth (Hypothesis 3f), or between inequality and the stock of physical capital (Hypothesis 3a). However, negative associations are found between income inequality and the stock of human capital, but the direction of causality is unclear as relationships defined in both ways reach significance. Whether this can be interpreted as evidence for the credit market imperfections theory, which stresses that inequality dampens investment in human capital and overall knowledge-building (Hypothesis 3d), requires further research.

The analyses presented in this section find evidence for the theories predicting that higher inequality stimulates economic growth, but only robustly so for a complemented database with the exclusion of the time dummies or without Ireland. Apparently, inequality is not so much an impediment to growth, or at least, the positive effects of inequality outweigh any negative effects under certain restrictions. In the literature, two main arguments are put forward why inequality would positively affect growth. The first group of arguments, noted by Hypothesis 3a, predicts a positive effect of inequality on the stock of physical capital, leading to a higher economic growth. The idea is that capital concentration and the higher marginal propensity to save of high income classes will lead to higher investment, which will lead to higher growth. Nevertheless, no evidence is found for effects of inequality on the stock of physical capital, which makes this line of reasoning implausible. Arguably, with the internationalisa-tion of the capital market, countries with lower saving rates due to lower inequality can rely on the savings of other countries to finance physical investment.

A second line of reasoning, noted by Hypothesis 3b, predicts a positive effect of inequality on economic growth through the incentives channel. A larger dispersion, the argument goes, has a positive effect on incentives and marginal benefits, leading to higher economic growth. This argument predicts that inequality leads to different, growth enhancing, behaviour. With the macro design adopted in this study it is not possible to investigate patterns of changing behaviour at the micro level, but from experimental economics, there is indeed evidence that relative incomes are important for perceived welfare

and well-being (Gruen and Klasen, 2007: 217-218). Positive effects of income inequality on firm productivity and on economic growth in Sweden through commuting patterns further support this assertion.

Not only is income inequality only significant under a number of restrictions, the effect found is rather marginal. The coefficient found suggests that without Ireland, for a given country, as inequality increases with 1 per cent across time, economic growth increases on average by .03 per cent annually in the subsequent five year period, holding the other variables constant. The low inequality coefficient might be a consequence of the underestimation of fixed effects estimation of time-persistent variables in growth equations (Hauk and Wacziarg, 2009).

The following two sections address the effects of the redistribution of income, in particular by means of different types of social policies. Together with these additional analyses, the research question can be answered whether it is indeed income inequality, or policies designed to equalise incomes that affect economic growth.

4. Redistribution, Social Expenditures, and Growth

This section addresses the effects of public interventions to alleviate income inequality on economic growth. This further inspection denotes that it is likely to be not so much income inequality, but redistribution, that affects economic growth, although the lack of data warrants caution with the interpretation of the findings. Public interventions to equalise incomes are found to impede subsequent economic growth, albeit marginally. This result is consistent with the trade-off argument, as public actions to promote income equality come with a cost in the form of (marginal) lower output. Even though redistribution seems to negatively affect economic growth, the social spending variables are found to have an insignificant effect on growth within the OECD area. The results imply that social policies as such do not lower economic growth, as for instance argued by the transaction cost theory, but that the distortion of market outcomes by public redistribution is likely to be more important.

4.1 Theoretical section

This sub-section derives expectations from political and economic theory. Appendix 3 summarises empirical studies on the relationship between social expenditures and economic growth; empirical reviews can be found in Irmen and Kuehnel (2009).

4.1.1 When social expenditures and redistribution impede growth

A first group of arguments pertains to the alteration of market outcomes by public redistribution. The 'distortion' of market outcomes by public reallocation is said to impede growth as it reduces marginal returns and thus financial incentives to gain individual wealth, which leads to a lower overall economic output (*e.g.* Okun, 1975; Lee, 1987). To put it simpler, redistribution lowers the benefits of gaining wealth, which will cause people to gain less wealth, leading to lower overall income. With lower marginal returns to work, 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 the returns to work decrease (sometimes referred to as the welfare trap, *e.g.* Blundell, 2000).

Hypothesis 4a: Redistribution has a negative effect on economic growth

A number of other arguments focus on the alleged lower effectiveness of social spending. First, reallocation increases transaction costs, or in the words of Okun (1975: 91): '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'. Second, public choice theorists argue that public production is generally less efficient than private production, due to lower competition and institutional abundance caused by utility-maximising interest groups and bureaucrats (*e.g.* Niskanen, 1971; Olson, 1971). A related theory is Baumol's cost disease (Baumol, 1967). Although labour productivity does not

significantly increase over time in public sector, the wages of bureaucrats rise as a consequence of growing wages in private industries resulting from higher labour productivity growth. Third, social expenditures require financing through taxes, which might decrease international opportunities of a country on the international economic playing field. This argument presumes lower flows of capital or labour in countries with higher marginal tax rates, leading to a lower economic growth (McKenzie and Lee, 1991; Jessop and Sum, 2006).

This group of arguments predicts that higher amounts of public spending will lead to higher transaction costs, efficiency losses, or a weaker international competitive position, and subsequently, to a lower economic growth. Empirical evidence comes amongst others from Forbes (2000) and Scully (2002), who find a negative relationship between a larger state, measured in per capita gross government investment and consumption, and GDP growth rates.

Hypothesis 4b: Social spending has a negative effect on economic growth

Related, higher public capital accumulation might 'crowd out' private investment by pushing investment rates, which subsequently can lower growth (*e.g.* Ahmed and Miller, 1999).

Hypothesis 4c: Social spending has a negative effect on the stock of physical capital, leading to lower economic growth

4.1.2 When social expenditures and redistribution can stimulate growth

The idea of a trade-off has been criticised by scholars from a number of disciplines. Korpi (1985: 100) summarises the comments as follows: 'Instead of a leaky bucket […], the welfare state can be an irrigation system which supports economic efficiency and growth'.

There are two ways in which redistribution may foster growth. According to some, redistribution should be seen as a 'social investment' in people who otherwise would not have the opportunity to realise their potential. This notion is based on presumed negative effects of income inequality due to credit market imperfections and poverty traps (see sub-section 3.1.2; Galor and Zeira, 1993; Bourguignon *et al.*, 2007: 236). Second, from a Keynesian perspective it could be argued that redistribution evens out business volatility and creates a more equal income distribution, contributing to more stable patterns in economic growth and societal development.[17]

Hypothesis 4d: Redistribution has a positive effect on economic growth

Rather than redistribution, social policies may facilitate growth by publicly providing for insurances against risks, such as unemployment, old age, and disabilities. The public

[17] The argument can also be turned around. When social expenditures are pro-cyclical, social expenditures can increase business volatility which would be detrimental to economic growth. Alesina and Bayoumi (1996) for instance argue that fiscal public policies have a negligible effect on business cycles, as the positive and negative effects cancel each other out.

provision of these insurances might well be more efficient because of market failure. 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.

Hypothesis 4e: Social spending has a positive effect on economic growth

4.1.3 Reverse effects

There are potential reverse effects, as economic growth might also affect levels of social expenditure and redistribution. Growth shapes possibilities for public policies. It might be the case that the richer a country is, the more it is willing to spend on insurances against unemployment, sickness, or on pensions. This phenomenon is called Wagner's law (1883) and it implies a positive income elasticity of demand of social spending (Arjona *et al.*, 2001: 23). Economic growth might also affect demand for social expenditures. In times of economic turmoil, more people will make an appeal to the government for unemployment benefits, whereas the opposite will hold in periods of economic boom. This system of automatic stabilisers leads to a negative effect of growth on demand for redistribution. In general, low economic growth might lead to social need, implying greater demand for social support.

As the level of social expenditures might be correlated with the stance of the economy, spending levels are essentially endogenous, leading to biased estimations. For that reason, Romer and Romer (2010) only investigate the effects of taxes that were passed mainly to raise 'normal' growth, instead of taxes implemented to counter cyclical movements, using white papers. They define exogenous tax implementations as '[…] tax changes that are not systematically correlated with other developments affecting output' (ibid: 763-764). They find that exogenous tax changes have a strong negative effect on output, as a tax increase of 1 per cent of GDP leads to a lower economic growth of over 2.5 per cent of GDP in the long run. Nevertheless, theoretically it can be argued that the underlying progressive tax system which accounts for the distortion of market outcomes is endogenous as well as it could be a result of societal demand.

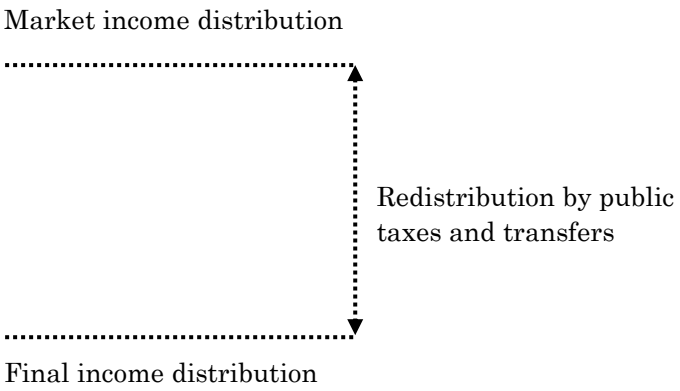
Although this 'exogenising' approach clearly sheds more light on the effects of taxes on growth from a theoretical stance, it is not the approach that is followed in this section for a number of reasons. First of all, the motivation for this study is to look at policies designed to alleviate inequalities which are by definition 'endogenous' policies according to the view of Romer and Romer (2010). From an applied perspective these endogenous policies are the ones that are of most interest. The estimations include the growth model variables as introduced in previous sections to control for the state of the economy, reducing possibilities of omitted variables. Second, levels of spending are measured at the beginning of the period to explain subsequent economic growth, and five year periods are taken to even out market volatilities. Third, more modest claims are made about the produced coefficients, as parts may be a consequence of reverse causality.

4.2 Operationalisation and extension of the growth model

The theoretical sub-section suggests the potential importance of distinguishing between social spending levels as such and the amount of actual redistribution. The amount of

redistribution or actual amount of income mitigation between different income groups can be defined as the difference between market income distribution and final income distribution.

Figure 4.1: Redistribution and social spending



Apart from the amount of money that is transferred, the level of redistribution depends on the classification of the payer and the recipient. In both situations of a progressive tax system – the rich pay relatively more – and a targeting recipient system – the poor receive relatively more – social spending is horizontally redistributive. By contrast, universal tax rates (flat rates) and universal provision of social spending are not horizontally redistributive, as everyone pays and receives an equal amount irrespective of their income. As noted in the introduction, it is outside the remit of this study to investigate the effects of the tax system on economic growth, although this is a potentially important topic (*e.g.* OECD, 2008; Johansson *et al*., 2008). The concluding section further reflects on this.

4.2.1 Redistribution indicator

The total amount of redistribution is defined as the logged difference between final and market income distribution. The variable is created using the Gini on entire population, introduced in last section. Because of data scarcity, the indicator is only available on a ten year period. All data come from OECD (Förster, 2000; Arjona *et al*., 2001; OECD, 2008) – only one observation is complemented using SWIID data to avoid a break in a time series.[18]

$$\ln\left((market\ income\ inequality_{it} - final\ income\ inequality_{it}) \times 100\right) \qquad (4.1)$$

4.2.2 Social expenditure indicators

This section focuses on aggregate levels and growth rates of social spending, whereas the next section differentiates between active and passive spending. The used variable is gross public total social expenditure. This is defined as the provision by public institutions of

[18] Portugal,1980 is complemented using SWIID data. Data for market income distribution of AUS 1970/1980, GRC 1970-1990, MEX 1970-1990 are taken from Arjona *et al*. (2001) and Förster (2000), all other data come from the OECD (2008).

benefits and financial contribution for households and individuals for welfare loss, excluding direct payment and individual transfers (Adema and Ladaique, 2009: 8). Included are cash benefits, such as pensions and social assistance, social services including childcare and care for the elderly, and tax credits such as family allowances. This definition does not cover (mandatory) private spending, which might add up to a number of percentage points of GDP. Moreover, not all countries tax social transfers which might lead to differences between gross and net social spending (ibid).

This section distinguishes between four indicators of public social spending. Health spending might have different consequences on work incentives and thus economic growth. Health expenditure might be beneficial to growth as it prevents people from becoming sick and it stimulates quick recovery. On the other hand, a substantial part of health expenditure is consumed by the elderly or by children. In addition, expenditure on the elderly and the disabled might not have similar effects as spending on the working age population. This leads to four indicators:

1. Public social spending;
2. Public social spending minus health expenditure;
3. Public social spending on working age population, defined as public social spending minus public social spending on the elderly, the disabled, and survivors (social spending for spouses or dependents of a deceased person);
4. Public social spending on working age population minus health expenditure.

Both level and growth rates of the variables are considered. Growth rates of spending might give a better picture of effects of social spending, as the levels of spending have a tendency to grow over time which partly reflects the population ageing within most OECD countries. In addition, looking at growth rates allows for expression of spending per working age person instead of in percentages of GDP. The expression in GDP can be problematic as the dependent variable is growth of GDP. For instance, when GDP would decline and the amount of spending does not change, the spending in percentage of GDP will increase because of the lower GDP. Hence, the expression of spending in percentage of GDP introduces a negative bias, which is potentially important to correct for.

