Income Inequality, Economic Growth, and the Effect of Redistribution

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Abstract

Evidence from a large set of well comparable worldwide data provided in the SWIID shows a robust negative correlation between income inequality and growth that can be traced back to three essential transmission channel. More unequal societies tend to have a less educated population, higher fertility rates, and—to some extent—lower investment shares. All of these effects are harmfull for growth and reinforced by a limited availability of credit. Higher public spending on education attenuates the negative effects of inequality.

Less evidence is found for a negative growth effect of public redistribution, measured via the pre-post approach. While redistribution hampers investments, its negative incentive effects on average do not seem to transmit to economic growth. Combined with the resulting decrease in net inequality, we find evidence that redistribution is beneficial for growth if market inequality is high. However, such an effect cannot be found at lower levels of initial market inequality.

The results stem from developing and middle-income countries where the negative potential of inequality is most severe, yielding a socio-political environment where equality of opportunities is much less pronounced than in advanced economies. In advanced economies, we do not detect any significant correlation between inequality and growth.

Keywords: Economic Growth, Redistribution, Inequality

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1 Introduction

The United States are among the most unequal economies in the world. The Gini coefficient of disposable income inequality amounts to almost 40 percent, indicating a level of inequality that no other developed country in the world exceeds. However, the United States also possess one of the most affluent economies on the globe, where per capita incomes are four times as high as the average income of the countries in the world. Inequality and prosperity sometimes go hand in hand with each other. In his famous 1975 book *"Equity and Efficiency: The Big Tradeoff"*, Arthur Okun points out that the tradeoff between social justice and economic efficiency "plagues us in dozens of dimensions of social policy".[1]

Okuns notion reflects the traditional view in economics, assuming that income inequality is beneficial for growth and—above all— that public redistribution via taxes and transfers creates disincentives and inefficiencies which Okun compares to a "leaky bucket", losing money whenever transfers are made from the rich to the poor. Yet, the empirical evidence on the existence of such a trade-off is rather weak. Indeed, aside from the previous example of the United States, there is a number of affluent countries with exceptionally low levels of inequality (e.g. Denmark, Sweden, Austria, Luxembourg).

The empirical literature that is concerned with the question on how inequality affects the prosperity of nations can be divided into two more or less independent strands: The first strand examines the link between inequality and growth, coming to a tentative consensus that a low level of inequality is good for growth, at least in the long-run. The second branch studies the growth effects of redistributive fiscal policies, especially taxes and social transfers. This paper follows a novel approach by simultaneously exploring the growth effects of both variables, examining on the one hand the "direct" growth effect of redistribution and on the other hand the "indirect" effect of the resulting net inequality. By this means we can not only evaluate whether and why lower levels of inequality may be good or bad for growth, but also to which extent governments affect growth by taking redistributive measures.

There is a rich and rapidly growing empirical literatur that is concerned with the effects of inequality on growth: Earlier studies based on cross-country growth regressions evolved into a consensus on a negative relationship between initial inequality and the growth rate in subsequent periods.[2] However, with the advent of panel data estimations, the results became more inconclusive. Particularly Li and Zou (1998) and Forbes (2000) contradict the earlier results by finding a positive inequality-growth relationship based on fixed-effects and first-differences (Arellano-Bond) estimations. Likewise, the simultaneous equation models applied by Barro (2000) yield a negative impact of inequality in developing economies, whereas the influence in advanced economies is insignificant. The study further brings to light a crucial entanglement of inequality and the fertility rate, as the significantly negative impact of inequality on growth in the whole sample estimations emerges only if the fertility

[1] See Okun (1975).

[2] The empirical growth literature of the 1990s is comprehensively reviewed in Aghion et al. (1999) and Benabou (1996).

rate is omitted. Voitchovsky (2005) enriches the debate by emphasizing the importance of the shape of the income distribution, but receives an overly negative effect of the Gini coefficient by applying a system GMM estimator. A very recent paper by Halter et al. (2014) explains the contradicting results of earlier studies by the choice of different empirical methods, which emphasize different time horizons of the inequality growth relation. It stresses that estimates based on time-series variations are likely to pick up positive short-run effects of inequality, while methods which also exploit cross-country variations reflect the negative impact of inequality in the medium to long-run. A couple of studies have also examined the transmission channels by which inequality effects growth, mostly based on cross-country variations (see, e.g. Perotti (1994, 1996)). However, with the exception of Barro (2000), to the best of our knowledge, only few studies are focusing on the transmission process with the help of panel data.

A further explanation of the substantial differences in the results concerning the impact of inequality on growth that previous studies brought to light is the scarcity of convincing data on inequality. Most studies struggle with a rather low number of observations, which results in several empirical drawbacks. First, with only few degrees of freedom, the econometric specification can incorporate only few covariates, which may yield an omitted variable bias and thus inconsistency in the estimated coefficients. Second, as many previous data sets only contain a small fraction of countries, a sample selection bias may distort the results. Especially since different data sets contain inequality measures for altering subsets of countries, albeit with a clear tendency to neglect developing economies. A further problem is the time dimension: Most of the time series regarding inequality measures are interrupted by large periods where no data is available. This complicates the use of panel data methods considerably. All of these disadvantages force researchers to compromise, which can easily result in deviations of the outcomes.

Regarding the growth effects of redistributive fiscal policy, Easterly and Rebelo (1993) and Perotti (1996) find if anything a positive growth effect of various policy instruments such as average or marginal tax rates, and different types of social spending. Tanzi and Zee (1997) survey the literature on the long run effects of fiscal policy in general and conclude that empirical studies are rather disappointing in its support of the theoretical predictions from the endogenous growth theory. This is broadly in line with Lindert (2004) who finds that large welfare states have come up with methods to minimize the negative growth impact of social spending. In contradiction, a recent study by Muinelo-Gallo and Roca-Sagalés (2013) shows that distributive expenditures and direct taxes deter growth in a panel of 21 high-income OECD countries.

A general problem concerning the judgment of the growth effects of redistribution based on the above mentioned literature is that it remains unclear in how far the examined fiscal policy instruments are indeed redistributive. Thus, this study contributes to the literature by following a fairly novel approach: Growth rates are regressed on effective redistribution instead of individual elements of redistributive fiscal policy. A new dataset by Solt (2009) allows us to distinguish neatly between the Gini coefficients of market and net income, thereby permitting the calculation of a variable of overall redistribution for a large number of countries and years. Moreover, it allows us to study the growth effects of net income inequality while controlling for public redistribution. Similarly, the overall effects of redistribution are assessed when market inequality is held constant. Applying the Blundell-Bond system GMM estimator—and Simultaneous Equation Models within the sensitivity analysis—this study indicates a negative inequality growth relationship, while growth appears to be surprisingly insensitive to redistribution. Owing to the advantages in data availability, our dataset is considerably extended compared to earlier studies: Based on a maximum of 962 observations from 152 countries between 1960 and 2012 we can now also account for the exceptionally high growth rates in many developing countries during the last decade. The exceptional size of the dataset not only provides a remedy for some of the above mentioned problems in the empirical literature, but it allows us to distinguish between several subsamples split by the development level or data quality. The clean distinction between inequality of market and disposable income enables some new perspectives on the transmission channels of inequality on growth. This examination is indeed fruitful, as it turns out that inequality acts through a variety of transmission channels, such as education, fertility, and investment. Holding constant these channels, the direct effect of inequality on growth vanishes.

Two recent studies have applied a similar approach as we did. Thewissen (2013) calculates a measure of effective redistribution from data of the Luxembourg Income Study and the OECD. In a panel of exclusively high-income countries, no robust association between inequality and growth or redistribution and growth can be found, while there is some indication for a positive relation between top income shares and growth. Berg et al. (2014) are using the preceding version of the SWIID in a study on redistribution, inequality and growth. The focus is on the impact of redistribution on medium term growth but also on growth spells duration, which appears to be small or non-existent. Regarding the inequality-growth nexus they find a negative relationship even when a number of control variables are held constant. Yet in contrast to the present paper, Berg et al. (2014) do not focus on the specific transmission channels of income inequality.

The paper is organized as follows: Section 2 briefly reviews the main theories on inequality, redistribution and growth, setting the groundwork for the empirical investigation of the relationship and its transmission channels. Section 3.1 presents our empirical model and estimation technique. Section 3.2 describes the data used in our regressions with a distint focus on the data concerning inequality and redistribution. In addition, some crucial relationships between the covariates, as well as the link between market inequality and redistribution are examined. The regression results follow in Section 4. After the illustration of the baseline findings, we conduct a sensitivity analysis using different estimation techniques in order to guarantee that the results are not primarily driven by the selected empirical method. Subsequently, we examine the overall effects of public redistribution, and investigate the transmission channels through wich inequality assumes its influence on growth. The empirical section closes with an examination of the effects of inequality and redistribution for different levels of development. We conclude in Section 5.

2 Theoretical link between inequality, redistribution, and economic growth

Numerous papers have been written on the theoretical link between inequality and economic growth. In this section we aim to illustrate the most convincing theories proposed by economic literature which we have consolidated into five categories.[3] By this means we are setting the groundwork for the following detailed examination of the theoretical transmission channels in our empirical regressions. A crucial distinction can be made between the first four and the last argument: While most of the arguments are related to the distribution of disposable income (or wealth), the final argument is related to market income and the growth effects of public redistribution. In constrast to most of the recent studies, it is our distinct purpose to give the latter argument a considerable amount of attention in the empirical investigation.

2.1 Differential Saving Rates

According to the well-known Kaldor (1955) hypothesis, the marginal propensity to save is positively correlated with the income level of individual households. Based on this assumption, Bourguignon (1981) shows that with a convex saving function, a more uneven distribution of income leads to higher aggregate savings which can be channeled into investments that are conducive to growth. However, from a Keynesian perspective the rise in savings by the rich can also lead to a structural drag on demand and to increasing financial instability [see for example Stiglitz (2012)].

2.2 Sociopolitical Unrest

A further channel through which inequality affects economic growth is emphasized by Alesina and Perotti (1996) and Alesina et al. (1996) and concerns the extent of socio-political stability. Political stability increases policy uncertainty, which has negative effects on a variety of productive economic decisions such as the investment in human or physical capital, or the saving rate. As income inequality increases political instability, it indirectly leads to a reduction of the growth rate. Especially the absence of a wealthy middle class enhances the vulnerability to instability. A high probability of a future government change increases uncertainty, which initiates capital exports as investments abroad may be associated with a

[3] A review on the perspective of the new growth theories can be found in Aghion et al. (1999). Voitchovsky (2005) and Ehrhart (2009) are covering both the theoretical and empirical literature. Neves and Silva (2014) are focusing primarily on the empirical literature.

lower risk. At the same time, foreign investors will be discouraged to invest in a country if the political and economic conditions are fragile.

On the other hand, high rates of inequality may also produce social instability. Particularly if inequality is accompanied by low rates of social mobility, individuals may make use of illegal sources of income, as their impression—subjective or not—may be that chances in the regular labor market are low. Investments in human capital will thus be deferred or substituted, which negatively affects economic growth. Enhancing crime rates may also lead to political instability. In either case, it will prevent foreign and domestic investors to invest in the country, which decreases capital accumulation and deteriorates the situation in the labor market.

One further argument that is related to the socio-political environment is the existence of crony capitalism and nepotism. In societies with a highly unequal distribution of incomes, especially due to an exorbitantly wealthy upper class, the rich may have manifold possibilities for political influence. The more unequal the income distribution, the lower may be the opposition to such actions. However, if the government devotes itself disproportionately to the interests of the rich, one can expect a variety of efficiency losses for the economy, especially with respect to factor allocation and human capital investments.

2.3 Credit Market Imperfections, Unequal Opportunities and Investment Indivisibilities

An equable distribution of wealth or disposable income can be growth enhancing if marginal returns of human capital and physical investment are decreasing and credit markets are imperfect. One line of this argument goes back to Stiglitz (1969) and is modified by Aghion et al. (1999). It essentially assumes people as potential entrepreneurs facing individual investment projects that are bound by decreasing marginal returns.[4] If capital markets are limited, the poor will not be able to exploit their opportunities, while the wealthy are overinvesting in their own projects so that marginal returns are relatively low. Wealth distribution should thus affect the average productivity of physical investment in the aggregate economy, while its quantity may be relatively unaffected. Another line of reasoning has been brought forward by Galdor and Zeira (1993) and is focused on human capital investment. An unequal distribution of parental wealth will prevent some individuals from exploiting their full intellectual potential via formal education if the direct costs of education or—more relevant in developing economies— the opportunity costs of forgone income, cannot be covered by credit or the government. As the maximum amount of human capital investment per capita is limited, at least in terms of years of formal education, inequality is likely to affect both the quantity and average productivity of human capital investment in aggregate. Naturally, educational inequality and its negative growth effect can also be directly mitigated by a

[4]Piketty (1997, 2000) additionally stresses the role of investment indivisibilities. In the absence of minimum set-up costs for investments, poorer families could be gradually catching up by investing in larger and larger projects.

public education system which provides free and high quality education to children from poor families.

