# Inequality and Growth: Relying on Quantile Shares


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5th December 2013


**Abstract**

This paper explores how different forms of income inequality affect subsequent economic performance. To do so, we run growth regressions which include quantile shares to control for the income distribution (instead of overall statistics like the Gini coefficient). In line with recent theoretical findings, we show that inequality is neither uniformly good nor uniformly bad for growth. More specifically, in a sub-set of richer countries, we find that higher bottom-end inequality (i.e., a lower income share of the poorest segment of society) has a strong negative impact on subsequent growth while higher top-end inequality (i.e., a higher income share of the rich at the expense of the middle class) seems to promote economic performance. In poorer countries, however, higher top-end inequality is harmful while strengthen the middle class (at the expense of the rich) promotes economic growth.



*JEL classification:* O11, O15, O43, C23

*Keywords:* Inequality, growth, quantile shares, middle class



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Support by the SNF Sinergia grant CRSI11_132272 Economic Inequality and International Trade is gratefully acknowledged.

# 1 Introduction

Over the past two decades, the relationship between inequality and subsequent economic growth has often been discussed in the context of credit market imperfections. A highly influential view in this literature holds that - with an imperfect credit market - inequality is bad for economic performance. The reasoning behind this view is intuitive. If the credit market does not function well, access to external finance depends on individual wealth - which means that marginal returns are not equalized across investment opportunities. Thus, if technologies are convex, bringing down inequality should reduce the heterogeneity in investment returns and, as a result, boost economic performance (see, e.g., Bénabou (1996)).

A recent paper by Foellmi and Oechslin (2008) challenges this view. Relying on a general equilibrium framework, Foellmi and Oechslin show that - even in presence of globally convex technologies and severe credit market imperfections - we should not expect inequality to have a consistently negative impact on economic performance. In fact, there are good reasons to expect that a higher degree of overall inequality (as measured by, e.g., the Gini coefficient) boosts subsequent growth. To see this, consider a distortion-free transfer from the top to the middle of the distribution. Since - with convex technologies - investment functions are concave in wealth, such a transfer must increase the economy-wide demand for capital - and hence boost the borrowing rate. Yet, a higher borrowing rate means that the poorest people can borrow, and therefore invest, less - which is particularly bad for aggregate output since the poor have the highest marginal returns.

However, Foellmi and Oechslin (2008) also find that a specific form of inequality, namely bottom-end inequality, is clearly bad for economic performance. More specifically, it is shown that a distortion-free redistribution of wealth towards the poorest part of the population unambiguously increases aggregate output. An immediate implication of these findings is that empirical work assessing the relevance of the credit-market channel should not rely on single summary statistics of overall inequality (such as the Gini coefficient). Instead, what needs to be done is to account separately for inequality arising from different parts in the distribution.

Relying on a sample that covers 83 countries over the 1965-2000 period (oder bis 2005, da Wachstum von 1965-2005?), the present paper makes a first step into this direction. In particular, we run growth regressions which include selected quantile shares as controls for the income distribution (in lieu of an overall measure like the Gini coefficient). More specifically, in some of the specifications we include the income share of the lowest quintile, Q1, along with the share of the middle class, MC (which consists of the second, third, and fourth quintile); in alternative specifications, we control for the share of the middle class along with the share of the richest quintile, Q5.

Our empirical findings are highly consistent with the theoretical predictions in the sub-sample of the high and upper middle income countries (40 out of 83 countries). In particular, we consistently find that (i) countries with a higher Q1 (at the expense of a lower Q5) have a significantly higher growth rate; (ii) countries with a higher MC (at the expense of a lower Q5) have a significantly lower growth rate. Similarly, countries which have a higher MC or Q5 at the expense of a lower Q1 grow consistently slower. Thus, at least among high and upper middle income countries, different types of inequality have different effects on economic performance: A rise in bottom-end inequality consistently impairs economic performance whereas an increase in top-end inequality (i.e., a shift of income from the middle class to the rich) seems to promote growth. Thus, it is no surprise that - in this sub-sample of countries - we do not find a systematic relationship between the Gini coefficient and subsequent economic performance.