To investigate whether policies or inequality itself affect growth, income inequality indicators are added to the estimations. The complemented database introduced in the previous section, using Gini on entire population, final income distribution, is used.

4.2.3 Data

The OECD SOCX database contains comparable data on social spending. It allows for the specification of social spending on health, the elderly, and the disabled. It covers spending from 1980 up to and including 2007. A complementary data source for total social spending and spending minus health exists for the period 1970-1980 for a number of countries. The method of collection of this data source differs slightly (Arjona *et al.*, 2001: 23), and for that reason, sensitivity analyses are conducted. No significant differences were found.

Box 4.1: List of social spending indicators

The levels of social spending are defined as follows (see Adema and Ladaique, 2009: 8, 20):

- Public social spending: gross public total social expenditure on '[…] the provision by public and private institutions of benefits to, and financial contributions targeted at, households and individuals in order to provide support during circumstances which adversely affect their welfare, provided that the provision of the benefits and financial contributions constitutes neither a direct payment for a particular good or service nor an individual contract or transfer' (Adema and Ladaique, 2009: 8);
- Public social spending minus health expenditure: gross public total social expenditure minus expenditures related to in- and out-patient care, prevention policies, and medical commodities;
- Public social spending on working age population: gross public total social expenditure minus expenditure related to (early retirement) pensions, residential services for elderly, spending related to survivors, and incapacity-related benefits such as disability and occupational injury benefits, employee sickness spending, and care services;
- Public social spending on working age population minus health expenditure combines these.

Growth rates of spending are defined in the following fashion:

- The growth rates of the spending variables in percentage of GDP are defined as the average of the annual difference in logs of two adjacent spending levels within a five year period:

$$\frac{1}{5}\sum_{i=1}^{5}\left(\ln(\Omega_{iy+1}) - \ln(\Omega_{iy})\right) \quad (4.2)$$

- The growth rate of spending per working age person is also expressed as the average of the annual difference in logs of two adjacent spending levels. The level variables are created in the following fashion. First, social expenditure in percentage of GDP are multiplied by GDP (expenditure approach, national currency, current prices). This measure is expressed in 2000 prices and PPP by dividing it through a deflator and the PPP for GDP for national currency in 2000 US dollar. This aggregate level of spending is subsequently divided by the working age population as defined in section 2. Hence, the variable can be interpreted as spending in 2000 US dollar per working age person. As described in the text, the level of spending per working age person has an almost linear tendency to grow over time. Therefore, only the growth of spending per working age person can be used as an explanatory variable. The growth of spending working age person follows the same definition as the growth rates of spending in percentage of GDP.

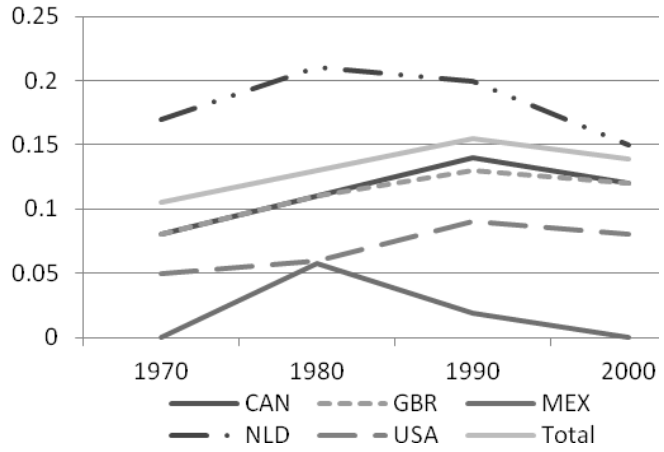
All social spending data come from the OECD SOCX. The data on GDP, PPP, and the deflator come from OECD, National Accounts, and for the working age population the database introduced in section 2 is used.

4.3 Data descriptions and trends

4.3.1 Trends in redistribution

Figure 4.1 summarises the amount of redistribution in a number of countries. Results not shown here indicate that the amount of redistribution is highly correlated with the level of public social spending variables (around .8). Total redistribution in Mexico is negligible in 1970 and 2000. The US and Korea also show low values. The highest values are more dispersed, although continental and Scandinavian states are well-represented. The level of redistribution has a minor tendency to grow over time, with a notable increase from 1970-1980 to 1980-1990.

Figure 4.1: Development of redistribution for a selection of countries



Total covers AUS, CAN, FIN, GBR, NLD, PRT, SWE, USA

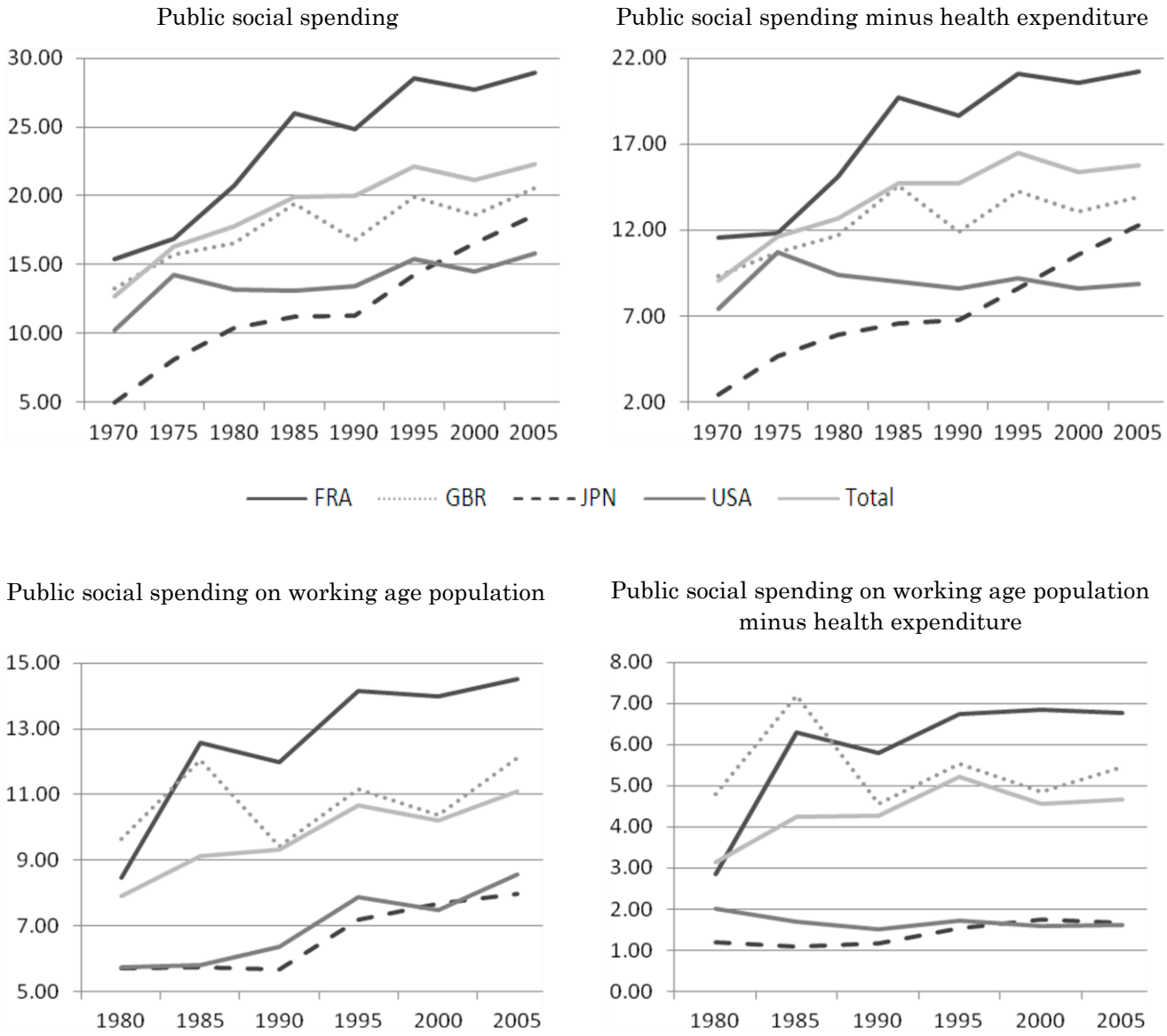
4.3.2 Trends in public social expenditures

On average, public social spending in percentage of GDP has increased by roughly 10 percentage points in OECD countries for the full sample period. There are clear differences between countries. The public social expenditure to GDP ratios of the Scandinavian countries are almost 30 per cent in 2005, whilst the Anglophone countries show rates between 15 and 20 per cent in 2005. Mexico, Korea, and Turkey show by far the lowest rates of social expenditures in percentage of GDP, although the figures are rising over time which implies a process of convergence. Three countries show a deviating pattern. Social expenditures increased in percentage of GDP in The Netherlands until approximately 1990, and decreased after that. New Zealand and Slovak Republic show a gradual decreasing rate over time.

Public social expenditures spending excluding health expenditure in percentage of GDP shows a roughly similar pattern, with a mean over time roughly 5 percentage points (or 28 per cent) lower (17.88 versus 12.89 per cent of GDP). Public social spending on working age population in percentage of GDP shows a slightly lower growth over time, which might be a consequence of increased spending on elderly due to population ageing within the OECD area. Italy shows a deviating pattern with relatively much lower spending rates on working age population compared to its spending rates on total spending (with and without health spending). These three types of public social spending follow roughly similar patterns and are highly correlated.

Public social spending on working age population minus health expenditure follows a more stable pattern, which again suggests that population ageing is a driving force behind growth of aggregate social spending. The US even shows a slight decrease in this type of spending. This social spending type shows the lowest correlations with the other level of spending variables (between .5 and .8).

Figure 4.2: Development of public social spending in percentage of GDP for a selection of countries



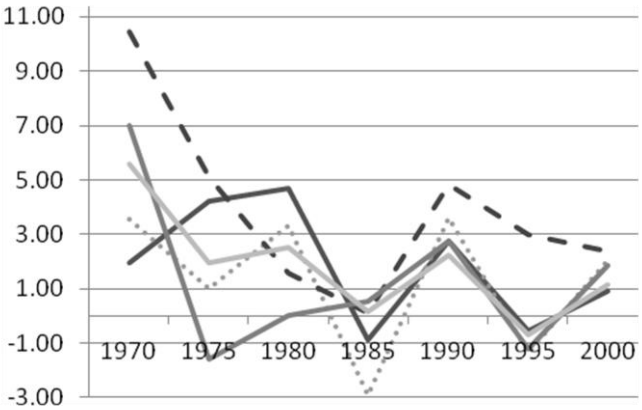
For the two graphs on working age population, total excludes CZE, HUN, ISL, KOR, MEX, POL, SVK. For the other two graphs ESP, LUX, PRT, TUR are excluded as well.

When spending is expressed per working age person instead of in percentage of GDP, an almost linear rising trend is shown. Therefore, for this expression only the growth rate can be used. Figure 4.3 plots growth of public social spending in percentage of GDP and per

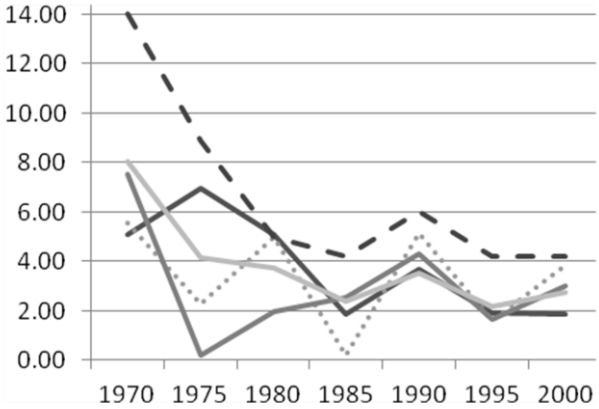
working age person. For the growth rates, the last period 2005 disappears because of data limitations.[19] The growth rates vary much more than the level variables. The growth rates in percentage of GDP and per working age person are highly correlated.

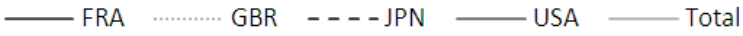
Figure 4.3: Development of growth of public social spending for a selection of countries

Growth of social spending in % GDP



Growth of social spending per working age person





Total excludes CZE, ESP, HUN, LUX, ISL, KOR, MEX, POL, PRT, SVK, and TUR

The level and growth rates of the social spending variables are strongly negatively correlated. This pattern suggests a process of convergence in social expenditure. The correlations between the level indicators of social spending and economic growth are negative but weak. Growth of spending in percentage of GDP shows moderately high negative correlations with economic growth, whereas growth in spending per working age person mostly shows positive signs. This is a first sign of negative bias incorporated in growth rates of spending in percentage of GDP.