Instead of decreasing marginal returns, it is as well possible that large setup costs and economies of scale prevail in certain economies. In this case an uneven distribution of wealth may be beneficial for growth as it lifts at least some people above the threshold to start a profitable business or to obtain higher education, which could both exert positive spillover effects.[5]

2.4 Endogenous Fertility

Initial inequality can be detrimental to growth due to a positive link between inequality and the fertility rate. The transmission channel is closely related to the human capital argument as decisions concerning human capital investment and family size are interrelated, according to a prominent line of reasoning first brought forward by Becker and Barro (1988). In general, most families are facing a trade-off between the quantity of children and their education.[6] Poor parents may lack the resources to invest in the education of their children, particularly when they are excluded from capital markets. Thus their only chance to increase family income (or their old-age support) is to increase household size. In contrast, for richer parents and in more developed countries, the opportunity costs of raising children are relatively high. Thus it may be optimal to have fewer children and to invest more in human capital so that they will earn higher lifetime incomes.[7]

Firstly, from this it follows, that poor societies tend to have high fertility rates and low levels of education. Secondly, empirical evidence by Kremer and Chen (2002) underlines that more inequality is associated with larger fertility differentials between educated and uneducated women, foremost in middle-income countries.

Building up on this evidence, De la Croix and Doepke (2003) emphasize the growth effects of fertility differentials between the rich and the poor. In their model, income inequality strictly stems from disparities in human capital provision. A mean-preserving spread in income distribution increases the number of poorly educated children from underprivileged families, relative to well-educated children from richer families. As the relative weight of the less educated increases, average human capital in the aggregate economy is diluted and economic growth in forthcoming periods is depressed. Additionally, due to the shape of the fertility function proposed in the model, an increase in inequality is not only associated with higher fertility differentials but also with a higher rate of overall fertility. Earlier growth regressions conducted by Barro (2000) and Perotti (1996) have stressed the importance of the aggregate fertility rate for understanding the transmission of inequality to economic growth.

[5]See Perotti (1993) for a model of a positive link between inequality, human capital investment, and growth based on this mechanism.

[6]It is often called the tradeoff bewteen the “quality” and the “quantity” of children.

[7]See Galdor and Zang (1997), Morand (1999), Kremer and Chen (2002) and De la Croix and Doepke (2003) for models of endogenous fertility arguing along this line of reasoning.

The work of De la Croix and Doepke (2003) confirms the empirical evidence provided by Barro (2000), who finds that the aggregate fertility rate is negatively correlated with economic growth and that the Gini coefficient of income inequality becomes insignificant when the fertility rate is introduced into the regression model. Moreover, De la Croix and Doepke (2003) provide evidence that differential fertility has a negative growth effect which even remains significant if inequality and total fertility are held constant.

2.5 Political Economy: Market inequality and redistribution

Until now, we have described growth effects of inequality that are directly related to the distribution of disposable income. However, there is another line of the literature emphasizing growth effects which are more closely related to market inequality and the redistributive activity which may result from it. It was Perotti (1996) who called the theory put forward by Bertola (1993), Alesina and Rodrik (1994) and Persson and Tabellini (1994) the "endogenous fiscal policy approach", dividing it into two successive arguments. The first argument—called the *political mechanism*—is based on a seminal paper by Meltzer and Richard (1981). It states that an unequal distribution of market income may create a high demand for redistributive taxes and transfers via the political voting process. The second argument—the *economic* mechanism—stresses negative incentive effects of redistribution. By lowering the returns of investments in physical or human capital, redistributive taxes may reduce capital accumulation and thus deter future growth.[8] Moreover, a generous welfare system may discourage labor effort.

The empirical literature provides little evidence for the channel of endogenous fiscal policy. Particularly the results from Perotti (1996) are standing in sharp contrast to the theoretical predictions.[9] The data rejects the political mechanism as inequality is standing in a negative relationship with redistribution, measured by the marginal tax rate and several other measures of taxation and redistributive expenditures. Moreover, the results also contradict the economic mechanism by showing that tax rates and various welfare expenditures can be positively correlated with economic growth.

Milanovic (1999) suggests that the unexpected results from the earlier literature could be due to the application of inadequate measures of inequality and redistribution. He emphasizes that the endogenous fiscal policy channel is triggered by market inequality and not by net inequality which was sometimes applied as an exogenous variable in earlier growth regressions. Furthermore, he criticizes the use of imperfect measures of redistribution, as the size of public transfers or taxes might say little about their redistributive impact. Using data form the Luxembourg Income Survey (LIS), Milanovic calculates the distribution of market

[8] A first formalization of these incentive considerations was provided by Mirrlees, James (1971). Rebelo (1991) has focused on the effects of taxation in an endogenous growth model.

[9] Similar structural form estimates have been done before by Persson and Tabellini (1994) who have found inconclusive results. Perotti (1994) studies the effects of endogenous fiscal policy regarding the investment share, but the results are inconsistent with the theoretical predictions.

income as well as effective redistribution, which is measured by the difference between the distribution of market and disposable income. The data confirms the political mechanism. Apparently, countries with a more unequal distribution tend to distribute more in favor of poor households, but not necessarily in favor of the median voter.

Two additional arguments should be emphasized: Firstly, there is a further line of theoretical literature that considers the insurance effects of public redistribution. The existence of a social safety net could be stimulating productive risk taking, entrepreneurship, and innovation, which means that redistribution could be directly beneficial for growth.[10] Secondly, it may make a difference whether the government redistributes directly through a progressive tax system accompanied by transfer payments, or whether it provides *indirect redistribution* via an improvement of equality of opportunities. While direct redistribution may trigger negative effects on labor supply and the decision to invest in a child's human capital, indirect redistribution softens the budget constraint for poor families which leads to an increase in both social mobility and the average level of human capital. A variety of endogenous growth models illustrate the positive effects on incomes emanating from a higher average level of human capital and the interweavement of human capital and innovation activity.

3 Empirical strategy

Economic theory provides a manifold of theoretical channels through which inequality interacts with growth. As some theories emphasize the positive economic effects of a more equal society, others stress that the opposite is true. The question which strand of theory dominates is—as often in macroeconomic explorations—an empirical one. In this section, we empirically analyze the effect of inequality and redistribution on economic growth using data for a large sample of countries between 1960 and 2014.

3.1 Empirical model and estimation technique

Our empirical model follows the specification of Barro (1991, 2003, 2013), considering the growth rate of real per capita GDP a function

$$\frac{\mathrm{d}}{\mathrm{d}t}(y) = F(y_{t-1}, h_t, \mathbf{X}, \Psi, R)$$

where y_{t-1} denotes initial GDP per capita, h_t is human capital endowment per person, and $\mathbf{X}$ comprises an array of control and environment variables. The application of the latter is of great importance, as a number of authors, such as Mankiw et al. (1992) and Barro (2003), conclude that the absolute convergence hypothesis proposed by the standard growth model of Solow (1956), Koopmans (1965), and Cass (1965) cannot be confirmed

[10] Yet, Sinn (1996) shows that redistribution does not necessarily result in a decrease in net inequality. We will come back to this issue in our data description in section 3.

empirically. What is observable in the data, however, is *conditional* convergence, meaning that the relation between the initial level of GDP per capita and the growth rate must be examined after holding constant some crucial variables that distinguish the countries. The variables include state and environment determinants and capture country specific potentials for economic growth. When holding constant the effects emanating from these variables, we study to what extent inequality Ψ and redistribution R can contribute to the explanation of empirical growth patterns. It is crucial to specify the basic system very accurately, as the disregard of covariates would lead to inconsistency in the estimated coefficients. Omitted variables furthermore can yield an over-estimation of the coefficients of redistribution and inequality, as these variables itself may depend on the political and institutional environment of the countries. Moreover, empirical growth regressions often tend to be fragile to changes in the specification. However, it is impossible to establish an empirical system that captures all the growth determinants that have been identified by empirical research. Durlauf et al. (2005) illustrate that there exist approximately as many growth determinants in empirical literature as there are countries to be examined. It is thus difficult to identify the subset that really matters. For this reason, we choose to apply the basic system specification of Barro (1991, 2003, 2013) which has been proven to explain empirical growth patterns quite accurately in a number of studies. As many of these variables can be considered channels through which inequality assumes its influence on growth, we compare the outcome with the results of reduced models consisting only of some of the variables in $\mathbf{X}$.

In general, when taking the standard growth model serious, such a set of growth determinants should also include physical capital in order to capture the effect of convergence when economies approximate their individual steady state level. Yet data on physical capital is quite unreliable due to arbitrary assumptions on depreciation and approximation on both initial values and investment flows that need to be made for its calculation. This problem can yield serious biases in the estimations, especially when the data set includes developing economies. Thus, we assume that higher levels of y_{t-1} and h_t reflect a greater stock of physical capital. As a result, an equiproportionate increase in y_{t-1} and h_t reduces growth in the basic specification, since the accumulation of reproducible factors inherently yields diminishing returns. Human capital is approximated using average years of schooling (SCHOOLY). A further dimension of human capital is health, as measured by life expectancy at birth (LIFEEX). Health increases productivity since healthier people can work longer and harder. Yet whereas life expectancies reflect better health, increasing rates of life expectancy simultaneously lead to an increase in effective depreciation. In order to disentangle these two effects, we also include the logarithmic value of the fertility rate (FERT) in the empirical system. By this means, we capture the negative growth effect of an increase in the population, as the standard growth model predicts an increase in the effective depreciation rate if fertility rates are higher, thereby reducing the steady state level of income. The second part of the Solow model‘s central equation is captured by the investment share (INVS). In order to isolate the effect of investment on growth rather than the reverse, we include the lagged value of the investment share in the list of instruments. As poorer countries tend to have lower investment shares, it is crucial to sort out the direction of causation between INVS and the growth rate. A number of empirical studies, such as Alesina and Perotti (1996) and Alesina et al. (1996) stress the importance of political stability in the growth process. Especially when inequality is high, it can be expected that stability decreases; this, however, emanates harmful effects on investments and growth. Likewise, contractual freedom, individual liberty, property rights and the duty to take reliability for own actions assume direct effect on well-being, aside from the inequality growth nexus. To capture the effect of political stability, we include the variable POLRIGHTS which gives the extent of political liberty in a country.

Our analysis will also include government consumption (GOVC) which decreases the steady state level of output per effective worker. This is because many consumption expenditures of the government do not increase productivity, but are instead likely to cause distortions in the private sector. Finally, we account for the extent of foreign trade relations by incorporating the degree of openness (OPEN) as well as the terms of trade (TOTR) into the system. Endogenous growth theory emphasizes the role of technological spillovers in the growth process. Spillovers and technological diffusion increase the potential of improvements and vertical innovations, and enhance the level of knowledge of an economy. In addition, trade directly enhances the cardinality of the set of capital goods available to be utilized in the production. These mechanisms are the main trigger of growth in the seminal endogenous models of Romer (1990), Aghion and Howitt (1992), and Grossman and Helpman (1991). In adition, improvements in the terms of trade gauged by the ratio of export prices to import prices are assumed to increase the real income of countries and thus leads to a rise in domestic consumption. Furthermore, Diewart and Morrison (1986) note that improvements in terms of trade may further have direct effects on GDP that resemble technological progress, as such gains facilitate net output increases for any given amount of domestic input factors. Furthermore, we include the inflation rate INFL in the empirical model as a proxy of economic uncertainty. In combination with POLRIGHTS, the inflation rate captures the effect of political instability.

Controlling for the variables described above, we wish to examine whether inequality as measured by the Gini coefficient (GINI) and the amount of redistribution (REDIST) affect the growth rate of per capita incomes. Such an investigation long has been strongly restricted by data availability, as data concerning the Gini coefficient, and more importantly the amount of redistribution has been on hand for only few countries and time periods. Yet the Solt (2009) standardization of the WIID database dramatically increases the number of degrees of freedom in empirical growth regressions that consider inequality, thereby enabling the utilization of more elaborate estimation techniques.

We estimate the empirical model using the estimator proposed by Blundell and Bond (1998). When working with macroeconomic panel data, unobserved heterogeneity often turns out to be a serious problems. A simple way to overcome these problem would be a one-way fixed effects model or a first difference approach such as Anderson and Hsiao (1982). Yet, while the former most often suffers from a Nickell (1981) bias, the latter still has its drawbacks in not exploiting all possible information available in the sample. Particularly, the first-difference transform magnifies gaps in unbalanced panels. Thus, GMM may yield more efficient estimates. One widely-used approach in the GMM context is the estimator proposed by Arellano and Bond (1991). A potential weakness of this estimator is that lagged levels are often poor instruments for first-differenced variables. The modifications of Arellano and Bover (1995) and Blundell and Bond (1998) therefore includes lagged levels as well as lagged differences. This estimator is often called the "System-GMM estimator". Blundell and Bond (1998) and Blundell et al. (2000) provide Monte Carlo evidence that System-GMM is more robust than other dynamic panel data approaches in the presence of highly persistent series. One concern that is inherent to all GMM estimators used in growth regressions is the fact that GMM only is advantageous for large N and small T. Yet, restricted data availability may lead to an insufficiently large number of cross-sections. Soto (2009) analyses through Monte Carlo Simulations the performance of several standard panel estimators if N is small ($N = 100, 50, 35$). The study concludes that the System-GMM estimator yields the result with the lowest bias, declaring it to date as the most appropriate method to investigate empirical growth patterns in the class of the standard dynamic panel data estimators.

Our estimation strategy uses 5-year averages of the variables described above. This approach is determined by the long-term perspective of growth regressions, the need to smooth short-term fluctuations, and the availability of data. Estimating the origins of economic growth using annual panel data would lead to severe biases and contradict the implications of growth theory. In order to study whether other approaches yield different results, we contrast our baseline findings to the outcome of Simultaneous Equation Models utilizing 3SLS and GMM with HAC standard errors. The former equals the Barro (2000, 2003, 2013) approach.

A basic dynamic OLS model of the data described above would be

$$y_{it} = \theta y_{it-1} + \lambda h_{it} + \gamma \Psi_{it} + \delta R_{it} + \beta \mathbf{X}_{it} + \eta_i + \xi_t + v_{it} \tag{1}$$

where y_{it} is the log of initial per capita GDP in i at 5-year period t, h_{it} is human capital endowment, η_i denotes country-specific effects, ξ_t is a time effect of period t, and $v_{it} \equiv u_{it} - \xi_t - \eta_i$ is the error term of the estimation. Neglecting unobservable heterogeneity of the cross-section and period-specific effects, the error term would simply be u_{it}, where we would expect inconsistency and endogeneity. The marginal effects of our variables of interest—inequality and redistribution—are captured in the coefficients γ and δ. The control variables are included in $\mathbf{X}_{it}$ where β comprises the marginal effects.

To account for both a possible omitted variables bias due to unobserved heterogeneity, and endogeneity, one could apply the Arellano-Bond approach, as has been done in empirical growth regressions by, inter alia, Forbes (2000) and Panizza (2002). Define for reasons of lucidity $\Delta k \equiv (k_{it} - k_{it-1})$ and $\Delta_2 k \equiv (k_{it-1} - k_{it-2})$, the basic idea of this approach is to adjust (1) to

$$\Delta y = \theta \Delta_2 y + \lambda \Delta h + \gamma \Delta \Psi + \delta \Delta R + \beta \Delta X + \Delta \xi + \Delta v \tag{2}$$

and then using sufficiently lagged values of y_{it}, h_{it}, Ψ_{it}, R_{it}, and $\mathbf{X}_{it}$ as instruments for the first-differences. However, as any fixed-effects attempt, this approach discards much of the information in the data. In fact, it has been emphasized by a number of studies, such as Barro (2000), Dollar and Kraay (2002), and Voitchovsky (2005) that inequality time series are highly persistent. Thus, most of the variation in the data stems from cross-sectional information. The Blundell-Bond estimator ensures that some of the information in the equation in levels can be retained. We mentioned previously the superior properties of System-GMM. As it is of great importance to exploit the remaining information as efficiently as possible, the Blundell-Bond estimator reduces the relatively high cost of controlling for unobservable heterogeneity, thereby providing less biased and more precise estimates than Arellano-Bond.

To give a brief overview of the idea behind System-GMM, the estimator is computed using moment conditions for equation (2) applying suitably lagged values as instruments and additional moment conditions for the level equation in (1), utilizing lagged values of Δk and $\Delta_2 k$ as instruments. It is obvious that such an approach requires the condition that $\text{Cov}(\Delta k, \eta_i) = \text{Cov}(\Delta_2 k, \eta_i) = 0$. A more elaborate description of the estimator especially in the context of the empirical application can be found in Bond et al. (2001) and Roodman (2009).

One further issue researchers are confronted with when estimating the empirical determinants of growth patterns is the sorting out of the direction of causation. In a perfect econometric world, the effect of governmental and individual behavior is isolatable and the causality runs from the regressors to the dependent variable. In practice, however, economic behavior of both institutions and households reflect reactions to economic events. If the system model is incomplete, then it most likely does not hold that the covariates are uncorrelated with the error term, i.e. $\text{Cov}(\mathbf{u}, \mathbf{X}) \neq 0$. In such an event, endogeneity yields inconsistent estimates of the coefficients. The application of lagged instrumental variables, the consideration of unobserved heterogeneity, and the allowance of both heteroskedasticy and autocorrelation within country errors helps to reduce these problems to a minimum when applying Blundell and Bond (1998).

3.2 Data description

Our main explanatory variables are the Gini coefficient, which pictures overall personal income inequality in each country, and the amount of redistribution. Since the theoretical channels described previously are mostly related to the distribution of disposable income, we focus on the Gini of income net of taxes and transfers in the baseline regression and later turn to the effect of market inequality. We receive both variables from the Standardized World Income Inequality Database (SWIID) generated by Solt (2009). The SWIID is based on the UN World Income Inequality Database (WIID), which is the successor of the Deininger and Squire (1996) data set. Both the WIID and the Deininger and Squire databases have been applied in a number of studies, as both data sets at their time represented the most extensive collection of cross-country inequality data. Even so, panel data analyses have long been strongly restricted due to the limited availability of data across countries and over time. In addition, the original data lacks easy cross country and intertemporal comparability. Atkinson and Brandolini (2001) provide an intense discussion of this issue. The standardization of Solt (2009) tries to solve this problem while still offering the widest possible data coverage. Indeed, the data provided by SWIID—especially since their last update on September 2013—allows to evaluate the impact of inequality on growth much more profoundly than most of the recent studies that often have to struggle with a low number of degrees of freedom. The approach of Solt (2009) transforms and adjusts the WIID in several steps, which are summarized in appendix A1.

Our standard redistribution variable is calculated as the difference between the market Gini and the net Gini, whenever both are available in the SWIID. While we thus receive a large sample of worldwide data, the resulting measure of redistribution has to be interpreted with caution. Some of the data reflects only estimates stemming from other countries and may thus insufficiently reflect information about public redistribution.[11] Fortunately, from version 3.0 onwards, the SWIID reports a subsample of more reliable redistribution data. This redistribution variable is solely based on observations for which survey data on net and gross incomes is available. The utilization of this measure ensures that redistribution is not solely appraised using gross or net Ginis that were, themselves, calculated via some estimate for redistribution. Furthermore, this variable strikes out the least reliable observations coming from developing countries before 1985 and advanced economies before 1975. In order to distinguish between the two measures in the empirical investigations, we denote the full-sample of redistribution with REDIST, whereas the subsample of more convincing data is named REDIST(S). As a matter of fact, when utilizing these variables, there is always a trade-off between accuracy in the estimation due to a large number of degrees of freedom, and accuracy in the measurement of redistribution.

The measurement of redistribution as the difference between market and net inequality is fairly new in the empirical growth literature but common in the sociological and public

[11] Solt writes on his homepage: *"Observations for redistribution are omitted for countries for which the source data do not include multiple observations of either net or gross income inequality: in such cases, although the two inequality series each still constitute the most comparable available estimates, the difference between them reflects only information from other countries, and treating it as meaningful independent information about redistribution would be unwise. Similarly, because the underlying data is often thin in the early years included in the SWIID, redistribution is only reported after 1975 for most of the advanced countries and only after 1985 for most countries in the developing world."*

policy literature, where it is often named the pre-post approach.[12] It covers the effective redistribution through taxes and transfers, whereby several studies indicate that on average most of the redistribution is achieved by transfers.[13] However, redistribution via the in-kind provision of public goods is not included, since it is not captured in the net Gini provided in the SWIID. Like most inequality databases, the SWIID is based on surveys covering household disposable income, not adjusted for the individual consumption of public good. Furthermore, the pre-post approach does not cover public attempts to equalize market inequality, neither by the promotion of equal opportunities nor by the interference of the government in private wage agreements.

The pre-post approach comes with some further drawbacks, discussed in Bergh (2005). One major problem is that market inequality is not independent from the extent of public redistribution: On the lower end of the income scale, a generous welfare system may boost gross inequality by encouraging poor people to withdraw from the labor market and to live from transfers instead of market income. On the upper end, high income earners may be discouraged by taxes and thus reduce their labor supply, which equalizes gross inequality. In this paper, we follow Berg et al. (2014) who suggest that the effects on gross inequality can be neglected as the effects on the lower and on the upper scale of the income distribution are offsetting.

Whereas the pre-post approach measures the difference between the Gini coefficient of income inequality before and after taxes, the more narrow redistribution variable REDIST(S) proposed by Solt (2009) quantifies the estimated percentage reduction in market income inequality due to taxes and transfers, which is defined as

$$\frac{\mathrm{GINI(M)} - \mathrm{GINI(N)}}{\mathrm{GINI(M)}} * 100.$$

We calculate this data back in percentage point differences between net and market Ginis in order to facilitate the interpretation and the comparability to the results based on REDIST.

How is redistribution distributed across the countries available in the SWIID? Figure 1 illustrates the histogram of the variable using 5-year averages as in our empirical specification. The mean value of redistribution in the sample is 4.92, indicating that on average slightly less than 5 percentage points of the Gini coefficient are redistributed. Yet the variation around the mean is high as the standard deviation assumes a value of 5.51. The most expansive social system redistributes 35.89, while some policies yield increases in inequality (minimum value: -21.37). The Jarque-Bera test rejects the assumption of a normal distribution. The distribution further is right-skewed (skewness: 0.93), illustrating that in most

[12] Van den Bosch, Karel and Cantillon (2008) provide an overview on the role of the pre-post approach in measuring the redistributive impact of taxes and transfers in public policy research. Berg et al. (2014) and Thewissen (2013) are to our knowledge the only studies so far which apply pre-post redistribution as an explanatory variable in growth regressions.

[13] See e.g. Joumard, Isabelle and Pisu, Mauro and Bloch, Debbie (2012) and Woo et al. (2013). The latter also provide a comprehensive survey on the redistributive impacts of fiscal policy.

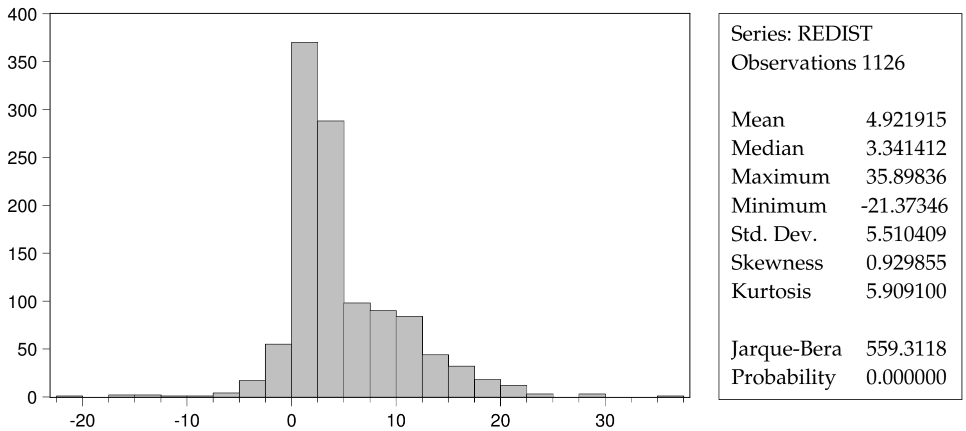

Figure 1 The distribution of the amount of redistribution across countries and over time, REDIST

economies, redistribution policies lead to a decrease of inequality.