Interestingly, the level and growth of social spending show opposite signs for the correlations with the growth model variables. The strongest correlations are amongst levels of social spending and level of income (positive) and working age population growth (negative). It is not clear whether the high correlation between level of income and social spending can be interpreted as evidence for Wagner's law, which entails that social expenditures increase when financial possibilities are higher, as all growth spending specifications show negative associations with the initial income. Both levels and growth rates of total spending show consistently higher correlations with economic growth and initial income than the indicators pertaining to total spending on working age population minus health.

[19] Data are only available up to and including 2007.

Table 4.1: Correlations between spending indicators and growth model variables

	Economic growth	**Initial level of income**	**Working population growth**	**Stock of physical capital**	**Stock of human capital**
Level of spending in percentage of GDP [1]					
Total spending	-0.09 (0.22)	0.54 (0.00)	-0.53 (0.00)	-0.20 (0.00)	0.33 (0.00)
Total spending minus health	-0.06 (0.41)	0.49 (0.00)	-0.53 (0.00)	-0.23 (0.00)	0.25 (0.00)
Total spending on working age population	-0.05 (0.55)	0.59 (0.00)	-0.51 (0.00)	-0.15 (0.06)	0.52 (0.00)
Total spending on working age minus health	-0.01 (0.87)	0.47 (0.00)	-0.35 (0.00)	-0.27 (0.00)	0.40 (0.00)
Growth of spending in percentage of GDP [1]					
Total spending	-0.33 (0.00)	-0.32 (0.00)	0.35 (0.00)	0.12 (0.13)	-0.29 (0.00)
Total spending minus health	-0.35 (0.00)	-0.32 (0.00)	0.32 (0.00)	0.12 (0.12)	-0.25 (0.00)
Total spending on working age population	-0.36 (0.00)	-0.14 (0.10)	0.35 (0.00)	0.04 (0.62)	-0.24 (0.00)
Total spending on working age minus health	-0.27 (0.00)	-0.00 (1.00)	0.11 (0.21)	0.09 (0.30)	-0.04 (0.61)
Growth of spending per working age person [1]					
Total spending	0.15 (0.05)	-0.39 (0.00)	0.26 (0.00)	0.29 (0.00)	-0.28 (0.00)
Total spending minus health	0.06 (0.47	-0.39 (0.00)	0.25 (0.00)	0.27 (0.00)	-0.24 (0.00)
Total spending on working age population	0.10 (0.26)	-0.17 (0.05)	0.29 (0.00)	0.17 (0.05)	-0.17 (0.04)
Total spending on working age minus health	-0.09 (0.31)	-0.01 (0.94)	0.08 (0.36)	0.14 (0.11)	-0.01 (0.89)
Redistribution [2]					
Level of redistribution	-0.15 (0.20)	0.44 (0.00)	-0.45 (0.00)	0.01 (0.91)	0.44 (0.00)

1 five year data set, 2 ten year data set. Significance between brackets, all variables in logs.

4.4 Estimation of the direct relationships

4.4.1 Redistribution

The redistribution indicator relying on OECD data is only available on a ten year time span. Even though the number of observations is limited, the results suggest a negative association between redistribution and economic growth. The size, between three and ten times higher than the coefficients for the level of public social spending variables, and significance of the coefficient suggests that the amount of redistribution is more important than social spending as such.

Mexico, with its extremely low redistributive levels and highly fluctuating pattern, is an outlier. The level of redistribution of Mexico is roughly ten times lower than the average. Nevertheless, both with and without Mexico, the redistribution coefficient is significant. The found coefficient suggests that without Mexico, for a given country, as redistribution increases with 1 per cent across time, economic decreases on average by 0.014 per cent annually in the subsequent decade, holding the other variables constant. As the data for Mexico come from Förster (2000) instead of the OECD, measurement error or data breaks might be an issue too.

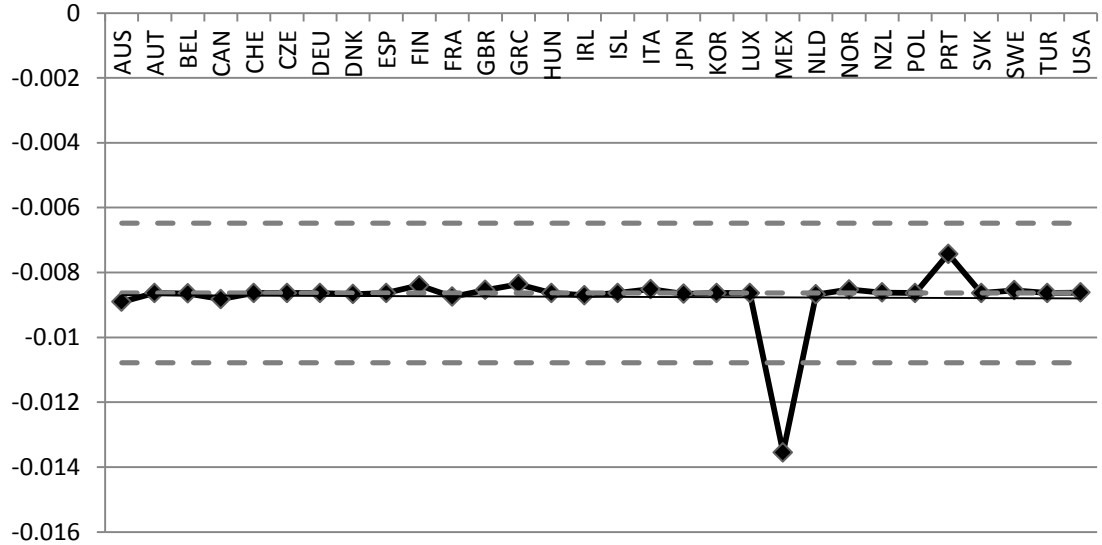
Table 4.2: Redistribution seems to have a small negative effect on economic growth

	Baseline	**All countries**	**Without Mexico**
Level of income	-.0701 (.0149) ***	-.0712 (.0132) ***	-.0832 (.0103) ***
Population growth	-.1646 (.1746)	-.1814 (.1647)	-.1746 (.1662)
Physical capital	.0046 (.0116)	.0006 (.0111)	-.0015 (.0111)
Human capital	-.0202 (.0195)	-.0103 (.0117)	-.0041 (.0114)
Level of redistribution		-.0086 (.0010) ***	-.0135 (.0046) ***
Constant	.2637 (.0917) ***	.2758 (.0701) ***	.3208 (.0579) ***
Observ	69	69	66
Countries	26	26	25
R-squared	0.7375	0.8764	0.8726
F test	32.93 ***	92.58 ***	52.59 ***

Country fixed effects, 1970-2009, ten year periods with time dummies, clustered standard errors. Significance levels are noted by *** (1 per cent), ** (5 per cent), or * (10 per cent), standard errors in brackets. All variables in logs. Dependent variable: average growth of real GDP per working age person during the subsequent period in 2000 US dollar PPP. Growth model variables: see Box 2.1. Level of redistribution: difference between Gini, entire population for market income distribution and final income distribution.

Without Mexico, the coefficients are robust to further dropping of periods and countries. The outlying position of Mexico is evident from Figure 4.4, displaying the coefficient and 95 per cent confidence interval.

Figure 4.4: Only dropping Mexico has a significant effect on redistribution coefficient



When economic growth is regressed on income inequality and the MRW set of control variables for the same sample, it is significant at the 5 per cent, showing a similar coefficient as reported before (.03). Yet, when redistribution is added to this equation, inequality becomes insignificant, whilst redistribution remains significant at the 1 per cent level. These results remain when the insignificant control variables are omitted from the model specification. Although the limited number of observations cautions against making general conclusions, the results suggest including the redistribution indicator leads to statistically insignificant results on the inequality indicator. This result tentatively suggests that it is not so much greater inequality, but lower redistribution, that positively affects economic growth. The conclusion further reflects on this finding.

Table 4.3: Inequality is no longer significant when redistribution is added

	Baseline	**Inequality**	**Inequality and redistri-bution**	**Inequality and redistri-bution, no insign.**
Level of income	-.0701 (.0149) ***	-.0688 (.0152) ***	-.0705 (.0137) ***	-.0890 (.0162) ***
Population growth	-.1646 (.1746)	-.1512 (.1286)	-.1742 (.1374)	
Physical capital	.0046 (.0116)	.0038 (.0097)	.0004 (.0105)	
Human capital	-.0202 (.0195)	-.0145 (.0184)	-.0081 (.0124)	
Level of inequality		.0316 (.0140) **	.0150 (.0144)	.0192 (.0150)
Level of redistribution			-.0082 (.0009) ***	-.0082 (.0006) ***
Constant	.2637 (.0917) ***	.1445 (.1033)	.2185 (.0933) **	.2429 (.0672) ***
Observ	69	69	69	72
Countries	26	26	26	26
R-squared	0.7375	0.7648	0.8822	0.8293
F test	32.93 ***	28.70 ***	114.15 ***	88.99 ***

Country fixed effects, 1970-2009, ten year periods with time dummies, clustered standard errors. Significance levels are noted by *** (1 per cent), ** (5 per cent), or * (10 per cent), standard errors in brackets. All variables in logs. Dependent variable: average growth of real GDP per working age person during the subsequent period in 2000 US dollar PPP. Growth model variables: see Box 2.1. Level of redistribution: difference between Gini, entire population for market income distribution and final income distribution. Income inequality: Gini, entire population, final income distribution

4.4.2 Social expenditures

Although data are limited, the previous empirical estimations suggest that redistribution negatively affects growth. One of the ways by which redistribution is achieved is through equalising social policies. Table 4.4 summarises fixed effects regressions of the different indicators of levels of social spending. Fixed effects estimation is preferred as results indicate that there is presence of country effects.[20] When all countries and periods are included, fixed effects yields negative but insignificant coefficients, except for fixed effects for public social spending on working age population excluding health expenditure, which is positive and insignificant. When time dummies are excluded, this last variable becomes significant at the 5 per cent.

Table 4.4 does not provide evidence that aggregate levels of social spending are positively or negatively related to economic growth. This finding is robust; when countries are dropped, none of the spending coefficients becomes significant. When Ireland is dropped, the inequality variable becomes consistently significant.

[20] *F* tests that all (a_i) are zero are rejected at the 1 or 5 per cent for all growth and level public social spending variables.

Table 4.4: Levels of social spending in % GDP do not seem to systematically affect growth

	Social spending	**Spending excl. health**	**Spending excl. elderly and disabled**	**Spending excl. elderly, disabled, health**
Level of income	-.0602 (.0117) ***	-.0587 (.0128) ***	-.0649 (.0184) ***	-.0612 (.0195) ***
Population growth	-.5044 (.1833) ***	-.4629 (.1833) **	-.5820 (.3556)	-.4980 (.3453)
Physical capital	-.0038 (.0104)	-.0029 (.0109)	-.0123 (.0137)	-.0130 (.0142)
Human capital	.0068 (.0121)	.0039 (.0121)	.0149 (.0107)	.0115 (.0099)
Level of spending	-.0072 (.0076)	-.0015 (.0052)	-.0080 (.0062)	.0008 (.0026)
Level of inequality	.0220 (.0146)	.0226 (.0149)	.0053 (.0228)	.0068 (.0228)
Constant	.1531 (.0862)	.1348 (.0869)	.2292 (.1093)	.2040 (.1178) *
Observ	175	175	150	150
Countries	30	30	30	30
R-squared	0.5551	0.5509	0.5659	0.5611
F test	23.01 ***	22.22 ***	20.83 ***	25.65 ***

Country fixed effects, 1970-2009, five year periods with time dummies, clustered standard errors. Significance levels are noted by *** (1 per cent), ** (5 per cent), or * (10 per cent), standard errors in brackets. All variables in logs. Dependent variable: average growth of real GDP per working age person during the subsequent five year period in 2000 US dollar PPP. Growth model variables: see Box 2.1. Spending level: gross public social spending in percentage of GDP, see Box 4.1. Income inequality: Gini, entire population, final income distribution

It could be argued that it is better to use growth rates of spending as a variable, as the level of spending in percentage of GDP has a general tendency to grow for instance due to population ageing. A disadvantage of using growth rates is that these are more sensitive to the economic state. When growth rates of social spending in percentage of GDP are used, all spending indicators are strongly negative and significant, see appendix 6.[21] However, further analysis shows that this is due to its expression in percentage of GDP. As explained before, the expression in percentage of GDP introduces a negative bias in the growth of spending coefficient.

When social expenditure growth rates are expressed per working age person instead of in percentage of GDP, again no significant relationship between aggregate spending and economic growth is found, as is shown in Table 4.5. Again, income inequality becomes significant when Ireland is excluded except for the last social policy definition.

[21] With fixed effects estimation the coefficients lie between -.161 and -.044. Total social spending consistently has the strongest negative association, whereas spending excluding health and elderly has a less strong association. All coefficients are significant.

All in all, there is no evidence that levels or growth rates of different types of aggregate public social spending are associated with economic growth. Leaving out the inequality indicator does not change the results; the social spending variables remain consistently insignificant (results not shown here). This leads to a perhaps at first sight counterintuitive conclusion. Even though a higher redistribution leads to lower growth, the amount and growth rates of money spent on social policies does not seem to be associated with subsequent economic growth in any systematic way.

Table 4.5: Growth rates of social spending do not seem to systematically affect growth

	Social spending	**Spending excl. health**	**Spending excl. elderly and disabled**	**Spending excl. elderly, disabled, health**
Level of income	-.0640 (.0179) ***	-.0637 (.0188) ***	-.0769 (.0262) ***	-.0759 (.0243) ***
Population growth	-.2517 (.2272)	-.1870 (.2438)	-.0039 (.4613)	.1955 (.4993)
Physical capital	-.0015 (.0112)	.0002 (.0110)	-.0177 (.0158)	-.0135 (.0147)
Human capital	.0072 (.0150)	.0046 (.0151)	.0183 (.0148)	.0171 (.0142)
Growth of spending	.0295 (.0466)	-.0464 (.0379)	.0277 (.0463)	-.0303 (.0196)
Level of inequality	.0241 (.0164)	.0220 (.0171)	-.0013 (.0263)	.0073 (.0225)
Constant	.1264 (.0873)	.1374 (.0839)	.2744 (.1280)	.2340 (.1101)
Observ	146	146	120	120
Countries	28	28	28	28
R-squared	0.4803	0.4860	0.5047	0.5260
F test	12.05 ***	21.26 ***	17.16 ***	27.49 ***

Country fixed effects, 1970-2009, five year periods with time dummies, clustered standard errors. Significance levels are noted by *** (1 per cent), ** (5 per cent), or * (10 per cent), standard errors in brackets. All variables in logs. Dependent variable: average growth of real GDP per working age person during the subsequent five year period in 2000 US dollar PPP. Growth model variables: see Box 2.1. Growth of spending: growth of real gross public social spending per working age person, see Box 4.1. Income inequality: Gini, entire population, final income distribution

4.5 Additional analyses

Hypothesis 4c expressed the prediction that social spending has a negative effect on economic growth by crowding out private investment. As the stock of physical capital is included as a control variable, this effect does not show up in the estimations.[22]

[22] Another way is to use interaction terms, but an interaction term of social spending times the stock of physical capital does not become significant.

Table 4.5: No evidence for a crowding out effect of public spending

	Stock of physical capital
Level of income	-.3213 (.1178) **
Population growth	.1462 (2.303)
Human capital	-.0148 (.2160)
Level of spending	-.0705 (.0933)
Constant	4.258 (.5530) ***
Observ	195
Countries	30
R-squared	0.2763
F test	11.41 ***

Country fixed effects, 1970-2009, five year periods with time dummies, clustered standard errors. Significance levels are noted by *** (1 per cent), ** (5 per cent), or * (10 per cent), standard errors in brackets. All variables in logs. Dependent variable: average stock of physical capital in percentage of GDP. Growth model variables: see Box 2.1. Level of spending: gross public social spending in percentage of GDP, see Box 4.1.

Table 4.5, using the stock of physical capital as dependent variable with the same set of control variables, does not provide evidence for any significant crowding-out effect of public spending. Yet, this is only an exploratory estimation. For example, in addition to this, the effects of public spending on investment rates should be investigated (Ahmed and Miller, 1999), but this analysis is beyond the purview of this study.

4.6 Conclusions

From a theoretical stance, both positive and negative associations between public interventions and subsequent economic growth rates can be postulated. It is desirable to distinguish between the money spent per se and the amount of income that is mitigated, as spending can have different effects on growth than redistribution. Social policies can impede growth by the inefficiency of social spending (transaction cost theory), whilst redistribution can affect growth by lowering incentives to gain wealth. For the aggregate social spending variables, both level and growth rates are discerned for four types of policies: total public spending and public spending excluding expenditures on the elderly, disabled, and survivors, both with and without health expenditures.

Although the limited number of observations cautions against drawing general conclusions, redistribution is robustly associated with lower economic growth rates in the subsequent period. Including Mexico, with its extremely low redistributive values, significantly affects both the redistribution coefficient and the standard error, but it does not affect the significance of the indicator on redistribution. The finding suggests a significant albeit marginal negative association of redistribution on subsequent growth rates

(Hypothesis 4a). The low effect might (partially) be a consequence of the use of fixed effects estimation, a topic discussed further in the concluding section. A further investigation of the effects of redistribution, which apparently is an important channel to understand the relationship between income inequality and economic growth, requires additional data on market income distribution.

Last section found evidence that, bearing in mind data limitations and the outlying position of Ireland, inequality is positively associated with subsequent growth rates. Yet, this section suggests that this relationship is spurious. When a redistribution indicator is added to the equation, income inequality becomes insignificant, whilst the redistribution coefficient remains robust and significant. This finding suggests that it is not so much the income distribution per se, but the amount of redistribution to equalise incomes that affects growth. Redistribution is found to negatively affect growth by equalising incomes, which is consistent with the trade-off argument, which involves that public actions to promote income equality come at the cost of (marginally) reduced output growth. Inequality was significant as a lower redistribution by definition leads to a higher income inequality.

Even though redistribution seems to lower economic growth, different types of aggregate public social expenditure variables are not found to affect economic growth in any systematic way. This finding is robust and holds for both level and growth rates per working age person of the different aggregates of public social spending. Results do not change when the income inequality indicator is excluded.

The insignificance of the social spending variables might be a consequence of the aggregate levels of social spending that are used. Social programmes have different objectives and might therefore affect growth in different ways. The next section further delves into the composition of different types of social policies. It could also point to the role of other types of redistributive policies or the structure of the tax system, which are topics that are outside the remit of this study. In any case, the results show that social policies as such do not lower economic growth, as for instance argued by the transaction cost theory (Hypothesis 4b), but that the distortion of market outcomes by public redistribution is likely to be more important (Hypothesis 4a).

5. Active and Passive Social Expenditures and Growth

Social policies have different objectives and thus may well affect growth differently. This section investigates whether active and passive social policies have a different effect on economic growth. Using multiple definitions, the model specifications do not generate significantly different results for indicators on active and passive spending: both variables remain insignificant, although they have the expected sign (positive for active spending; negative for passive spending). When time dummies that control for common shocks in time periods are excluded, spending on active labour market policies becomes significant, even though the coefficient remains low.

5.1 Theoretical section

Active labour market policies (ALMPs) are designed to stimulate employment and earning capacities of peopl, by providing incentives to work or by helping people gaining skills to enter an employment relationship. ALMPs are meant to be 'market-enabling'; instead of redistributing benefits to unemployed people, people are encouraged to provide for themselves (Armingeon, 2007; OECD, 2010). Conversely, passive labour market programmes are sole cash transfers between groups, such as unemployment benefits and early retirement schemes (OECD, 1994).

Because of their different design, active and passive spending might affect economic growth differently. [23] Active programmes can have an additional positive effect by increasing employment. In addition, it can be expected that passive spending are more of a barrier to economic growth, as the provision of a safety net potentially makes substitution effects to leisure or unemployment stronger, because at the margin, changing from unemployment to work becomes less worthwhile as financial gains decrease.

Hypothesis 5a: Active spending has a positive effect on economic growth
Hypothesis 5b: Passive spending has a negative effect on economic growth

Nevertheless, a number of positive and negative effects are applicable to both types of spending, both types of spending might raise transaction costs or lower efficiency.

Hypothesis 5c: Active and passive spending have a similar effect on economic growth

[23] It could also be expected that active and passive labour market policies have different effects on income inequality. As ALMPs are designed to stimulate employment, they can be expected to both reduce market and final income distribution. On the contrary, passive labour market programs are likely to have complex effects on income inequality. If the existence of a passive safety net does not alter the behaviour of people, the market income distribution remains unaffected. Yet, it is more realistic to assume that people adapt their behaviour to the existence of a safety net. At the margin, changing from unemployment to work becomes less worthwhile as financial gains decrease, which could potentially even raise market income inequality. Nevertheless, passive labour market policies may equalise final incomes when the provision of transfers and the financing are redistributive enough to offset any widened market income inequalities (see also Arjona *et al.*, 2001).

5.2 Operationalisation, data descriptions and trends

Active programmes can be defined in narrower and broader fashions. This section uses three definitions for active spending (see Box 5.1). By subtracting these definitions from total public social spending, three passive policy definitions are created.

1. Public spending on ALMP;
2. Public spending on ALMP and family policies. Family spending, especially related to child care, can be beneficial to growth by stimulating employment amongst parents;
3. Public spending on ALMP, family, and health policies. Following Arjona *et al.* (2001: 31), a certain amount of health expenditure can be seen as active by preventing or reducing sickness and work absenteeism.

This section employs public gross levels of public spending. Only levels of spending are used, as growth rates of spending would lead to a loss of a period of data and less data are available as is explained in the next sub-section.

Box 5.1: List of indicators

All social spending data come from the OECD SOCX. Definitions are derived from Adema and Ladaique (2009). Different sums of the following variables are used:

- Public social expenditure on ALMP: gross public spending pertaining to incentives on employment, training, and start-up, direct job creation, and the integration of disabled people;
- Public social expenditure on family policies: gross public spending on childcare support, allowances, credits, income support schemes for leave and for sole parents;
- Public social expenditure on health: see last section; it covers gross public spending on patient care, medical supplies, and preventive care.

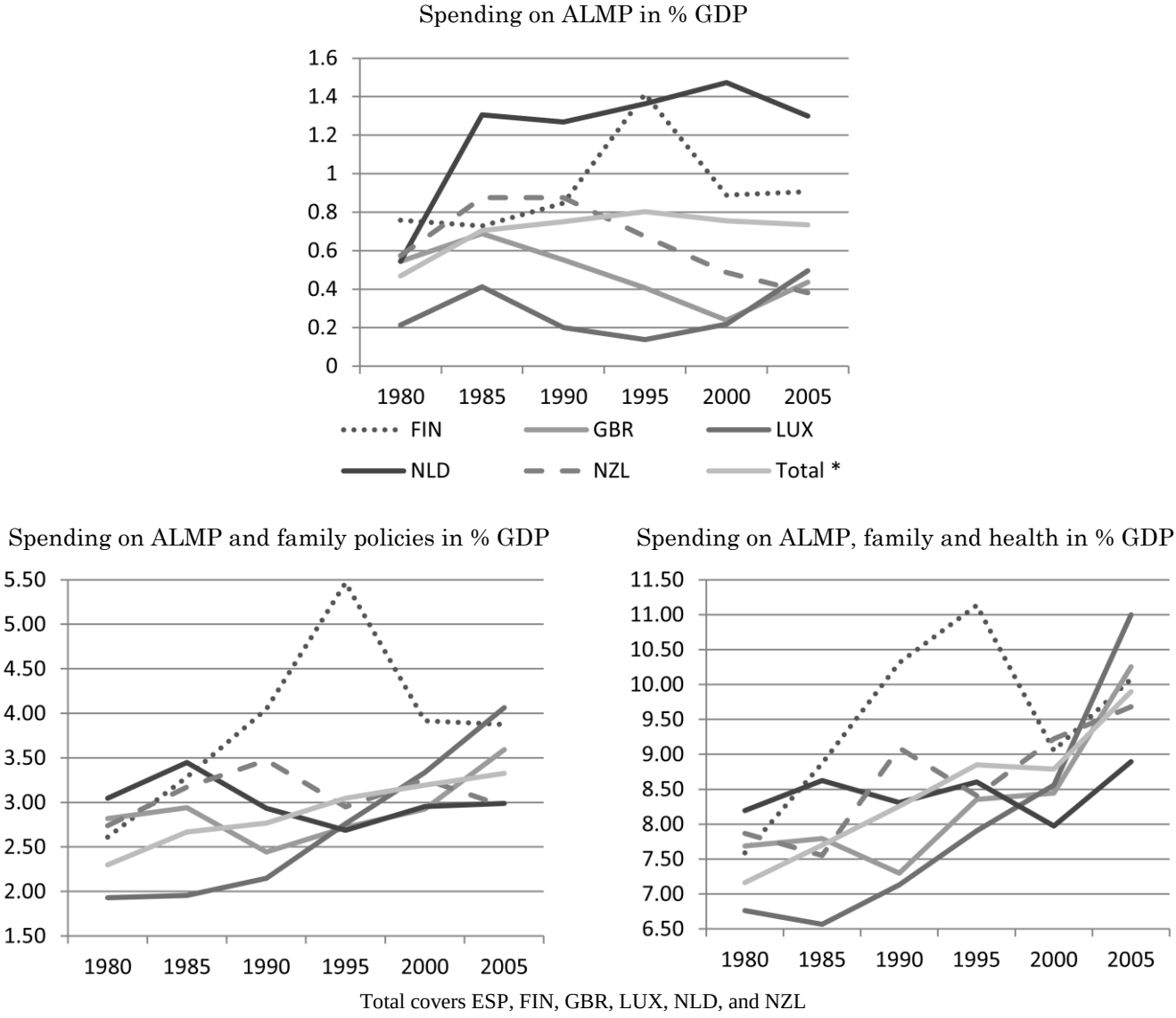
Data on active and passive labour market policies are only available for five or six periods for the country cases (earliest observations are from 1980). For a number of time points, data for one year later or earlier have been used to complement missing data at the beginning of the period.[24]

Public social spending on ALMP in percentage of GDP ranges substantially between 0.1 (Turkey) and roughly 2 (Sweden) per cent of GDP. The level of public spending on ALMP does not change much over time within a country. Countries spend more comparable amounts on family policies. On average, public spending on family policies has increased within the OECD area. Both in absolute numbers and in percentage of total social spending, the Scandinavian countries spend more on ALMP and family policies, followed by continental Europe. Mexico and Turkey, followed by Korea and the US, spend significantly less than the other countries. Public health spending further decreases variation between

[24] For all definitions, 1991 is used for 1990 for Czech Republic, and 1986 is used for 1985 for Denmark, Portugal, and Turkey. 1991 is used for 1990 Slovak Republic for all active types of spending, 1992 Hungary for spending on ALMP in 1990, and Turkey 1999 for 2000 active and passive spending types with family policies.

countries. It follows an increasing trend over time, which is likely to be a consequence of population ageing. Continental European countries (France, Luxembourg, and Belgium) show the highest spending rates on this variable.