When exploring the amount of redistribution, one can suspect that there are significant differences between countries in different stages of development. This is indeed the case. Using the classification of the World Bank, the mean value of redistribution in the sample of high-income countries is 5.32 percentage points and substantially exceeds the mean redistribution in low-income countries (3.54). The higher developed an economy, the higher is the average value of redistribution. The data also indicate major differences in distribution policies across different political systems: In democracies, the mean value of redistribution equals 6.15, whereas non-democratic forms of government tend to significantly redistribute less (2.81).

The picture changes slightly when only considering REDIST(S) as illustrated in figure 2. Both the mean and the median increase, indicating that the countries for which measures of REDIST(S) are available on average tend to redistribute more. Yet, the number of available observation reduces from 1,126 in REDIST to only 517 when considering REDIST(S). Furthermore, it is remarkable that the relative frequency of a high amount of redistribution is substantially higher than in REDIST. At the same time, there are only few observations where redistributive activities yield negative effects on the Gini coefficient. Most of the differences towards the full sample arise from the larger share of developed economies in the restricted sample.

The rest of the data that concerns our dependent and control variables stems from commonly used data sets. The growth rate of real per capita GDP as well as the initial level of GDP, the investment share (INV), the degree of openness (OPEN), and government consumption (GOVC) are from PWT 8.0 as published by Feenstra et al. (2013). The average years of schooling (SCHOOLY) is from Barro and Lee (2013) and includes the years

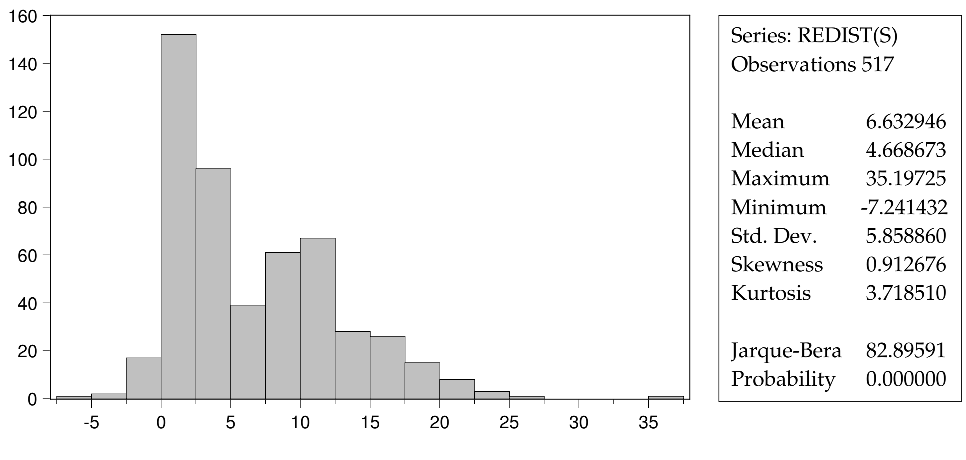

Figure 2 The distribution of the amount of redistribution across countries and over time, REDIST(S)

of primary, secondary, and tertiary education that individuals of age 25 and older have received during their educational training. Democracy and political liberty (POLRIGHT) enters in the specification using data on political rights and liberty from Freedom House (2014), which provides an index on democracy and rule of law where the data is $d \in (1, 7)$. As the variable is coded inversely, i.e. lower numbers are associated with higher rates of democracy, we recode the variable applying POLRIGHT $= 8 - d$ in order to make sure that the coefficient in the estimation illustrates the impact of an increase in democracy on growth, rather than the reverse. The advantage of Freedom House (2014) is the large number of available data in both time and cross-section, while the application of comparable indices such as Jodice and Taylor (1983), Gupta (1990), Alesina and Perotti (1996), World Bank (2013), and Vanhanen (2000) leads to a significant reduction of observations, especially in the time dimension. We further use fertility rates (FERT), changes in the terms of trade (TOTR), inflation rates (INFL) and data on life expectancy at birth (LIFEEX) as reported by World Bank (2014).

Table 1 provides an overview of the data used in our empirical specification, their means, maxima, minima, and standard deviations. Note that due to some periods of hyperinflation that can be detected in the sample, the mean value of INFL is relatively high (6.67). The high inflation observations took place in the 1990-1995 period in Congo and Georgia, and during the 1985-1990 period in Bolivia. Further observations include Armenia, Angola, Brazil, and Peru, although to a lesser extent. Most of these data points will not enter in the regression, as the intersections of data availability of the regressors do not include the critical observations in most cases.

One crucial point that has to be noted when examining the influence of inequality and

Table 1 Descriptive statistics of variables used in the regression

Variable	N	Mean	Std. Dev.	Min	Max
GROWTH	1624	0.0218823	0.040689	-0.302555	0.3210244
log(CGDP)	1626	8.387529	1.30292	5.317263	11.80222
GINI(N)	1126	0.3890027	0.1114037	0.1605069	0.7643369
GINI(M)	1126	0.4393836	0.0946583	0.185827	0.7561138
REDIST	1126	0.0503809	0.0559007	-0.2137346	0.3589836
REDIST(S)	517	16.77721	13.68035	-12.83622	50.61449
INVS	1626	0.2064493	0.111355	-0.0131223	1.684564
SCHOOLY	1584	5.900455	3.063374	0.04	13.09
log(LIFEEX)	2027	4.126937	0.1997474	3.080882	4.42237
GOVC	1626	0.2050443	0.1180274	-0.0240873	0.9337125
INFL	1656	0.361469	2.624121	-0.0662845	69.62831
OPEN	1822	0.7599636	0.4862227	0.0198891	4.378075
POLRIGHT	1624	4.083528	2.194809	1	8
log(FERT)	2029	1.2833	0.5502135	-0.1369659	2.21336
TOTR	771	0.0700488	0.2676975	-0.6612992	0.9457714

redistribution on growth is that these variables cannot be analyzed in isolation. Instead, the effects of the controls and the inequality variables are strongly interwoven and need to be disentangled empirically, particularly as theory suggests that inequality does not directly affect growth but assumes its influence through various transmission variables which often are components of standard growth models. Indeed, there are some crucial correlations between the covariates and the variables of interest, GINI(N), GINI(M) and REDIST. Table A2 in the appendix depicts the correlation matrix of the data used in the regression.

As it turns out, the Gini coefficient net of taxes and transfers is correlated with a number of variables used in the regression. Particularly the correlation with the fertility rate (65 percent), the average years of schooling (-58 percent) and the amount of redistribution (-60 percent) is high. The latter is obvious, as stronger redistribution policies directly lead to a decline in inequality. Likewise, the higher the average human capital endowment of individuals in a society, the lesser is the inequality of incomes. One interpretation of this correlation concerns returns to education that may be lower in economies where the average human capital level is higher, leading to a reduction in wage inequality. Indeed, Psacharopoulus (1994) provides evidence that Mincerian returns to education decline when average years of schooling increase. Furthermore, Barro (2000) and Perotti (1996) report that greater inequality predicts significantly higher fertility rates. De la Croix and Doepke (2003) argue that poor families —especially in unequal societies—tend to have a higher fertility rate, so that education often cannot be provided to all of the children, thereby leading to a decline in average school attainment.

The correlation matrix suggests that the latter channel indeed may be important, as high fertility rates are associated with a lower number of average years of schooling (-64 percent). If high fertility rates decrease social mobility via the education channel, then fertility and inequality are positively correlated in the long-run.

A further relationship concerns the dependence of the investment share and the level of inequality. A variety of theoretical channels—such as credit-market imperfections and sociopolitical unrest–suggest that these variables should be negatively related. In fact, the data exposes a negative correlation of -19 percent. However, the correlation significantly increases when taking into account economies with less developed credit markets. In addition, the correlation between life expectancy and inequality is strongly pronounced (-45 percent), suggesting that higher rates of inequality lead to a decrease in life expectancy, as the poor in strongly unequal countries do not have sufficient access to the health system, live in poor hygienic conditions, or are undernourished. This may create a poverty trap, where a lower health status on its part further enhances inequality.

The second focus of this paper is on the relation between inequality of market incomes, redistribution and the resulting net inequality. It is therefore worthwhile to have a look at the simple correlation between these variables before we use them as explanatory variables in our growth regressions. Figure 3 pictures the level of net inequality compared to market inequality in all countries for which reliable data is available in the 2005 to 2009 period. It turns out that countries that are more unequal before redistribution are also more unequal afterwards. Yet, the positive relationship that is obvious in the scatterplot is far from a perfect correlation. Many observations are located considerably below a 45-degree line, indicating a substantial amount of redistribution in several economies.[14]

Table 2 Regressions of REDIST(S) on market inequality

	(1) POLS	(2) Fixed Effects
GINI(M)	0.135*	0.422***
	[0.0712]	[0.0654]
log(CGDP)	0.0364***	-0.00369
	[0.00475]	[0.00901]
Constant	-0.323***	-0.0771
	[0.0541]	[0.0671]
N	477	477
R squared	0.366	0.407

Notes: The table reports regressions of REDIST(S) on GINI(M) using Pooled OLS (column 1) and Fixed Effects (Column 2). Standard deviation is reported in brackets.

According to the Meltzer-Richard effect, higher market inequality should lead to more public redistribution. However, strong deviations from a positive relationship can be detected in Figure 4, which shows public redistribution at different levels of market inequality.

[14] When we split the data into advanced and developing economies according to the threshold of 12,746 USD defined by the World Bank, we find that the correlation is 97 percent in the developing sample. In the group of advanced economies the correlation is much weaker (54 percent), but still highly significant.

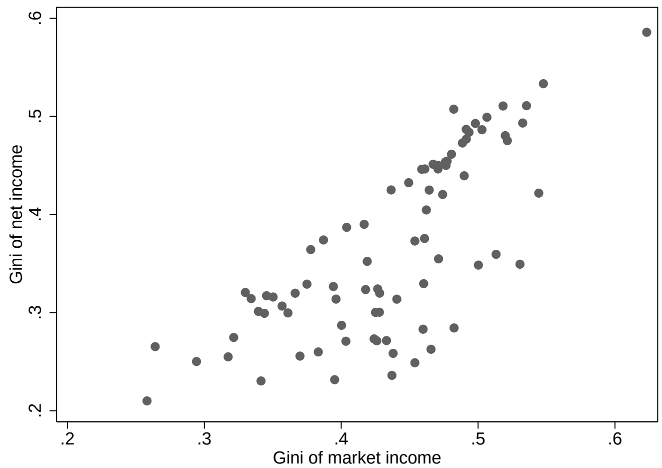

Figure 3 The relationship between Gini of net income (GINI(N)) and Gini of market income (GINI(M))

Notes: The figure plots observations for each country within the 2005-2009 period. Data is from the restricted sample

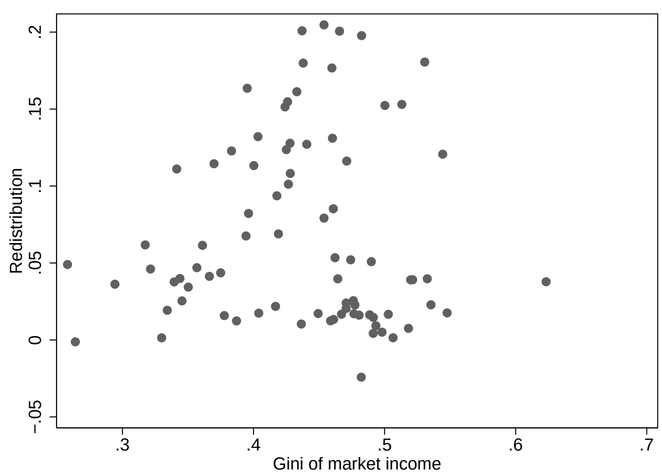

Figure 4 The relationship between the level of redistribution (REDIST(S)) and Gini of market income (GINI(M))

Notes: The figure plots observations for each country within the 2005-2009 period. Data is from the restricted sample

Among the pictured observations a group of developing and newly developed countries is standing out due to high levels of market inequality but low redistribution. One major outlier is South Africa which has a Gini coefficient of market incomes of 63 percent, but redistribution is much less pronounced (4 percentage points). Likewise, the data shows that a number of developing economies tends to significantly redistribute less than advanced economies. It is therefore necessary to hold constant the developing level when examining the relationship between GINI(M) and REDIST(S). Table 2 is concerned with this investigation, where a basic model is used to explain the level of redistribution. The results reveal substantial differences in redistribution activity across different developing levels in the POLS estimation. When analyzing the influence of development using the Fixed-Effects estimator, this influence vanishes. This may be traced back to the elimination of unobservable heterogeneity. In both models, a higher level of market inequality leads to an increase in REDIST(S).