Figure 5.1: Development of active labour market spending for a selection of countries



Total covers ESP, FIN, GBR, LUX, NLD, and NZL

Public spending on ALMP and ALMP plus family policies, and passive public spending minus ALMP, family, and health policies have positive correlations with economic growth, whereas the other spending specifications show negative correlations. All specifications with health spending show negative coefficients with economic growth, although it requires a separate study on health expenditure to determine whether this is indeed a causal relationship. Again, the levels of the spending variables show moderately strong positive correlations with level of GDP and with the stock of human capital, although the correlations with the stock of human capital are higher for the active spending variables.

Results not shown here indicate an increasing pattern of correlations with public social spending (see Box 4.1). Public spending on ALMP and public spending on ALMP and family policies show correlations of .72 and .79 respectively, whereas the other indicators have correlations above .93 with public social spending.

Table 5.1: Correlations between spending indicators and growth model variables

	Economic growth	**Initial level of income**	**Working population growth**	**Stock of physical capital**	**Stock of human capital**
Active levels of spending in percentage of GDP					
Public spending on ALMP	0.09 (0.29)	0.45 (0.00)	-0.52 (0.00)	-0.11 (0.18)	0.45 (0.00)
Public spending on ALMP and family	0.01 (0.91)	0.48 (0.00)	-0.43 (0.00)	-0.15 (0.08)	0.45 (0.00)
Public spending on ALMP, family, and health	-0.09 (0.27)	0.61 (0.00)	-0.52 (0.00)	-0.13 (0.14)	0.53 (0.00)
Passive levels of spending in percentage of GDP					
Total minus ALMP	-0.03 (0.76)	0.53 (0.00)	-0.61 (0.00)	-0.16 (0.06)	0.39 (0.00)
Total minus ALMP and family	-0.02 (0.84)	0.52 (0.00)	-0.63 (0.00)	-0.15 (.08)	0.37 (0.00)
Total minus ALMP, family, and health	0.02 (0.82)	0.47 (0.00)	-0.64 (0.00)	-0.18 (004)	0.30 (0.00)

Significance between brackets, all variables in logs

5.3 Estimation of direct relationships

5.3.1 Active spending

This sub-section tests the association with the three types of active spending that are discerned. Fixed effects estimations are shown as for all specifications the use of OLS is rejected at the 1 per cent significance.

Generally speaking, the active spending levels have neither significant nor strong coefficients when time dummies are included. At best, the table indicates a pattern in which public spending on ALMP shows a positive association with growth, whilst the coefficient of public spending on ALMP and family policies is just below zero, and public spending on ALMP, family, and health policies, the most extensive active spending definition, shows a negative association that is significant at the 5 per cent. A similar pattern shows up when lagged values of the spending variables are used.

In this estimation, the inclusion of time dummies has a significant effect, especially for spending on ALMP. Without time dummies, the coefficient of spending on ALMP is roughly ten times higher, showing a significant positive association at the 5 per cent level. Time dummies correct for unobserved effects that differ across time but not across countries, which implies that variation in economic growth that is common across countries is absorbed (Acemoglu *et al*., 2005a: 45, 48). A significant effect of time dummies could imply that a

factor not incorporated in the model can explain common shocks or trends in economic growth. Apparently, spending on ALMP has an association with that part of economic growth that is common across countries. The strong influence of time dummies might be a consequence of the frequent use of ALMP as a stimulating measure when growth is low (*e.g.* Chung & Thewissen, 2011), although the model specification with temporal difference should account for this reverse effect. As it is difficult to interpret what this unobserved factor can be, results are shown both with and without time dummies.

Table 5.2: Spending on ALMP only positively affects growth without time dummies

	Baseline model	**ALMP**	**ALMP without time dummies**	**ALMP, family policies**	**ALMP, family, health policies**
Level of income	-.0663 (.0157) ***	-.0648 (.0181) ***	-.0450 (.0108) ***	-.0689 (.0176) ***	-.0724 (.0158) ***
Population growth	-.7129 (.2899) **	-.7154 (.2960) **	-1.175 (.2895) ***	-.6885 (.2947) **	-.8973 (.2954) ***
Physical capital	-.0078(.0144)	-.0071 (.0146)	.0059 (.0139)	-.0072 (.0146)	-.0017 (.0139)
Human capital	.0010(.0097)	.0048 (.0103)	.0127 (.0139)	.0070 (.0112)	.0128 (.0101)
Spending level		.0003 (.0018)	.0037 (.0017) **	-.0013 (.0009)	-.0199 (.0078) **
Level of inequality		.0163 (.0220)	.0363 (.0202) *	.0160 (.0217)	.0080 (.0210)
Constant	.2489 (.0652) ***	.1806 (.1275)	.0148 (.0740)	.1904 (.1251)	.2373 (.1035) **
Observ	136	136	136	135	135
Countries	30	30	30	30	30
R-squared	0.6152	0.6187	0.4159	0.6186	0.6437
F test	52.03 ***	46.06 ***	21.84 ***	40.89 ***	46.55 ***

Country fixed effects, 1980-2009, five year periods with time dummies, clustered standard errors. Significance levels are noted by *** (1 per cent), ** (5 per cent), or * (10 per cent), standard errors in brackets. All variables in logs. Dependent variable: average growth of real GDP per working age person during the subsequent five year period in 2000 US dollar PPP. Growth model variables: see Box 2.1. Spending level: gross public social spending in percentage of GDP, see Box 5.1. Income inequality: Gini, entire population, final income distribution

Sensitivity analyses indicate that Korea and Mexico show slightly different paths, as they combine low levels of active spending with substantial economic growth. When they are both excluded, signs remain the same, but public spending on ALMP, family, and health policies becomes significant at the 5 per cent with a coefficient of -.025. The exclusion of income inequality does not have a significant effect.

5.3.2 Passive spending

As is shown in Table 5.3, none of the passive spending specifications reach significance, although the coefficients are consistently negative. For what it is worth – which is not much

– exclusion of ALMP shows stronger negative values than the exclusion of the more diffuse specifications of passive spending.

Table 5.3: No systematic relation between passive spending and economic growth

	Baseline model	**Minus ALMP**	**Minus ALMP, family**	**Minus ALMP, family, health**
Level of income	-.0672 (.0163) ***	-.0712 (.0169) ***	-.0708 (.0171) ***	-.0681 (.0181) ***
Population growth	-.7001 (.2986) **	-.8393 (.2608) ***	-.8408 (.2573) ***	-.7525 (.2357) ***
Physical capital	-.0083 (.0146)	-.0060 (.0146)	-.0061 (.0146)	-.0076 (.0147)
Human capital	.0010 (.0098)	.0113 (.0102)	.0108 (.0098)	.0074 (.0106)
Spending level		-.0102 (.0074)	-.0093 (.0076)	-.0031 (.0073)
Level of inequality		.0169 (.0218)	.0177 (.0216)	.0170 (.0207)
Constant	.2534 (.0673) ***	.2107 (.1285)	.2045 (.1286)	.1915 (.1326)
Observ	135	135	135	135
Countries	30	30	30	30
R-squared	0.6132	0.6240	0.6227	0.6175
F test	50.79 ***	52.73 ***	50.44 ***	44.68 ***

Country fixed effects, 1980-2009, five year periods with time dummies, clustered standard errors. Significance levels are noted by *** (1 per cent), ** (5 per cent), or * (10 per cent), standard errors in brackets. All variables in logs. Dependent variable: average growth of real GDP per working age person during the subsequent five year period in 2000 US dollar PPP. Growth model variables: see Box 2.1. Spending level: gross public social spending in percentage of GDP, see Box 5.1. Income inequality: Gini, entire population, final income distribution

When Mexico and Korea are excluded, the public spending coefficients increase with roughly 25 per cent, although all remain insignificant. The exclusion of income inequality does not have a significant effect. In addition, no significant changes occur when both active and passive spending variables are incorporated.

5.4 Conclusions

This section moves beyond aggregate levels of public social spending to investigate whether different types of public social policies have different associations with economic growth. Three types of active public social expenditures are distinguished: public spending on ALMPs, public spending on ALMP and on family policies including childcare, and public spending on ALMP, family, and health policies. By subtracting these definitions from total public social spending, three passive policy definitions are created.

Even though it might be expected that policies related to for instance activation and childcare are more beneficial to growth than passive spending pertaining to safety nets such as pensions and unemployment benefits, this section finds only little evidence for this. The

estimations of spending on ALMP and on ALMP and family policies show positive signs, whereas all other expenditure indicators are negative. Only spending on ALMP, family, and health policies reaches significance at the 10 per cent, but this coefficient is negative. It might point to negative effects of health expenditure on economic growth, but this requires further research. All in all, there is hardly any evidence that active spending has different effects than passive spending on economic growth (Hypotheses 5a and 5b). As found in the previous section, the spending variables are generally insignificant.

When time dummies are excluded, the coefficient of ALMP increases tenfold and becomes significant at the 5 per cent level. The next section further reflects on the use of time dummies.

The lack of significant results might result from the lower number of observations, as data are only collected from 1980s or even 1985s for active and passive spending. It might also be the case that the level of spending on ALMP is too low (between .01 and 2 per cent of GDP) to have a visible impact on economic growth. Last, it might be that the spending variables do not vary enough over time within a country, which makes it difficult for a fixed effects model specification to pick up any effect.

6. Discussion and Conclusion

This study addresses the central question in political economy how growth and distribution of income are related to each other. Even though many studies have empirically investigated this relationship, few studies investigate whether the income distribution as such, or the redistributing public policies put in place to equalise incomes affect economic growth. With a quantitative panel design covering 30 OECD countries between 1970 and 2009, this study aims to fill this gap by estimating the associations between economic growth and both income inequality and redistribution, in particular through social policies.

6.1 Putting things together

There is no unequivocal evidence that income inequality affects economic growth. Yet, in correspondence with previous literature, this study finds a positive association between income inequality and subsequent economic growth rates, but this association is only significant under certain restrictions. The estimations that only rely on OECD data are not robust, as the number of observations is limited. A complemented database for Gini for final income distribution for the entire population, in which 30 per cent of the observations is complemented using the trend in LIS and SWIID databases that follow a same definition, produces more robust results. Yet, the complementation process increases measurement error and a certain amount of subjectivity.

With the complemented dataset, income inequality significantly increases subsequent economic growth rates, but only when time dummies or outlier Ireland is excluded. Ireland might be an outlier due to data breaks, or because it combines turbulent economic growth rates with a stable income distribution. The coefficient suggests a modest relationship; excluding Ireland, an increase of 1 per cent of inequality at the beginning of the period is associated with a .03 per cent higher annual economic growth per working age person in the subsequent period within a country, controlling for the initial level of income, stocks of physical and human capital, working age population growth, and time effects.

Additional tests for indirect associations tentatively suggest that income inequality is not associated with a higher stock of physical capital. This finding contradicts theories stressing that inequality has a positive effect on growth, as a concentration of capital leads to higher physical investment. Furthermore, explorative evidence is found for a negative relationship between income inequality and the stock of human capital. Whether this last result is evidence for the credit market imperfections theory, which stresses that inequality dampens investment in human capital and overall knowledge-building, is not certain, as a higher average years of schooling within a country could have an equalising effect as well. Furthermore, the stock of human capital indicator, the average years of schooling in a country, shows an increasing trend over time which makes it potentially vulnerable to spurious findings. Nevertheless, this study suggests that the human capital channel is potentially important in understanding the relationship between income distribution and economic growth.

At first sight, this finding seems to imply that a higher income inequality has a positive effect on subsequent economic growth rates – although only so for a complemented

database excluding time dummies or outlier Ireland, and only modestly so. Keeping in mind these restrictions, this finding could be interpreted as evidence that income inequality is not so much an impediment to growth, or at least, that the positive effects of inequality outweigh any negative effects. As no evidence is found for the concentration of capital theory, the evidence seems to point to the incentives channel, postulating that a larger dispersion has a positive effect on incentives and marginal benefits, leading to higher economic growth. This requires further research however, as the macro design adopted in this study is not capable of investigating patterns of changing behaviour at the micro level (see for evidence from experiments Gruen and Klasen, 2007: 217-218).

Yet, further analysis tentatively suggests that it is not so much income inequality, but the degree of redistribution that negatively affects economic growth, if only marginally and the lack of data warrants caution with the interpretation of the findings. When both a redistribution and income inequality indicator are added to the equation, the significance of the inequality indicator disappears, whilst the redistribution indicator remains significant. This result is consistent with the trade-off argument, which involves that public actions to promote income equality come at the cost of (marginally) reduced output growth, by reducing financial incentives to gain wealth. The previously reported positive effect of inequality was a consequence of the mitigating effect of redistribution: a higher redistribution, impeding growth, leads by definition to a lower inequality. Hence, without properly accounting for redistribution, inequality will have a positive but spurious effect on economic growth. Still the effect of redistribution on economic growth, even when excluding outlier Mexico, does not seem to be large. The found coefficient suggests that without Mexico, for a given country, as redistribution increases with 1 per cent across time, economic decreases on average by 0.014 per cent annually in the subsequent decade, holding the other variables constant.

Even though redistribution seems to negatively affect economic growth, the public social spending variables are found to have an insignificant effect on growth within the OECD area. This finding is robust and holds for both level and growth rates per working age person of an extensive array of aggregate public social policy definitions. The model specifications also do not generate significantly different results for indicators on active and passive spending: both variables remain insignificant, although they have the expected sign (positive for active spending; negative for passive spending). When time dummies that control for common shocks in a time period are excluded, spending on active labour market policies becomes significant at the 5 per cent level as its coefficient increases roughly tenfold, but the coefficient remains low. It might be the case that there is not yet sufficient data available to pick up any differences between active and passive spending, as the classification only exists in the data from 1985 onwards. It could also be due to the low predictive power of fixed effects estimation in the presence of time-persistent variables, topics that are discussed further below.

The negative effect of redistribution whilst social spending itself is insignificant implies that social policies as such do not lower economic growth, as for instance argued by the transaction cost theory, but that the distortion of market outcomes by public redistribution is likely to be more important. Moreover, the finding points to effects of public expenditures outside the social policy field, or to the role of tax systems in redistribution, which are topics that are outside the remit of this study (see *e.g.* Johansson *et al.*, 2008).

Coming back to the research question, keeping in mind the data limitations, this study finds that both the amount of actual inequality within a country and the amount of public redistribution to equalise incomes should be taken into account in order to understand the relationship between growth and distribution of income within developed countries. Tentatively, this study presents evidence that redistribution is more important than the amount of income inequality in affecting growth, which is consistent with the trade-off argument. This argument predicts that public actions to promote income equality come at the cost of (marginally) reduced output growth by reducing financial incentives to gain wealth.

6.2 Discussion of limitations

As has been mentioned briefly already, there are a number of limitations to this study that should be taken into account when interpreting the results.

Simultaneity

First, the panel design is merely an ad hoc correction for feedback loops by introducing a temporal difference between the explanatory variables and the dependent variable. However, it is likely that economic growth affects demand and need for redistribution, and unless all people gain equally from economic growth, it affects the distribution of income as well. It might therefore be that the levels of inequality or redistribution measured at the beginning of the period were already consequences of economic growth before that period. It is hard to fully overcome this simultaneity problem; therefore, due care should be exercised when causally interpreting the results.

Time dummies

Time dummies absorb variation that is time specific but does not vary per country. They correct for unobserved variables, such as macro-economic shocks including the oil crisis between 1970 and 1975, and the current financial crisis, to reveal the long-term impact of the explanatory variables on economic growth. The inclusion of time dummies makes a significant difference for the regressions of growth on income inequality and active spending. One could conclude from this that accidental time effects have a distorting effect, or, that the relationship is historically embedded because of the substantial temporal effect. Regardless of the interpretation, a disadvantage of the inclusion of time dummies is that they are difficult to interpret as they correct for unobserved variables. Therefore, results are shown both with and without time dummies for these regressions. Researchers in the field of income inequality and growth should include time dummies at least to weigh their effect.

Predictive power

Fixed effects estimation filters persistent country differences in all variables, which makes the estimation technique unaffected by omitted constant country effects, called heterogeneity bias. Heterogeneity bias is an important issue in this field of research. For the estimations of

the effects of inequality on growth, OLS and fixed effects estimation even yield opposite signs. Nevertheless, this correction comes with a cost. It is known that fixed effects estimation has low predictive power when variables are highly persistent over time. As the fixed part is swept away, the varying part that remains is relatively minor and random measurement error becomes more influential. Hauk and Wacziarg (2009) show that in growth regressions, stocks of physical and human capital are substantially biased downwards. The variables of interest in this study, income inequality, redistribution, and the policy variables, are also quite time persistent and their influence is therefore also likely to be underestimated. The effects of the inequality, redistribution, and social spending on economic growth might therefore well be stronger than the found coefficients suggest.

Data and design

Another fundamental problem of this study is the data availability. Especially for market income distribution, which is needed to construct the redistribution indicator, only a few observations per country are available. The inequality regressions are only robust when a complemented data set is created using three databases – an exercise that has consequences for the reliability of the measurements. The lack of data warrants caution with the interpretation of the findings.

All in all, a macro design with a few observations per country might not be fully appropriate in investigating the complex relationship between distribution and growth of income. As an alternative, a micro design based on national household surveys allows for more complex models with other estimation methods (System-GMM, pooled OLS) and more robustness checks. Yet, the macro design employed here has the advantage that countries with different levels of inequality, redistribution, and social spending can be compared. There seems to be a methodological trade-off; a national household survey allows for investigation of more complex questions, but as only one or a few countries can be incorporated in this way, the scope of the study will be more limited.

6.3 Repercussions for research

This study shows that the relationship between income distribution and economic growth cannot be investigated without taking into account the effect of redistribution by public interventions, or vice versa. Thus, a study on the effects of income inequality on economic growth should properly control for the influence of redistribution. One possible way of controlling for differences in redistribution is by comparing regions within a country (*e.g.* Rooth and Stenberg, 2011), or, as long as the amount of redistribution is relatively stable over time, by tracking a country over time (*e.g.* Romer and Romer, 2010). Another way would be to include a redistribution variable.

This study points to two channels through which inequality can affect economic growth. The first one is redistribution, which, as the results of this study seem to imply, negatively affects growth by lowering marginal benefits to gain wealth. This is still a rather general conclusion; further research can shed light on this process how redistribution affects marginal benefits or incentives, and by which factors this relationship is affected. This study shows that the negative effect of redistribution on growth is not a consequence of levels and

growth rates of social policy expenditures. This result points to the role of other types of redistributive policies or to the structure of the tax system (see *e.g.* Johansson *et al*., 2008). Yet, a further investigation of the effects of redistribution requires additional data on market income distribution.

Second, inequality might well affect growth through the human capital channel. Explorative analyses in this study suggest a negative effect of inequality on the attainment of human capital, although it could also be a reverse relationship (the equalising effect of investment in human capital). Further research could focus on the influence of income inequality on human capital inequality, or the effects of human capital inequality on economic growth (*e.g.* Castelló-Climent, 2008; 2011). Related, the effects of education expenditures on growth can be scrutinised; Sylwester (2002) for instance notes that education expenditures are associated with subsequently lower levels of income inequality in developed countries. If education expenditures are effective in increasing the stock of human capital, this seems to be a promising policy field in overcoming the trade-off between public interventions and economic growth. Furthermore, the human capital channel is likely to become more important in attaining growth for developed countries in the future due to the current transition towards knowledge economies.

Another interesting topic would be to investigate the effects of different types of social policies on income inequality (*e.g.* OECD, 2008). Combined with the findings in this study, this could point out whether there are policies that alleviate inequalities without impeding economic growth.

As noted in the previous sub-sections, it might well pay off to consult different data sources and a micro design, allowing for testing more complex relationships. A micro design with a larger number of observations is probably better capable of picking up effects of highly persistent variables, such as (social) policies.

6.4 Policy implications

The study has policy implications as well. First, redistribution is a practice that might be desirable to alleviate inequality, but it comes with a (marginal) cost by reducing total output growth. This cost does not seem to be a consequence of the composition of social policies, but might be due to the tax system or different types of policies, topics outside the remit of this study. Policies that are most likely to be growth enhancing are active labour market policies, found to be significant under certain model restrictions, and, again not part of this study, education policies. It requires further research to assess the effects of these policies on income inequality (see *e.g.* OECD, 2008). Even though redistribution has a negative effect on growth, the findings imply that this result is quite small, although it might be underestimated as explained above as a result of the low explanatory power of the estimation method.

Most fundamentally, taken into account the limitations, this study shows that there is indeed evidence for the existence of a trade-off between attaining economic growth and equalising incomes by public interventions, even though the found effect suggests only a 'minor trade-off'. Apparently, states are not able to reach these two goals simultaneously using the same instrument of redistribution. This means that societies have to prioritise

values or aim for a certain balance, at least to the marginal extent that redistribution negatively affects growth. Governments have to decide whether economic expansion as such is preferred over restraining inequality or vice versa. Which value should be favoured is a normative dispute that cannot be settled by this study – nor by any empirical investigation for that matter.

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Appendices

Appendix 1: Growth model and baseline tests

Introduction

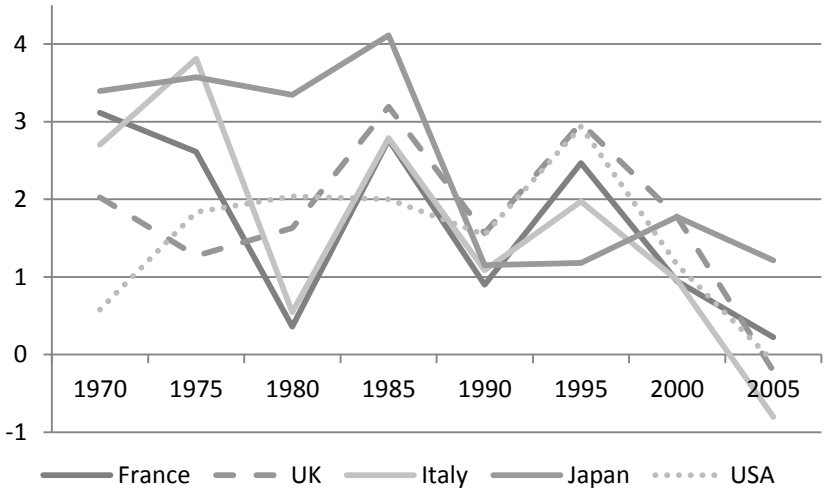
The Mankiw, Romer, and Weil (1992; hereafter MRW) model is designed to understand conditional convergence, that is, the process in which countries reach similar levels of income per capita conditional on a number of included explanatory variables. The model is also often used in literature on determinants of economic growth (see Temple, 1999 and Hauk and Wacziarg, 2009 for more elaborate discussions on growth models).

The MRW model departs from a Solow framework (1956), assuming diminishing returns to the production factors and an exogenous long-term determination of growth. Three production factors are distinguished, which are labour, physical capital, and human capital. Technological progress and depreciation rates are assumed to be exogenous across countries. The rate of convergence is estimated by the inclusion of initial level of income per working age person as an explanatory variable.

$$\frac{1}{n}\sum_{t=1}^{n}(\ln(y_{it+1}) - \ln(y_{it})) = \beta_0 + \beta_1 \ln(y_{it}) + \beta_2 \ln(n_{it}) + \beta_3 \frac{1}{n}\sum_{t=1}^{n}(\ln(s_{it})) + \beta_4 \ln(h_{it}) + a_i + \eta_t + u_{it} \quad \text{(A1.1)}$$

The dependent variable is real GDP growth, expressed as the average of annual differences in real GDP. Following the original specification, growth is standardised by dividing it by the working age population. The four explanatory variables are the initial level of income per working age person (y_{it}), working age population growth (n_{it}), the stock of human capital (h_{it}), and the average of annual propensity to accumulate physical capital or the stock of physical capital ($1/n \sum_{t=1}^{n}(\ln(s_{it}))$, see Box 2.1). As a sensitivity test, different specifications were used for working age population growth and the stock of physical capital, which did not affect results much. Figure A1.1 shows that economic growth varies significantly over time.

Figure A1.1: Development of economic growth for a selection of countries



Two of the explanatory variables, the initial level of income and average years of schooling, show a persistent rising trend over time. As indicated in appendix 2, this increasing trend in the stock of human capital might lead to problems when it is used as dependent variable in the indirect association tests. These tests are therefore exploratory. All variables show variation across time and across countries.