A final relationship of interest concerns the correlation between redistribution and government consumption. Several earlier empirical studies, for instance Barro (2000, 2003, 2013), found a significant negative relationship between government consumption and economic growth. Since redistributive expenditures like social transfers are classified as government consumption, one could expect a close correlation between redistribution and government consumption variables and thus anticipate a negative growth effect of redistribution. Yet the correlation between REDIST and GOVC is surprisingly small in our sample. The correlation coefficient of 6 percent shows that a great amount of government expenditures is far from being redistributive. Alternatively, a large part of redistribution could emerge via the progressivity of taxes and transfers which is not necessarily related to the size of government expenditures. Our following examination of the relationship between growth and effective redistribution is thus definitely worth the effort.

4 Regression results

4.1 Baseline regressions

Table 3 shows the results of our linear baseline growth estimations, when the full sample of available data from the SWIID is used. Our full regression sample covers a maximum of 962 observations from 152 countries over a time span of 52 years, between 1960 and 2012.

The first Column shows a very basic specification in which—aside from time dummies and country fixed-effects—the lagged level of per capita income is the only control variable. As mentioned previously, theory does not suggest a direct effect of inequality on growth, but rather proposes several transmission channels by which inequality affects growth. This channels include standard growth determinants like the accumulation of physical and human capital, fertility rates, and political stability. Ignoring some of the usual controls is thus the only way of seizing the full growth effect of income inequality, although it comes with the risk of an omitted variable bias. Column 1 shows the results of this stripped down estimation. Indeed, the point estimate of the net Gini is similar to the baseline result from Berg et al. (2014). It is highly significant and suggests that an increase of the Gini by one percentage point would lower the yearly GDP growth rate by roughly 0.17 percentage points on average. Notably and in contrast to Berg et al. (2014), the coefficient of redistribution is negative but insignificant.

Table 3 Baseline regressions, full sample, redistribution variable is REDIST

	(1)	(2)	(3)	(4)	(5)
log(CGDP)	-0.00241	-0.0150***	-0.0203***	-0.0219***	-0.0227***
	[0.00476]	[0.00409]	[0.00417]	[0.00482]	[0.00543]
GINI(N)	-0.168***	-0.0672***	-0.0543***	-0.00793	-0.00775
	[0.0487]	[0.0250]	[0.0206]	[0.0216]	[0.0379]
REDIST	-0.146	-0.0737	0.00962	0.0230	0.0128
	[0.0915]	[0.0565]	[0.0343]	[0.0421]	[0.0476]
INVS		0.137***	0.0873***	0.0700***	0.0352
		[0.0244]	[0.0274]	[0.0248]	[0.0326]
SCHOOLY		0.00719***	0.00274*	0.000775	0.00299
		[0.00187]	[0.00155]	[0.00157]	[0.00219]
log(LIFEEX)			0.0893***	0.0515**	0.0491**
			[0.0173]	[0.0245]	[0.0211]
GOVC			-0.0445*	-0.0516**	-0.0592**
			[0.0237]	[0.0223]	[0.0298]
INFL			-0.000420	0.000108	-0.0000930
			[0.000485]	[0.000440]	[0.000777]
OPEN			0.00728	0.00812*	0.00646
			[0.00481]	[0.00491]	[0.00494]
POLRIGHT			-0.00146	-0.00238	-0.00376*
			[0.00164]	[0.00157]	[0.00207]
log(FERT)				-0.0363***	-0.0302***
				[0.00751]	[0.00966]
TOTR					-0.000283
					[0.00820]
N	962	867	745	745	385
Countries	152	126	125	125	120
Hansen	0.0168	0.307	1	1	0.985
AR1	0.00000546	0.0000157	0.0000759	0.0000810	0.0133
AR2	0.831	0.838	0.893	0.972	0.863
Instruments	88	114	184	209	134

Notes: The table reports Blundell-Bond estimations. Standard deviation is reported in brackets. Hansen gives the J-test for overidentifying restrictions, AR1 and AR2 report the results of the AR(n) test. Instruments illustrates the number of instruments utilized in the regression.

In Column 2 the investment share and average years of school attainment are introduced into our model. Both variables are essential components of empirical growth models but also part of the transmission process according to the theories of unequal opportunities and credit-market imperfections, sociopolitical unrest, and Keynesian saving rates. Thus one would expect a lower impact of the Gini in this model. Indeed, the estimator of the Gini shrinks to -0.067, which is less than half of Column 1, although it remains significant at the 1 percent level.[15] The newly introduced controls are both positive and highly significant, which is in line with theory and previous empirical studies.

The estimator of the Gini shrinks only slightly, when we introduce a number of additional controls in Column 3. While the log of life expectancy—our health variable—is positively related to economic growth, government consumption seems to stand in a negative relationship. Inflation, the simple openness ratio and political rights are insignificant in our sample.

In Column 4 we incorporate the fertility rate into the model. Fertility and population growth determine the capital-labor ratio and thus the steady-state output in the neoclassical growth model. Furthermore, raising many children may either detract resources away from the production of goods (see Becker and Barro (1988)), or force children into work and thereby deter school attainment and human capital investments.[16] Thus it is not surprising that the coefficient on the log of the fertility rate is negative and highly significant. In addition, the theoretical models mentioned previously propose that fertility is endogenous to income inequality. Indeed, the estimator of the Gini becomes completely insignificant when fertility is held constant in Column 4, which is in line with Barro (2000). As our sample composition does not change from Regression 3 to Regression 4, the disappearance of the Gini effect could be evidence for the endogenous fertility channel. However, one also has to be aware of reverse causality: If inequality is more the result than the source of fertility, our preceding estimations of the Gini may be biased. We examine this issue more in detail when we regress fertility on inequality in section 4.4.

When we finally add the growth rate of the terms of trade to our model (Column 5), the coefficient of the Gini remains virtually unchanged. Yet, our sample shrinks considerably to only 385 observations, which is most likely the reason why many of our control variables are losing significance. Due to the risk of sample selection bias and the absence of any strong relationship between inequality and the terms of trade, neither from theory nor from the correlations in our sample, the terms of trade variable will be spared out in all further regressions.[17]

Until now, we have focused on the Gini but devoted only little attention to redistribution, which seems to be insignificant in every specification so far. In fact, regarding the direct effects of redistribution we recommend to interpret the results given in Table 3 cautiously. While the maximum number of available observations is utilized here, redistribution may be measured imprecisely in certain cases. In Table 4, we thus apply REDIST(S); which is the

[15] By controlling for investment and schooling successively and separately, we find that both variables have a similar effect on the estimator of the Gini.

[16] The latter effect is controlled for by our variable of average schooling.

[17] It shall be noted that the results reported subsequently do not change considerably when incorporating TOTR. Yet, neglecting TOTR enables the exploration on the basis of a significantly higher number of degrees of freedom.

Table 4 Baseline regressions, full sample, redistribution variable is REDIST(S)

	(1)	(2)	(3)	(4)	(5)
GINI(N)	-0.209***	-0.0537	-0.0467	-0.0186	0.000230
	[0.0479]	[0.0414]	[0.0413]	[0.0350]	[0.0377]
REDIST(S)	-0.104	-0.0468	0.0628	0.0197	0.0727*
	[0.0891]	[0.0769]	[0.0588]	[0.0674]	[0.0413]
N	477	454	411	411	234
Countries	80	74	73	73	72
Hansen	0.211	0.778	1	1	1
AR1	0.000163	0.0000779	0.0000711	0.0000243	0.00258
AR2	0.678	0.781	0.179	0.123	0.115
Instruments	69	91	157	179	134

Notes: The table reports Blundell-Bond estimations. Standard deviation is reported in brackets. Hansen gives the J-test for overidentifying restrictions, AR1 and AR2 report the results of the AR(n) test. Instruments illustrates the number of instruments utilized in the regression.

alternative redistribution variable directly reported in the SWIID. As it is measured much more accurately, it is recommended by the authors of SWIID when the focus lies specifically on redistribution. Aside from the redistribution variable, the rest of the specification in each column exactly follows the specifications shown in the same column in Table 3. However, our regression sample now shrinks to a maximum of 477 observations from 80 countries, inducing the risk of a some sample selection bias which may stem from the smaller share of poor economies in the restricted sample.

In the restricted sample, the coefficient of redistribution is always insignificant and changes its sign from negative to positive when government consumption is held constant in Column 3. The estimated impact of the Gini coefficient is stronger than in table 3, at least in the very basic model. Even more than in the full sample, it becomes obvious how inequality assumes its influence via its transmission channels: When investment and schooling are controlled for in Column 2, the estimator of Gini shrinks by almost three quarters from -0.21 to -0.054 and loses significance. In Column 4—when the fertility rate is incorporated as an additional covariate—it virtually disappears. The latter strongly resembles the result from the full sample estimations.

What have we learned about the relationship between inequality, redistribution and growth so far? As in many previous studies, our results suggest that an equable distribution of income is on average beneficial for growth. However, we emphasize the transmission channels by which inequality affects growth. If these channels are held constant, the correlation between inequality and growth gradually disappears. Regarding the effects of redistribution, we do not find evidence for the equity efficiency trade off so far. Considering the baseline model illustrated in Column 1 of Table 4, the results impliy that a government which choses to equalize the income distribution by one percentage point may lower growth by roughly 0.1 percentage points via the direct effects of taxes and transfers. On the other hand growth may on average be improved by 0.2 percentage points due to the resulting reduction in net inequality. So far, the net effect of redistribution seems to be positive. However, a premature conclusion of the redistributive effect may be naive, especially in the light of the transmission channels illustrated in the theoretical section. We will thus examine the overall effects of redistribution and the channels though wich this effect is assumed more in detail in the subsequent sections.

4.2 Sensitivity analysis of the baseline results

We are convinced that our estimation technique is the most promising approach to analyze the effect of redistribution on economic growth as it best fits the data and encompasses most of the econometric issues that emerge in empirical growth regressions. Yet it is essential to analyze whether the results are due to an underlying economic rule or to the estimation approach itself. For this reason, we want to investigate the stability of the results when altering the applied estimator.

One technique often utilized in empirical growth explorations is the estimation of simultaneous equation models (SEM). This approach has been applied by, inter alia, Barro (2003, 2013) and Berthold and Gründler (2015). The general idea is to model each 5-year average period as a separate equation and then estimate the coefficients using optimal GMM, and—to ensure comparability to Barro (2003, 2013)—3SLS. The advantage of this approach is that it eliminates endogeneity that is caused by simultaneity, as can be expected in empirical growth patterns.

Table 5 illustrates the results of the SEM regressions. The findings remarkably resemble the Blundell-Bond outcomes. Our main focus is on the effects of inequality and redistribution, both remaining unaltered in the SEM specification. The Gini coefficient net of taxes and transfers is negatively associated with economic growth, whereas redistribution does not significantly influence income increases in neither direction. This result emerges regardless of the applied estimator, suggesting a high stability of the baseline findings. Furthermore, there is only one major deviation in the covariates: The political rights index in the SEM specification indicates that democracy contributes negatively to economic growth. However, it must be emphasized that we already hold constant some crucial channels through which democracy assumes its influence on income increases, particularly a higher average level of schooling and health (both correlations are close to 60 percent), and higher investment shares (correlation: 30 percent). As POLRIGHT is strongly associated with the level of development, it may capture to some extent the effect of convergence, thereby contributing to a negative influence on growth. Aside from POLRIGHT, all the variables have the expected sign.

Table 5 Sensitivity analysis of the results

	(1) GMM	(2) 3SLS
log(CGDP)	-0.0124***	-0.0121***
	[0.000802]	[0.00173]
GINI(N)	-0.0273***	-0.0275*
	[0.0071]	[0.0153]
REDIST	-0.00912	-0.015
	[0.0112]	[0.0304]
INVS	0.028741***	0.025495
	[0.006994]	[0.016626]
SCHOOLY	0.0783**	0.0753
	[0.031]	[0.0665]
LIFEEX	0.00161	-0.00316
	[0.0098]	[0.0215]
GOVC	-0.7903	-0.619
	[0.7605]	[1.4427]
INFL	-0.00115**	-0.00184
	[0.000527]	[0.00177]
OPEN	0.4491***	0.3054
	[0.1298]	[0.2355]
POLRIGHT	-0.2172***	-0.2226*
	[0.046]	[0.0828]
log(FERT)	-2.3949***	-2.4813***
	[0.2196]	[0.4537]
N	644	644
Countries	118	118
R Squared	.09, .29, .35, .02, .15, .33, .23 .09	.09, .30, .37, .02, .10, .33, .20, .11
S.E.	.026, .019, .022, .027, .029, .025, .027, .026	.026, .018, .021, .028, .021, .025, .027, .025
Hansen	0.324234	

Notes: The table reports 3SLS and GMM estimations with HAC standard errors. Standard deviation is reported in brackets. Hansen gives the J-test for overidentifying restrictions.