Figure A1.2: Development of growth model variables for a selection of countries

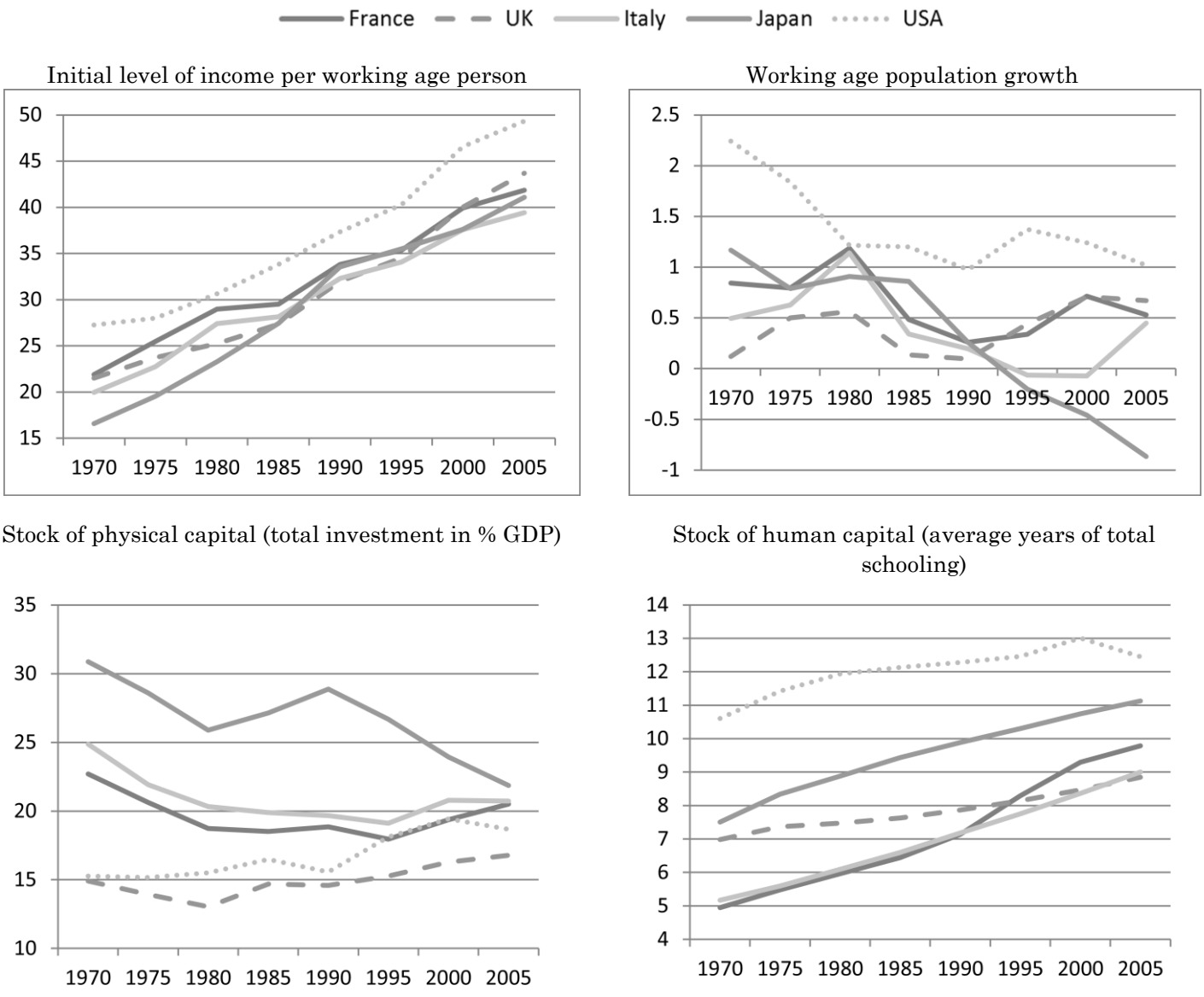


Table A1.1 summarises the main characteristics of the variables in log specification for the five year data set. The explanatory variables show most variation between countries, whereas economic growth varies slightly more within countries.

Table A1.1: Overview of growth model variables as used in inferential estimations

	Mean	**Standard deviation**	**Minimum**	**Maximum**	***N***
Economic growth	.0194	.0164	-.0157	.0783	222
Initial level of income	3.295	.4444	1.412	4.489	222
Population growth	.0095	.0090	-.0082	.0462	240
Physical capital	3.033	.1785	2.568	3.600	216
Human capital	2.126	.3120	.7069	2.572	240

Estimation

Mankiw *et al.* (1992) use cross-country comparisons, as they assume that '[…] the rates of saving and population growth are independent of country-specific factors shifting the production function'. This assumption allows them to use OLS. This approach has been criticised (*e.g.* Islam, 1995; Hauk and Wacziarg, 2009: 107). Islam (1995) advocates the use of panel data to allow for correlation between country-specific effects and explanatory variables. Indeed, *F* tests indicate that fixed effects should be preferred due to existence of country effects at the 1 per cent significance level. This study also incorporates time dummies as a further correction of unobserved variables.

Table A1.2: Baseline regression

	Five year data set	**Ten year data set**
Level of income	-.0282 (.0057) ***	-.0270 (.0053) ***
Population growth	-.4545 (.1206) ***	-.3118 (.1266) **
Physical capital	.0107 (.0090)	.0181 (.0080) **
Human capital	-.0141 (.0087)	-.0104 (.0070)
Constant	.1085 (.0276) ***	.0719 (.0296) **
Observ	216	106
Countries	30	30
R-squared	0.4593	0.5508
F test	74.33 ***	34.51 ***

Fixed effects, 1970-2009, time dummies, clustered standard errors. Significance levels are noted by *** (1 per cent), ** (5 per cent), or * (10 per cent), standard errors in brackets. All variables in logs. Dependent variable: average growth of real GDP per working age person during the subsequent period in 2000 US dollar PPP. Growth model variables: see Box 2.1.

In this study, the stock of physical and human capital are generally found to have an insignificant association with economic growth, which is more often reported (*e.g.* Islam, 1995; Pritchett, 2001). The insignificance of these time persistent stock variables is likely to be (at least partially) a consequence of the use of fixed effects estimation which sweeps away constant differences over time, see appendix 2.

Appendix 2: Glossary of statistical terms and estimation techniques

A2.1 Glossary of statistical terms

Attenuation bias: the coefficient of an explanatory variable is *biased* towards zero, thus, the size of the effect is consistently underestimated.

Autocorrelation: the *error terms* in consecutive periods are *correlated*.

Baseline equation: the original equation, here the one from the MRW framework, to which indicators of interest are added.

Bias: a difference between the estimation and the population value.

Breusch-Godfrey test: *autocorrelation* test in which the *residual* is regressed on its lags and the other explanatory variables.

Breusch-Pagan test: *heteroskedasticity* test in which the squared *residual* is regressed on the explanatory variables.

Ceteris paribus: all other included explanatory variables held constant.

Clustered standard error: *standard error* with alternative assumptions which allows for general forms of *heteroskedasticity* and *autocorrelation* within countries.

Control variable: an added *explanatory variable* to explain variation in the *dependent variable* that is not of first interest.

Correlation: an indicator of linear dependence between two variables. It is bounded between -1 (perfect negative linear relationship) and 1 (perfect positive linear relationship).

Country effect: in this study, this concept refers to the fixed *unobserved* effect of the *error term* that does not change over time (a_i). If not adequately dealt with it can lead to *heterogeneity bias*.

Dependent variable: the variable to be explained by means of estimation.

Elasticity: the percentage change in the dependent variable as a consequence of a 1 per cent increase in an explanatory variable, *ceteris paribus*.

Endogeneity: the presence of an endogenous explanatory variable, which means that this variable is *correlated* with the *error term*, because of *measurement error*, an *omitted variable*, or *simultaneity*. If not adequately dealt with, this causes estimations to be *biased*.

Error term: the right-hand side variable that contains *unobserved* or *omitted* factors that have an effect on the *dependent variable*, and *measurement error* in the observed variables.

Exogenous variable: a non-*endogenous* explanatory variable, thus not *correlated* with the*error term*.

Explanatory variable: a variable on the right-hand side of the equation which explains variation in the *dependent variable*.

F test: a statistical test used to test multiple hypotheses about the parameters (*e.g.*, all country effects are zero).

Fixed effects estimation: a common panel estimation technique that is unaffected by heterogeneity bias. See the second sub section in this appendix for a further explanation.

Heterogeneity bias: the bias in *OLS* as a consequence of *omitted variables*, in particular, by not accounting for the *country effects*.

Heteroskedasticity: the variance of the *error term* depends on the explanatory variables and is therefore not constant.

Idiosyncratic error term: in a panel design, that part of the *error term* that varies both in time and between units (here, countries).

Instrumental variable: an *instrument* that does not appear in the original equation which is *uncorrelated* with the *error term* but correlated with an *endogenous* explanatory variable is used to instrument the endogenous variable.

Measurement error: a difference between an observed and 'real' observation. It can lead to *bias* because of *endogeneity*.

OLS: Ordinary least squares is an estimation method that minimises the sum of squared residuals. It is not by definition a panel estimation technique. See the second sub section in this appendix for a further explanation.

Omitted variable: a variable that might affect the dependent variable is not included as an explanatory variable. This can lead to *bias* because of *endogeneity*.

Residual: difference between the actual and predicted value for every observation.

Reverse causality: causality runs the other way than of initial interest.

Simultaneity: an explanatory variable is jointly determined with the dependent variable, or even a consequence of the dependent variable (*reverse causality*). This can lead to *bias* because of *endogeneity*.

Spurious correlation: a *correlation* between variables is not a consequence of causality, but is due to a third variable or a common but unrelated *trend* over time.

Structural equation: an equation which formalises a theory or reasoning.

Structural model: a (set of) *structural equation(s)*.

System-GMM: estimation technique that uses lags of endogenous variables as *instruments*. See the second sub section in this appendix for a further explanation.

Standard error: an estimate of the standard deviation, which is a common measure of spread in the distribution, of a variable.

t-test: a statistical test used to test a single parameter hypothesis (*e.g.*, the coefficient of a variable is zero).

Time dummies: a full set of explanatory dummies (a variable that take on value 0 or 1) to absorb variation that is common to all countries but only time specific (η_t).

Trend: a variable shows a decreasing or increasing pattern over time, which can have consequences for the estimation if this trend is highly persistent (*unit root*).

Unbalanced panel: panel data set with missing observations for a number of time periods for a number of countries.

Unit root: a variable follows a highly persistent trend over time, which means that its current values strongly depend on past values.

Unobserved variable: see *omitted variable*.

A2.2 Estimation techniques

Ordinary least squares

Ordinary least squares estimation (OLS) does not make a distinction between the cross-country and time series dimension. Both intercepts and slopes of countries are forced to be constant. This leads to the following equation, with ($\ln(\boldsymbol{X}_{it})$) as the vector of explanatory variables next to initial income, and (η_t) as a set of time dummies:

$$\frac{1}{n}\sum_{t=1}^{n}(\ln(y_{it+1}) - \ln(y_{it})) = \beta_0 + \beta_1 \ln(y_{it}) + \ln(\boldsymbol{X}_{it})\,\beta + \eta_t + u_{it} \qquad \text{(A2.1)}$$

The major advantage of OLS is that it can be shown to be the best linear unbiased estimator under the Gauss-Markov assumptions (see Wooldridge, 2002), and that it has a straightforward interpretation. Yet, as OLS does not allow for unobserved country effects (a_i), the country effects become part of the error term (v_{it}). In this study, it might be the case that certain country specific effects, for instance persistent country institutions or differences in technology adaption or culture, affect the stock of physical or human capital (*e.g.* Acemoglu *et al.*, 2005b: 7). This entails that the error term, which contains the country effects, is related to the explanatory variables, which causes OLS to be biased (called endogeneity because of heterogeneity bias).

OLS estimation is more efficient than static panel estimation techniques such as fixed and random effects estimation (discussed next) when the country effects are insignificant. The significance of country effects can be tested by means of an *F* test. In this study, the zero hypothesis that country effects are insignificant is always rejected.

Fixed effects

Fixed effects estimation is a typical static panel data estimation technique. The fixed effects model has constant slopes but the cross-sectional unit, here countries, are allowed to have different intercepts. The model involves a transformation to eliminate the country effects. For each country i each variable is averaged over time, noted by a bar above the indicator (*e.g.*, $\overline{y_i} \equiv \sum_t^n \frac{y_{it}}{T_i}$). Subsequently, the country average over time is subtracted from each country observation for every variable. As the unobserved country-specific effect (a_i) is constant over time, its average is its own value, thus, it disappears during the transformation. Therefore, fixed effects estimation is not affected by correlation between country effects and the explanatory variables (heterogeneity bias). The interpretation of the coefficients is intuitive, as is explained later in this appendix.