4.3 Overall effects of public redistribution at different levels of market inequality

In section 4.1 we illustrate the effects of redistribution when net inequality is held constant. As a consequence, the coefficient of redistribution can be interpreted as the intrinsic effect of redistributive taxes and transfers, while the effects of net inequality are observed separately. Based on these regressions we assess the overall effects of redistribution by comparing the coefficients of redistribution and the net Gini, which resembles the approach of Berg et al. (2014).

This section is concerned with an alternative view on the inequality growth nexus. Subsequently, we aim to directly examine the overall growth effects of public redistribution. By leaving net inequality open, the coefficient of redistribution explicitly comprehends both the *direct* incentive effect of redistributive taxes and transfers, and the *indirect* effect of the resulting net inequality. Gross Ginis, which are possibly effected further by some feedback effects of redistribution, can be held constant in this case, i.e. we are examining the overall effects of redistribution for a given level of market inequality [GINI(M)].[18] The results from this setting are given in Table 6. In contrast to our baseline specification, the coefficient of REDIST(S) now becomes significant and positive in the basic model given in Column 1, but also in most of the other specifications. The estimator picks up the insignificant effects of redistribution plus the significantly positive effect of a lower level of inequality, which we have already seized in previous estimations. For a given level of market inequality public redistribution seems to be beneficial for growth as long as all transmission channels of net inequality are left open. Market inequality, however, is also negatively correlated to economic growth. As no theory aside from the explanation arguing via redistribution explains a negative effect of market inequality itself, we assume that market inequality is still capturing parts of the effects of net inequality in these regressions. Despite of redistribution both market and net Ginis are still closely correlated in the overall sample, as we have shown in the data description of section 3.2.

In Column 2 the basic model is again augmented by the investment share and average school attainment. As two of its main transmission channels are incorporated, the coefficients of redistribution and market Gini shrink considerably and become insignificant. Thus the increase in the estimators of interest in the successive extended models is somewhat surprising. While both GINI(M) and REDIST(S) turn out to be significant in Column 3, the effect of redistribution remains significantly positive, even when we control for the fertility rate in Column 4. Thus, redistribution seems to be contribute to growth even when some crucial covariates—investments, schooling and fertility—remain unchanged. However, one has to bear in mind that the regression models given in Columns 3 and 4 control for government consumption. Government consumption is positively related to redistribution and exerts a negative effect on growth. An increase in redistribution usually goes along with rising government consumption, which is negative for growth and thus may offset the originally positive effect found in table 6. However, when government consumption remains constant, redistribution is growth enhancing, even when some of its transmission channels are held constant. An interpretation of this result is that redistribution is most growth friendly when it does not stem from the size of taxes and transfers (and thus the volume of government consumption) but rather from its progressiveness.

So far we know that inequality is on average detrimental for growth and that public redistribution in sum seems to be growth enhancing. Subsequently, we aim to explore whether the growth effect of redistribution depends on the initial level of market inequality. There is

[18] Ideally we would be examining the growth effects of market inequality, redistribution and net inequality all at once. However, this is of course not possible due to perfect multi-collinearity.

Table 6 Overall effects of redistribution

	(1)	(2)	(3)	(4)
log(CGDP)	-0.0191***	-0.0195***	-0.0308***	-0.0364***
	[0.00681]	[0.00434]	[0.00835]	[0.00768]
GINI(M)	-0.211***	-0.0468	-0.0612*	-0.0495
	[0.0494]	[0.0390]	[0.0358]	[0.0477]
REDIST(S)	0.144*	0.00714	0.113**	0.0996*
	[0.0853]	[0.0630]	[0.0530]	[0.0581]
INVS		0.173***	0.113***	0.0890***
		[0.0312]	[0.0308]	[0.0258]
SCHOOLY		0.00677***	0.00680***	0.00445**
		[0.00201]	[0.00212]	[0.00191]
log(LIFEEX)			0.0745	0.0720
			[0.0544]	[0.0479]
GOVC			-0.0994***	-0.117***
			[0.0259]	[0.0249]
INFL			-0.000370	-0.0000295
			[0.000894]	[0.000786]
OPEN			0.00789	0.00346
			[0.00643]	[0.00462]
POLRIGHT			-0.00107	-0.00126
			[0.00287]	[0.00161]
log(FERT)				-0.0405***
				[0.0101]
N 477	454	411	411	
Countries	80	74	73	73
Hansen	0.192	0.777	1	1
AR1	0.000166	0.0000798	0.0000627	0.0000228
AR2	0.717	0.748	0.222	0.182
Instruments	69	91	157	179

Notes: The table reports Blundell-Bond estimations. Standard deviation is reported in brackets. Hansen gives the J-test for overidentifying restrictions, AR1 and AR2 report the results of the AR(n) test. Instruments illustrates the number of instruments utilized in the regression.

reason to suspect that there may remain an undetected negative effect of redistribution, as suggested by the negative but insignificant sign of redistribution in the baseline regressions. If true, the negative effect of redistribution on incentives has to be be balanced with the positive effects of an equable income distribution; possibly arguing for more redistribution when market inequality is high and less when it is low. We test this *conditional* effect of redistribution by introducing an interaction term between redistribution and the market Gini into our model. The results given in Table 7 offer tentative evidence as the interaction term is positive and significant in the restricted models illustrated in Columns 1 and 2, while redistribution is now significantly negative. When calculating the marginal effects of redistribution based on the results of Column 1, we learn that redistribution acts negatively as long as the market Gini is lower than 43, which is its median value in our sample, but becomes positive afterwards. Given a market Gini of 37–which is the 25th percentile of our

Table 7 Interaction of redistribution with market Gini

	(1)	(2)	(3)	(4)
Log(CGDP)	-0.0108	-0.0137***	-0.0278***	-0.0301***
	[0.00785]	[0.00495]	[0.00674]	[0.00648]
GINI(M)	-0.275***	-0.116**	-0.122**	-0.0561
	[0.0514]	[0.0454]	[0.0563]	[0.0620]
REDIST(S)	-0.542*	-0.548**	-0.118	-0.100
	[0.314]	[0.269]	[0.205]	[0.185]
GINI(M)×REDIST(S)	1.275**	1.101**	0.493	0.364
	[0.513]	[0.476]	[0.415]	[0.379]
INVS		0.153***	0.113***	0.0925***
		[0.0301]	[0.0371]	[0.0255]
SCHOOLY		0.00598***	0.00564***	0.00355**
		[0.00200]	[0.00213]	[0.00166]
log(LIFEEX)			0.0732	0.0396
			[0.0551]	[0.0462]
GOVC			-0.0967***	-0.115***
			[0.0286]	[0.0246]
INFL			-0.000363	-0.000325
			[0.000955]	[0.000851]
OPEN			0.00219	0.00175
			[0.00693]	[0.00503]
POLRIGHT			-0.000900	-0.00134
			[0.00237]	[0.00148]
log(FERT)				-0.0429***
				[0.00985]
N	477	454	411	411
Countries	80	74	73	73
Hansen	0.591	0.976	1	1
AR1	0.000233	0.000185	0.000116	0.0000345
AR2	0.881	0.713	0.262	0.170
Instruments	86	108	196	196

Notes: The table reports Blundell-Bond estimations. Standard deviation is reported in brackets. Hansen gives the J-test for overidentifying restrictions, AR1 and AR2 report the results of the AR(n) test. Instruments illustrates the number of instruments utilized in the regression.

sample— equalizing the Gini by one percentage point would lower the growth rate by 0.07 percentage points. At a market Gini of 47—the 75th percentile—growth would on average be increased by 0.06 percentage points. The results of this more in-depth analysis is crucial for policy implications, as it suggest that the initial level of inequality assumes a significant impact on the direction of the influence of redistribution.

Before closing our study on the growth effects of redistribution we want to recall the potential feedback effects of redistribution on market inequality which we only briefly addressed in section 3. So far we have considered two options to study the impacts of redistribution: In the first option, when the net Gini is controlled for and the gross Gini is left open, redistribution features only the direct effects of taxes and transfers, but inherits feedback effects on gross inequality. In the second option redistribution explicitly comprehends its indirect effects via net inequality, but market inequality is held constant.

4.4 Empirical investigation of the transmission channels

The previous regressions suggest that inequality may be harmful for growth. However, as illustrated in the theoretical section, inequality assumes its influence via a number of transmission channels. Studying the underlying causes of the negative effect of inequality provides a more in-depth understanding of the relationship between the extent of inequality in societies and their level of income.

According to the theoretical literature reviewed previously, income inequality should be particularly detrimental to growth when credit is not available to equalize investment and education opportunities. Empirically, such a conditional effect can be detected by the introduction of an interaction term. Ideally, the Gini would be interacted with a moderator variable that directly measures the ease of financing profitable investments or education for poorer people. As such a variable is not available, we use the ratio of private credit to GDP (CREDIT) as a proxy.[19]

In the very basic model given in Column 1 of Table 8 both the Gini and its product with CREDIT are highly significant, individually and jointly. The coefficients imply that the marginal effect of the Gini is negative at low values of CREDIT but becomes positive at a credit to GDP ratio of roughly 0.8, which is located around the 80th percentile of our sample. Thus we find evidence for a negative growth effect of inequality in case of credit market imperfections. Moreover, inequality seems less severe in countries where financial markets are highly developed. According to these findings, we can assume that much of the negative influence of inequality on growth is due to forgone investments in human and physical capital. Especially highly productive investment opportunities may fall by the wayside. In countries where the possibilities of these investments are insufficient and where individuals at the bottom of the income distribution are hindered from exploiting their full intellectual and entrepreneurial potential, growth rates are lower. Unfortunately, we can only control for the quantity of both transmissions variables, but not for their average productivity, which should be primarily affected by inequality. This is one reason why the estimator of the interaction term becomes smaller, but still remains significant when we include the investment share and the average years of school attainment in Column 2.[20] Similarly to the baseline regressions, the Gini and its product with CREDIT only becomes insignificant if the fertility rate is held constant in Column 4. This is in line with theoretical models predicting that human capital investments are related to fertility decisions. If poorer families gain access to credit they may prefer to invest in human capital and to reduce fertility. By incorporating the fertility rate in the model, we effectively eliminate this transmission channel so that the effect of

[19] We instrument the credit ratio and the interaction term with its lagged values, as it is possibly endogenous to growth. The data source of CREDIT is World Bank (2014).

[20] A Wald test of the joint significance of Gini and the interaction term yields a p-value of 0.057.

Table 8 Interaction between the Gini coefficient, credit, and public spendings on education

	(1)	(2)	(3)	(4)	(5)	(6)
log(CGDP)	0.00176	-0.00579	-0.0147***	-0.0192***	-0.00202	-0.271***
	[0.00417]	[0.00476]	[0.00345]	[0.00329]	[0.00411]	[0.0741]
GINI(N)	-0.189***	-0.0732**	-0.0665**	-0.00796	-0.271***	-0.160***
	[0.0454]	[0.0325]	[0.0306]	[0.0357]	[0.0741]	[0.0485]
CREDIT	-0.0944***	-0.0514***	-0.0321**	-0.00358		
	[0.0193]	[0.0156]	[0.0143]	[0.0161]		
PSE					-1.471**	-1.284***
					[0.634]	[0.495]
GINI×CREDIT	0.235***	0.102**	0.0657*	-0.00378		
	[0.0565]	[0.0463]	[0.0399]	[0.0445]		
GINI×PSE					2.746**	2.178**
					[1.278]	[1.024]
REDIST	-0.0760	-0.0147	0.0241	0.00983	-0.0955	-0.0292
	[0.0609]	[0.0447]	[0.0423]	[0.0383]	[0.0711]	[0.0448]
INVS		0.125***	0.0894***	0.0731***		0.109***
		[0.0215]	[0.0296]	[0.0252]		[0.0217]
SCHOOLY		0.00453**	0.00182	-0.0000431		0.00663***
		[0.00178]	[0.00134]	[0.00134]		[0.00156]
log(LIFEEX)			0.0917***	0.0555***		
			[0.0147]	[0.0214]		
GOVC			-0.0280	-0.0384*		
			[0.0209]	[0.0231]		
INFL			-0.000713	-0.000396		
			[0.000519]	[0.000442]		
OPENCO			0.00635	0.00749		
			[0.00451]	[0.00484]		
POLRIGHT			-0.00215	-0.00236*		
			[0.00183]	[0.00144]		
log(FERT)				-0.0369***		
				[0.00863]		
N	899	809	719	719	718	659
Countries	149	124	123	123	143	123
Hansen	0.278	0.988	1	1	0.309	0.924
AR1	0.00000414	0.0000194	0.0000745	0.0000942	0.00000429	0.000000822
AR2	0.766	0.893	0.886	0.928	0.882	0.911
Instruments	140	166	234	259	124	149

Notes: The table reports Blundell-Bond estimations. Standard deviation is reported in brackets. Hansen gives the J-test for overidentifying restrictions, AR1 and AR2 report the results of the AR(n) test. Instruments illustrates the number of instruments utilized in the regression.

inequality vanishes.

We can further investigate the transmission channels with the help of another conditionality discussed above. It is clear that a dissipation of intellectual potential will foremost occur if inequality is high and education is expensive for poorer households. Thus the growth effect of inequality could depend on the volume of public spending on education

(PSE), which can serve as a substitute for deficient private education spending.[21] Indeed, the interaction term between Gini and the ratio of public education spending to GDP is positive and significant at the 5 percent level, both in the very basic model shown in Column 4 of Table 8, but also if the investment share and schooling are held constant in the second regression. Mindful of the negative and highly significant impact of the Gini coefficient, it turns out that the marginal effect of inequality is larger if public education expenditures are low. If public education expenditures increase, the marginal effect of inequality becomes smaller. However, the effect remains negative unless education expenditures are roughly 10 percent of GDP, which is an extremely high value, located in the 99th percentile of our sample.[22]

In many of our reduced form regressions reported previously, the introduction of certain control variables considerably changes the estimated coefficient of the Gini. There is much reason to suspect that this is due to the transmission channels through which inequality acts. If we hold constant these channels—e.g. if we control for fertility, investment, and schooling—the impact of inequality becomes smaller and eventually insignificant. Subsequently, we aim to directly examine how inequality and redistribution affect the three most common transmission variables, namely the investment share, schooling, and fertility. Similar to Barro (2000) we regress each transmission variable on the empirical model which we have used before to explain economic growth. While the model and estimation method is not perfectly suited for explaining the transmission variables, this procedure comes with the advantage of good comparability among the transmission regressions and with our main growth regressions.[23] The results from this exercise are shown in Table 9.

Regarding the estimation of the investment share given in Column 1, a significant impact of net inequality seems to be nonexistent. As the positive effect of differential saving rates is counteracted by the channels of capital market imperfections and sociopolitical unrest, which are closely related to investments into physical capital, this finding is broadly in line with economic theory. Notably, investment is strongly negatively related to redistribution. Apparently, incentive effects play an important role here, which is not surprising as redistributive taxes should be directly affecting the return of investment projects.

The estimations of schooling and fertility directly confirm our expectations from the growth regressions. While average years of school attainment are negatively related to inequality, the fertility rate is standing in a positive relation to the Gini coefficient, resembling the results from Perotti (1996) and Barro (2000). Apart from its indirect effect via a lower level of net inequality, redistribution is insignificantly related to schooling and fertility. Nevertheless, one could speculate that the negative sign of redistribution in the schooling

[21] The data soucre of PSE is World Bank (2014).

[22] In the augmented model given in Column 2 the critical value is located around 7 percent of GDP. Interaction effects are robust to the exclusion of observations with extremely high and possibly doubtful values of public education expenditure (> 10).

[23] Although the Blundell-Bond estimator is designed for dynamic models, the `xtabond2` command does not necessarily require the dependent variable to appear on the right hand side, see Roodman (2009).

Table 9 Transmission channels of inequality

	(1) INVS	(2) SCHOOLY	(3) FERT	(4) INVS	(5) SCHOOLY	(6) FERT
log(CGD)	0.0799***	0.806***	-0.446***	0.0393**	1.489***	-0.587***
	[0.0155]	[0.286]	[0.139]	[0.0168]	[0.289]	[0.137]
GINI(N)	-0.0723	-10.87***	6.429***	-0.325**	-12.85***	9.681***
	[0.143]	[2.637]	[1.385]	[0.160]	[3.558]	[2.058]
REDIST(S)	-0.832**	-2,440	2,346	-0.489*	-7.004*	0.525
	[0.329]	[3.168]	[1.924]	[0.270]	[3.800]	[2.368]
GINI(N) $\times$CREDIT				0.425**	5.591*	-8.029***
				[0.211]	[3.096]	[2.325]
CREDIT				-0.0978	-2.909***	3.220***
				[0.0695]	[1.034]	[0.761]
N	477	454	469	447	428	447
Countries	80	74	79	78	73	78
Hansen	0.211	0.353	0.0959	0.972	0.998	0.992
AR1	0.517	0.0244	0.00000914	0.514	0.0788	0.00141
AR2	0.0650	0.361	0.253	0.245	0.166	0.0617
Instruments	69	69	69	113	113	113

Notes: The table reports Blundell-Bond estimations. Standard deviation is reported in brackets. Hansen gives the J-test for overidentifying restrictions, AR1 and AR2 report the results of the AR(n) test. Instruments illustrates the number of instruments utilized in the regression.

regression hints a negative incentive effect of redistributive taxes and transfers.

From theory we know that capital market imperfections should be reinforcing the impact of inequality on its transmission variables. Indeed, an interaction term between GINI and CREDIT is significant in all three regressions. The negative effects of inequality—both on investments and schooling—are stronger if availability of credit is low. Moreover, the positive correlation between inequality and fertility is strongest if credit availability is limited. Thus the mutual relation between inequality, schooling and fertility becomes obvious. Our data seems to confirm the endogenous fertility channel. Facing the trade-off between the quantity and education of their children, poorer families seem to choose quantity instead of education when inequality and credit market imperfections are high. As De la Croix and Doepke (2003) illustrate, this can lead to the decline in economic growth. This is exactly what we observe in our growth regressions. From a policy perspective our results argue for enhancing the equality of opportunities by directly providing an equal access to education. Focusing on redistribution instead may partly offset the positive effects of lower inequality, as the significant coefficient of REDIST(S) in Column 5 suggests negative incentive effects of larger taxes and transfers.

4.5 Different development levels

The basic regression results suggest that inequality and growth are negatively related. Yet, we drew this conclusion on the basis of the whole sample, where we can suspect that there are substantial differences between the countries, especially between countries of diverging development levels. One early hypothesis of the relation between inequality and development comes from Kuznets (1965) who proposes a parabolic link between the two variables. The underlying mechanism of this relationship is structural change: In agricultural societies, all individuals earn more or less comparable wages. Yet, the emergence of technical change increases productivity of the workers that are able to master the new technologies. Eventually, a large fraction of individuals learns to handle the new technologies, but this is a process which requires both educational training, and time. Short time after the introduction, only few workers can be employed in the new sector. Marginal productivity compensation raises wages in the new sector, redounding to a substantial increase in wage inequality. As more and more individuals gain access to the new technologies and the required human capital level, wage inequality eventually goes back to the initial level. Theoretically, the process is completed when all individuals are employed in the new sector. More generally, the skill-premium can be explained not only if some major structural changes appear, but also if innovations or productivity-enhancing improvements are implemented in existing sectors. Here we can use two different lines in the argumentation: First, as Aghion and Howitt (1998) point out, the emergence and diffusion of new technologies triggers wage inequality across skill groups. Yet a substantial amount of the increase in wage inequality over the past years has been due to inequality within education groups. Therefore, the theory can be enlarged to a second branch incorporating wage inequality within education groups. Aghion and Howitt (2002) argue that most of this type of inequality is originated in learning-by-doing and intersectoral mobility. However, when investigating the relationship between the two variables using macroeconomic data, we can only explore the first effect, as there is hardly any data concerning the second branch of argumentation.

Barro (2008) provides evidence that there are indeed some major deviations in the impact of inequality on growth when analyzing different income levels. As it turns out, economies with incomes less than 11,900 USD show a negative correlation between inequality and growth, whereas the relationship is positive in the group of countries with yearly incomes that increase the critical threshold of 11,900 USD. Barro (2008) investigates the period 1965-2004 where strong restrictions in data availability concerning inequality prompts him to estimate the effect only on the basis of very few observations (depending on the regression between 47 and 70 in the whole sample estimates). The larger availability of data in SWIID and other sources allows us to explore this link on a broader basis. Especially with respect to less-developed countries, the unavailability of inequality data for some countries may cause a sample selection bias in studies building on earlier data. In addition, low-income countries on average have gained some major income increases over the past ten years (+62 percent between 2003 and 2013), offering the possibility that the distinct effect observed by Barro (2008) may have vanished.

Table 10 illustrates the results of our baseline estimations, conducted separately for high and low income countries. The critical value separating the two income groups is 12,746 USD, as proposed by the classification of the World Bank. The results obtained from the separation of the sample according to the level of development yields unambiguous conclusions: If only the countries with incomes less than 12,746 USD are to be examined, there is a strong and significantly negative influence of inequality on growth. However, as the economies develop, the growth-hindering effect of inequality declines and eventually becomes insignificant. In the sample of high-income countries, the Gini coefficient even assumes a positive impact on growth, albeit this influence is far from significance. With few exceptions, the control variables of the regression remain relatively stable, even though there are some deviations in the effect of life expectancy and government consumption. The former may be due to the ambiguous effect emanating from the variable. Unlike in developing economies, the depreciation-increasing effect of population growth may predominate the health-effect in advanced economies, especially as the level of health does not deviate substantially in high-income countries (standard deviation high-income: 5 years, low-income: 11 years). Regarding government consumption, a possible explanation is that financial markets are much more developed in high-income countries. The crowding out effect of government consumption may thus be less severe than in low income countries. In addition, it can be suspected that government spendings are used more efficiently in advanced economies, as a higher level of factor productivity accompanied by less corruption and a more consequent devotion to the quality of the education sector may exert positive effects on economic growth.

Table 10 The impact of inequality on growth for different levels of development, baseline regression for high and low income countries

	Low-Income Countries				High-Income Countries			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
log(CGDP)	0.0125**	-0.00955**	-0.0190***	-0.0219***	-0.0192**	-0.0182**	-0.0120	0.0126
	[0.00491]	[0.00393]	[0.00518]	[0.00553]	[0.00748]	[0.00793]	[0.0169]	[0.0162]
GINI(N)	-0.133***	-0.0905***	-0.0400	-0.0110	0.0414	0.0409	-0.0484	0.0624
	[0.0487]	[0.0230]	[0.0257]	[0.0262]	[0.0862]	[0.0954]	[0.110]	[0.101]
REDIST	0.0102	0.0162	0.0726	0.0664	-0.0931	-0.0555	-0.0232	-0.0513
	[0.0718]	[0.0537]	[0.0637]	[0.0647]	[0.0755]	[0.111]	[0.143]	[0.142]
INVS		0.141***	0.0690**	0.0507		0.0909	0.0373	0.114
		[0.0241]	[0.0307]	[0.0328]		[0.0583]	[0.0776]	[0.0796]
SCHOOLY		0.00617***	0.00231	-0.000267		0.0000280	-0.00137	-0.000482
		[0.00166]	[0.00163]	[0.00161]		[0.00265]	[0.00274]	[0.00273]
log(LIFEEX)			0.0824***	0.0578**			-0.0861	-0.209*
			[0.0188]	[0.0226]			[0.104]	[0.107]
GOVC			-0.0360*	-0.0451*			0.0843	0.154**
			[0.0215]	[0.0245]			[0.194]	[0.0730]
INFL			-0.000787	-0.000150			-0.0121	0.00204
			[0.000534]	[0.000407]			[0.0143]	[0.0135]
OPEN			0.00789	0.0114*			0.00481	-0.000665
			[0.00685]	[0.00663]			[0.00919]	[0.00547]
POLRIGHT			0.0000833	-0.000831			0.000806	0.00354
			[0.00182]	[0.00120]			[0.00880]	[0.00377]
log(FERT)				-0.0380***				-0.0299*
				[0.00893]				[0.0158]
N	674	586	504	504	259	253	220	220
Countries	128	103	99	99	43	42	38	38
Hansen	0.301	0.876	1,000	1,000	1,000	1,000	1	1
AR1	0.000101	0.000175	0.000532	0.000613	0.00512	0.0165	0.0184	0.0237
AR2	0.605	0.590	0.956	0.928	0.483	0.658	0.753	0.991
Instruments	88	114	184	209	88	114	183	203

Notes: The table reports Blundell-Bond estimations. Standard deviation is reported in brackets. Hansen gives the J-test for overidentifying restrictions, AR1 and AR2 report the results of the AR(n) test. Instruments illustrates the number of instruments utilized in the regression.