Assumptions can be found in Wooldridge (2002: Ch. 10). A random sample from the cross section is required and the zero conditional mean assumption of no correlation between the explanatory variables and the error term must still hold for the idiosyncratic error (u_{it}). Therefore, if there are omitted factors that vary both across time and countries that are correlated with the explanatory variables, fixed effects estimation still is biased. Explanatory variables are assumed to be strictly exogenous. Amongst others, this implies that the explanatory variables do not suffer from high persistence over time, called a unit root. Two of the explanatory variables, the stock of human capital and initial GDP per

working age person, are likely to be highly persistent trend over time. The presence of these unit roots can lead to invalid estimates and spurious relations. A common solution to a unit root is first differencing which means that the growth rate instead of the level is used. However, this implies that the theoretical reasoning that the *level* of income is related to the *growth* of income can no longer be followed. In addition, it leads to a lagged dependent variable (lagged growth of income) which also leads to endogeneity problems for which an instrument has to be found (see Verbeek, 2009). For these reasons, no corrections are made. Problems are most likely to occur for the indirect estimations with the stock of human capital as dependent variable. Explanatory variables with a similar upward trend over time are likely to be significant, which could be spurious, leading to inflated t- and R-squared statistics (Granger and Newbold, 1974). These indirect estimations are therefore explorative.

For the standard errors and t-statistics to be valid, no autocorrelation and heteroskedasticity in the error terms are allowed. The Breusch-Godfrey test for autocorrelation never posed problems.[25] Clustered standard errors are used that allow for general forms of heteroskedasticity and autocorrelation within countries by imposing alternative assumptions on the covariance matrix structure (Verbeek, 2008: 372).

Random effects

Random effects estimation is a common static panel estimation method that exploits variation both within and between countries across time. Random effects does not allow for correlation between unobserved country effects and the explanatory variables, but is more efficient than fixed effects (see for an application in the inequality literature Banerjee and Duflo, 2003). The assumption of zero correlation between unobserved country effects and the explanatory variation is always rejected in this study. Furthermore, a Hausman test (1978) indicates that fixed effects is preferred over random effects (Wooldridge, 2009: 493).

System-GMM

The system generalised methods of moments (System-GMM) is an estimation technique in which endogenous variables are instrumented by their own lagged levels and first-differences (Blundell and Bond, 1998, see Bond *et al.*, 2001 for an application on growth models). When there is no presence of autocorrelation, this can be seen as an intuitive correction for endogeneity due to feedback loops, by introducing temporal differences. In addition, System-GMM is less sensitive to measurement error than fixed effects estimation (Hauk and Wacziarg, 2009).

Nevertheless, System-GMM is an advanced technique which requires reasonably strong assumptions that are likely not to hold in growth equations (Hauk and Wacziarg, 2009). As the equation is first-differenced to discard the country effect and afterwards lags are taken, at least three periods drop out. In addition, results are quite sensitive to the definition of the lag structure and the interpretation is less intuitive. The System-GMM estimations conducted for this study were indeed not particularly robust, hence, results are

[25] Lagged versions and the explanatory variables are regressed on the predicted residual after the regression. For the baseline regression (see appendix 1) this leads to a t-statistics of 1.24 and 1.04 for the first and second lag of the residual.

not shown here. This advanced technique requires more data, for instance a design based on micro-level data.

A2.3 Interpretation of coefficients expressed in logarithms

In the inferential estimations in this study all variables are expressed in natural logarithms. Logarithms are a common means for allowing nonlinear relationships between dependent and explanatory variables. The main advantage is that logarithms approximate percentage changes and that units of measurement of variables can therefore be ignored. In addition, models with a logarithmic dependent variable satisfy assumptions of normal distribution and homoskedasticity more closely (Wooldridge, 2009: 191).

Assume the following fixed effects model, in which dependent variable (y) is economic growth, (x_1) is working age population growth, and (x_2) is the stock of human capital.

$$\ln(y) = \beta_0 + \beta_1 \ln(x_1) + \beta_2 \ln(x_2) + u \qquad \text{(A2.2)}$$

In equation (A2.3), the coefficient (β_2) shows the elasticity of growth with respect to the working age population growth, holding the stock of human capital (x_1) constant. For example, when (β_2) has a value of -.30, this would imply that for an average country, an increase of 1 per cent in the stock of human capital leads to a fall in economic growth of -.30 per cent, holding the working age population growth constant.

Appendix 3: Country cases

Table A3.1: Overview of countries and main descriptive values

Country	First year covered	Average economic growth	Average inequality level	Average social spending level
Australia (AUS)	1970	1.45	0.31	12.71
Austria (AUT)	1970	1.94	0.25	23.61
Belgium (BEL)	1970	1.84	0.28	23.52
Canada (CAN)	1970	1.43	0.30	15.75
Switzerland (CHE)	1970	0.85	0.30	14.93
Czech Republic (CZE)	**1990**	1.38	0.26	18.39
Germany (DEU)	**1995**	1.75	0.27	22.27
Denmark (DNK)	1970	1.59	0.23	24.38
Spain (ESP)	1970	1.77	0.34	19.42
Finland (FIN)	1970	2.33	0.23	21.85
France (FRA)	1970	1.67	0.30	23.63
United Kingdom (GBR)	1970	1.78	0.33	17.60
Greece (GRC)	1970	1.89	0.35	14.56
Hungary (HUN)	**1995**	2.61	0.26	21.63
Ireland (IRL)	1970	3.08	0.32	15.34
Iceland (ISL)	1970	2.02	0.28	15.13
Italy (ITA)	1970	1.63	0.33	19.88
Japan (JPN)	1970	2.47	0.30	11.93
Korea (KOR)	1970	5.49	0.31	4.33
Luxembourg (LUX)	1970	2.82	0.26	20.58
Mexico (MEX)	1970	0.69	0.49	4.29
Netherlands (NLD)	1970	1.68	0.27	23.19
Norway (NOR)	1970	2.40	0.24	18.98
New Zealand (NZL)	1970	0.89	0.30	16.96
Poland (POL)	**1990**	3.38	0.31	19.89
Portugal (PRT)	1970	2.22	0.35	15.13
Slovak Republic (SVK)	**1995**	3.72	0.24	17.67
Sweden (SWE)	1970	1.69	0.22	27.02
Turkey (TUR)	1970	1.70	0.45	6.21
United States (USA)	1970	1.50	0.34	13.74

Five year data set. Average economic growth: average growth of real GDP per working age person in 2000 US dollar PPP during the complete period. Average inequality level: Gini, entire population, final income distribution. Average social spending level: gross public total social spending in percentage of GDP.

Appendix 4: Empirical literature overview

Studies on the link between economic growth, income inequality, and social protection

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	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	Inequality. 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:	Higher inequality lowers growth in poor countries and stimulates it in rich countries, following the Kuznets hypothesis.

	running FE regressions exacerbates the biases due to measurement error.		investment/GDP IV's are actual values of schooling and terms-of-trade, lagged values of other ones.	
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: Familiar from 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.
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 rates in developed countries.

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,	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	Inequality is always positive, significant at 5% and strong, no matter what panel estimation method is used (although FE and RE are inconsistent).

	180 observations. Fixed and random effects (inconsistent due to presence lagged dependent variable), Chamberlain's π-matrix, Arellano-Bond (1991)		and female education (average years of schooling), PPPI (market distortions, proxied by price level of investment) Alternative specifications are tested as sensitivity analysis.	
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.
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	Base models: 1. Growth 2. Gini	1. Education, government, M2/GDP (financial development), inflation,	Drawing from both literature on determinants of inequality and of growth, authors come up with a simultaneous

	& Runkle 3SLS, 38 countries, five year aggregated periods, 119 observations	Simultaneous assessment of growth and Gini	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)	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	Log of real GDP per capita	Inequality ratios, especially 50/10 for bottom and 90/75 for top inequality, Gini	Association inequality and growth differs alongside the inequality distribution. Inequality at the top end of the distribution is positively associated with growth,

	data growth model, 21 countries, 1975-2000		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	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	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	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

	(standard deviation of the cyclical component of the variables)		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	
Kneller *et al.* (1999)	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.

Appendix 5: Inequality

In this study inequality data come from the OECD. Yet, this data set does not contain data for the years 1970 and 1980. Data for the Gini indicator on entire population, final income distribution have been complemented with data using the same definition. 57 of 182 observations (roughly 30 per cent) are complemented. Yellow values are derived from the trend in the LIS database, whereas for the green values the trend in SWIID data is used. Data have been complemented when the overlapping years showed a comparable trend.

Table A5.1: Gini, entire population, final income distribution

	1970	1975	1980	1985	1990	1995	2000	2005
AUS	.	0.29	0.30	0.31	0.32	0.31	0.32	0.30
AUT	.	.	.	0.24	0.24	0.24	0.25	0.27
BEL	.	0.27	0.27	0.27	0.28	0.29	0.29	0.27
CAN	0.33	0.30	0.30	0.29	0.29	0.29	0.32	0.32
CHE	.	.	0.31	0.31	0.31	0.29	0.28	0.28
CZE	.	.	.	.	***0.23***	0.26	0.26	0.27
DEU	***0.27***	***0.27***	***0.24***	***0.26***	***0.26***	0.27	0.27	0.30
DNK	0.23	0.23	0.24	0.22	0.23	0.21	0.23	0.23
ESP	0.34	0.34	0.36	0.37	0.34	0.34	0.34	0.32
FIN	.	0.23	0.22	0.21	0.22	0.23	0.26	0.27
FRA	0.34	0.33	0.30	0.31	0.30	0.28	0.28	0.28
GBR	0.28	0.28	0.29	0.33	0.37	0.35	0.37	0.34
GRC	0.39	0.41	.	0.34	0.31	0.34	0.34	0.32
HUN	***0.25***	***0.23***	***0.21***	***0.23***	***0.27***	0.29	0.29	0.29
IRL	.	.	0.33	0.33	0.33	0.32	0.30	0.33
ISL	.	.	.	.	.	.	.	0.28
ITA	0.35	0.35	0.32	0.31	0.30	0.35	0.34	0.35
JPN	0.29	0.27	0.28	0.30	0.31	0.32	0.34	0.32
KOR	.	.	.	.	.	.	.	0.31
LUX	.	.	.	0.25	0.26	0.26	0.26	0.26
MEX	.	0.52	0.48	0.45	0.51	0.52	0.51	0.47
NLD	.	0.25	0.26	0.26	0.28	0.28	0.28	0.27
NOR	0.23	0.22	0.22	0.23	0.25	0.26	0.26	0.28
NZL	0.24	0.25	0.27	0.27	0.32	0.34	0.34	0.34
POL	***0.28***	***0.29***	***0.30***	***0.30***	***0.30***	0.35	0.32	0.37
PRT	.	0.35	0.33	0.33	0.33	0.36	0.36	0.38
SVK	.	.	.	.	***0.19***	0.24	0.27	0.27
SWE	0.25	0.21	0.18	0.20	0.21	0.21	0.24	0.23
TUR	.	.	.	0.43	0.49	0.49	0.41	0.43
USA	0.31	0.32	0.31	0.34	0.35	0.36	0.36	0.38
All	.	.	.	.	.	.	.	0.31
Total	0.29	0.29	0.27	0.29	0.29	0.30	0.31	0.31

A number of observations are only used in the descriptive statistics and not in the inferential estimations as they drop out due to missing values in the growth model variables. These numbers are put in bold italics.

Appendix 6: Additional social spending estimations

As described in sub-section 4.4.2, the aggregate social spending variables when expressed as growth rates in percentage of GDP have significant negative associations with subsequent growth. As the significance disappears when the growth rates are expressed per working age person, the significance of the growth rates in percentage of GDP are spurious and a result of their expression in percentage of GDP.

Table A6.1: Growth of social spending in percentage of GDP and economic growth

	Social spending	**Excl. health**	**Excl. elderly and disabled**	**Excl. elderly, disabled, health**
Level of income	-.0407 (.0189) ***	-.0415 (.0190) **	-.0627 (.0220) ***	-.0678 (.0199) ***
Population growth	-.1174 (.1681)	-.1143 (.1701)	.1817 (.4281)	.2963 (.4361)
Physical capital	.0053 (.0096)	.0057 (.0089)	-.0125 (.0134)	-.0102 (.0123)
Human capital	-.0093 (.0090)	-.0045 (.0088)	.0103 (.0120)	.0055 (.0136)
Growth of spending	-.1614 (.0490) ***	-.1527 (.0375) ***	-.0874 (.0460) *	-.0439 (.0220) *
Constant	.1585 (.0583) **	.1503 (.0595) **	.2264 (.0769) ***	.2447 (.0725) ***
Observ	166	166	130	130
Countries	30	30	30	30
R-squared	0.5261	0.5467	0.5242	0.5447
F test	29.66 ***	37.60 ***	36.52 ***	35.80 ***

Country fixed effects, 1970-2009, five year periods with time dummies, clustered standard errors. Significance levels are noted by *** (1 per cent), ** (5 per cent), or * (10 per cent), standard errors in brackets. All variables in logs. Dependent variable: average growth of real GDP per working age person during the subsequent five year period in 2000 US dollar PPP. Growth model variables: see Box 2.1. Growth of spending: growth of gross public social spending in percentage of GDP, see Box 4.1.