Table 11 The impact of inequality for different levels of development

	(1)	(2)	(3)	(4)
log(CGDP)	-0.0371***	-0.0415***	-0.0164*	-0.0200**
	[0.0118]	[0.00919]	[0.00921]	[0.00850]
GINI(N)	-0.933***	-0.683***	0.0390	0.0776
	[0.253]	[0.191]	[0.183]	[0.157]
GINI(N)×CGDP	0.0976***	0.0752***	-0.00839	-0.00853
	[0.0311]	[0.0233]	[0.0213]	[0.0184]
N	962	867	745	745
Countries	152	126	125	125
Hansen	0.103	0.684	1,000	1,000
AR1	0.00000664	0.0000163	0.0000827	0.0000828
AR2	0.922	0.999	0.824	0.960
Instruments	111	137	207	232

Notes: The table reports Blundell-Bond estimations. Standard deviation is reported in brackets. Hansen gives the J-test for overidentifying restrictions, AR1 and AR2 report the results of the AR(n) test. Instruments illustrates the number of instruments utilized in the regression.

In developing economies, contrariwise, some government expenditure may be used much less efficiently, especially in the light of a possibly higher extent of nepotism, crony capitalism, and higher rates of corruption.

Figure 5 pictures the marginal effect of the Gini coefficient for different development levels and the 95 percent confidence interval. The underlying model is Coulmn 1 of Table 11, where the interaction between the Gini coefficient and the development level allows us to investigate the impact of inequality as the economies evolve. We conduct the analysis identically to the baseline specification; however, for reasons of lucidity, we only report the inequality variables, as there are virtually no changes in the covariates. It turns out that the marginal effect of inequality is remarkable and significantly negative in poor economies, whereas the coefficient of inequality increases proportionately to ascending income levels. At the same time, the significance of inequality decreases as the econmies develop. The null is reached at an income level of 14,130 USD, which resembles the critical threshold of high-income groups that we assessed in the sample separation. The coefficient of inequality continues to increase in the group of rich countries, whereas the positive effect does not become significant, even at the rear edge of the function pictured in figure 5. However, the running of the function implies that there may be a possibility that the marginal effect continues to increase and eventually will be significant in economies that exceed the current level of development, but such considerations are pure speculation.

What is the underlying economic reason for the observed evolution of the influence of inequality? The results suggest that capital-market imperfections harden the budget constraints in low-income countries, making any progress in education a hard task for individuals. In addition, entrepreneurial activity and the possibility of both the creation and the im-

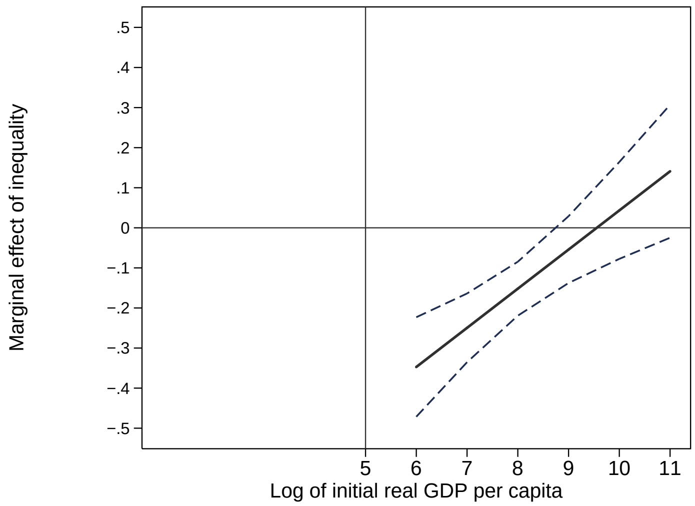

Figure 5 The impact of inequality for different levels of development

plementation of innovations is strongly reduced if financial markets are underdeveloped. As a high level of inequality allows some individuals to make use of their individual abilities and hinders some others from exploiting their full potential, growth rates will be substantially lower, especially when assuming an (approximately) equal distribution of initial cognitive skills of children across different income levels. As the social and financial environment in high-income countries help to ensure that the distribution of human capital endowment is much more due to preferences and individual skills rather than initial endowment of wealth, the influence of inequality declines. In addition, education rents in high-income countries may even lead to growth-enhancing effect of inequality, as the incentives concerning human capital investments, labor supply, and entrepreneurship may rise if income gaps increase. If true, social mobility can be expected to be lower in developing countries. Data on the correlation between the income of fathers and their sons is available in the Corak (2011) sample. Figure A3 in the appendix illustrates that the extent of social mobility is positively associated with the development level of the economies. The correlation of the variables is 60 percent. There is much reason to suspect that the negative impact of the Gini coefficient in our baseline estimations may to some extent reflect the effect of equality of opportunities. Whenever the initial wealth level of parents strongly determines the level of education a child is able to obtain, the growth rate of the economy is lower, as growth-enhancing potentials emanating from human capital, innovations, and entrepreneurship are wasted.

5 Conclusions

Evidence from a new set of fairly well comparable worldwide data shows a robust negative correlation between income inequality and growth, as long as the transmission variables of inequality are left open. Specifically, more unequal countries tend to have a less educated population and higher fertility rates. Both are harmful for growth and reinforced by capital market imperfections.

Regarding the endogenous fiscal policy channel, we have found little evidence for any negative growth effect of public redistribution in the whole sample of countries. While redistribution hampers investments, its negative incentive effects on average do not seem to transmit to economic growth. The findings suggest that most of the negative effects are offset by positive insurance effects which promote risk taking and entrepreneurship. An alternative interpretation is that the data simply reveals that governments on average have found the most efficient way to redistribute, whereas other possible redistribution measures are very likely to yield inefficiencies. In fact, in combination with the resulting decrease in net inequality, redistribution on average seems to be rather beneficial for growth, particularly when market inequality is high.

However, these results foremost stem from developing and middle-income countries where the negative potential of inequality is most severe due to capital market imperfections and an inferior provision of public goods, yielding a socio-political environment where equality of opportunities is much less pronounced than in advanced economies. When examining the link of inequality and growth in the sample of high-income countries, we do not find any significant correlation between inequality and growth. Policy implications may thus differ substantially depending on the development level of the economies.

Despite its insignificance, the negative sign of the redistribution variable in most of our estimations should not be ignored. The most growth friendly remedy for inequality is a direct intervention at its key transmission channels. By equalizing human capital provision and investment opportunities, governments may be able to perform the balancing act between a reduction of net-inequality and a facilitation of economic growth most effectively. Our findings suggest that the negative growth effects of inequality can be mitigated by public expenditures on education.

A policy that promotes equality of opportunity enhances social mobility, which makes an unequal distribution of incomes less severe, assuring that income differentials reflect preferences rather than parental wealth and budget restraints. In societies with high rates of social mobility, individuals are able to climb the income ladder through their own effort. As such policies do not exercise negative incentive effects, indirect redistribution may be more efficient than direct redistribution activities.

Two major limitations remain: First, it is possible that a low level of average education and a high fertility rate are the *cause*, rather than the *effect* of inequality. While we find evidence of a causal effect running from inequality to education and fertility, more research is necessary to establish a definite conclusion about the direction of causality in a large panel of countries. Second, the pre-post approach only measures effective redistribution while it does not provide any insights on the policy measures through which the observed redistribution occurs. As a next step, we will try to disentangle by which policy instruments redistribution is achieved and how redistribution can be accomplished most efficiently in terms of economic growth.

Appendix

Appendix A1: Standardization Procedure in the SWIID Our preferred measures of income

inequality and redistribution stem from the Standardized World Income Inequality Database (SWIID, Version 4.0, released in September 2013) generated by Solt (2009). The SWIID is based on the UN World Income Inequality Database (WIID), which is the successor of the Deininger and Squire (1996) data set. The SWIID transforms and adjusts the WIID data in several steps, which are best described in Solt (2009). We therefore restrict to a very brief overview of the steps taken by Solt (2009): 1. Observations which are based on only a local reference group and therefore not a good countrywide estimate are eliminated. 2. The data is sorted in comparable reference units and income definitions. Plus all available data series from the Luxembourg Income Study (LIS) are added as benchmarks. 3. Flexible ratios, which vary over countries and over time, are calculated between the different categories and are used to fill out missing data points. Thus 20 different time series are estimated for each country and combined into a single variable for net income inequality. 4. Possible measurement errors are corrected by using five-year weighted moving averages on all data points except those taken from the LIS dataset and certain time periods.

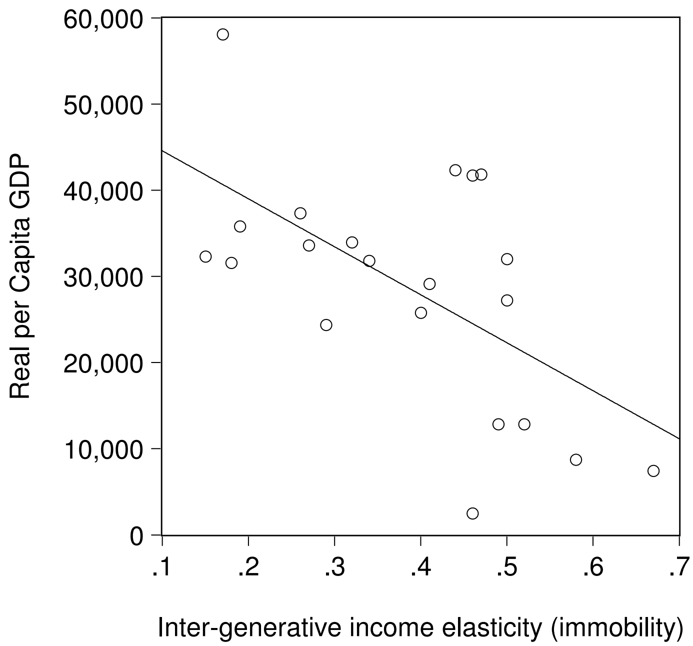

Figure A3 The relationship between the intergenerational income-elasticity (immobility) and real per capita GDP

Notes: The figure reports intergenerational income elasticities which reflect estimated values of β obtained from the OLS regression $\log y_t = \alpha + \beta \log y_{t-1} + \varepsilon_t$ where y_t is the income of the adult son, and y_{t-1} denotes the income of the father. Due to the nature of this measure, higher values of β indicate lower rates of social mobility. The data includes values for 21 countries and can be found in Corak (2011).

Table A2 Correlation matrix of the regressors

	GROWTH	log(CGDP)	GINI(N)	GINI(M)	REDIST	REDIST(S)	INVS	SCHOOLY	log(LIFEEX)	GOVC	INFL	OPEN	POLRIGHT	log(FERT)
GROWTH	1													
log(CGDP)	0.0073	1												
GINI(N)	0.058	-0.5626	1											
GINI(M)	0.0471	-0.2914	0.7839	1										
REDIST	-0.0328	0.5309	-0.6011	0.0249	1									
REDIST(S)	-0.0604	0.6101	-0.7254	-0.1578	0.9649	1								
INVS	0.1814	0.3911	-0.1858	-0.1388	0.1206	0.1458	1							
SCHOOLY	0.0188	0.6494	-0.5801	-0.4027	0.4158	0.5137	0.1255	1						
log(LIFEEX)	0.0807	0.7106	-0.53	-0.3225	0.4383	0.4924	0.2938	0.5319	1					
GOVC	-0.3048	-0.3284	-0.1277	-0.1128	0.0605	0.0782	-0.259	0.0764	-0.1137	1				
INFL	-0.3429	-0.1027	0.0829	0.0424	-0.079	-0.0816	-0.1064	-0.1261	-0.1449	0.1238	1			
OPEN	0.0792	0.1378	-0.1062	-0.1222	0.0136	0.0465	0.2542	0.0989	0.1481	0.0428	-0.0865	1		
POLRIGHT	0.0432	0.5405	-0.3182	-0.1328	0.3414	0.4241	0.1211	0.4384	0.5133	-0.0911	-0.1083	-0.1111	1	
log(FERT)	-0.1482	-0.6795	0.6527	0.4539	-0.4668	-0.5503	-0.35	-0.6438	-0.6621	-0.0095	0.0822	-0.2035	-0.4241	1
TOTR	0.1091	0.1423	-0.0161	0.032	0.0672	0.0707	0.0647	0.1943	0.0779	-0.0095	-0.0553	0.1641	0.0335	-0.1835

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