These results, however, do not hold in the sub-sample of the low and lower middle income countries (and therefore neither in the full sample of 83 countries). Echoing Easterly (2001) results, it seems that a higher middle-class share (at the expense of a lower Q5) promotes economic growth. One interpretation could be that the middle class in poorer places takes the role of Q1 in richer countries whereas the poorest people in poor countries do neither invest in physical nor human capital (because, for instance, a set-up cost is required which the poor cannot bring up). Under these circumstances, consistent with the empirical findings, the Foellmi-Oechslin framework would predict that an increase in the middle-class share unambiguously promotes economic performance.

This paper contributes to a growing empirical literature on the inequality-growth nexus (see Halter, Oechslin, and Zweimüller (2011) for a recent and brief overview). There is a particularly strong link to more recent papers which look at the impact of different forms of inequality (or poverty) on economic performance. Among these contributions is a paper by Voitchovsky (2005) who uses income percentile ratios (such as the 50/10 or 90/50) to control for relative poverty or top-end inequality. Voitchovsky also tends to find that top-end inequality promotes economic growth (while higher relative poverty seems to have a negative impact). Yet, Voitchovsky's results are based on a relatively small sample of 25 high-income countries (while our sample covers 83 countries); moreover, the way we control for the income distribution is directly derived from a theoretical framework. Other related empirical papers are those by Bhatta (2001) or Lopez and Servén (2009) which explore the impact of (absolute) poverty on growth. Our paper differs from these contributions because, among other things, we not only control for (relative) poverty but simultaneously for inequality originating further up in the income distribution.

The rest of this paper is organized as follows. Section 2 reviews the Foellmi-Oechslin (2008) framework and suggests a theory-based way to control for the income distribution. In Section 3, the data and the estimation methods are described. Section 4 presents and discusses the empirical results. Finally, Section 5 concludes.

# 2 Theory

The theoretical framework, that we use, is a slight generalization of the model by Foellmi and Oechslin (2008). We consider a closed and static economy that is populated by a continuum of individuals of measure 1. The individuals derive utility from consumption of a single output good; marginal utility is strictly positive. The agents are heterogeneous with respect to their initial capital endowment ("wealth"), $\omega_i$, $i \in [0, 1]$. Initial capital is distributed according to the distribution function $G(\omega)$.

Each individual runs a single firm which uses capital to produce the homogeneous output good. The amount of capital invested by agent $i$ is denoted by $k_i$. The technology, which is identical across firms, is given by $y = f(k)$, where $f(\cdot)$ is increasing, strictly concave, and $f(0) = 0$. The price of the output good is normalized to unity.

The imperfection lies in the fact that the entrepreneur cannot plead to pay the full output of the project: we assume that the pledgeable income is equal or lower than the project output, $I(k) \leq f(k)$. We assume that $I(k)$ is increasing and concave. The idea is that with decreasing returns, the impact of additional wealth on the size of the pledgeable income falls as the wealth level rises. There are several microfoundations giving rise to such outcome. A first example is imperfect contract enforcement when the agent loses only a constant fraction $\lambda \in (0, 1]$ of the firm revenue, $f(k)$, hence the pledgeable income amounts to $\lambda f(k)$, concave in $k$. Another example is the case of non-enforceable effort supply. Also here a lower interest rate or a higher endowment allow for larger investments because the incentives to supply effort are stronger. But the impact of additional wealth is decreasing because the cost of effort is convex or marginal utility from consumption is falling.[1]

The individuals take the equilibrium interest rate, $\rho(k, \omega)$, as given.[2]

**Investment Decision.** Agent $i$ chooses $k_i$ to maximize income, $f(k_i) - \rho(k_i, \omega_i)(k_i - \omega_i)$. We omit the index $i$ in what follows, because initial capital is the only source of heterogeneity across

[1] Such a continuous-effort model is presented in Piketty (1992), for instance.

[2] Alternatively, we could assume that the interest rate may depend on the project size and own wealth, $\rho(k, \omega)$. Thus, an increased project size, holding equity constant, may lead to a reduced probability of success, implying that the borrowers require higher interest rates $\rho_k \geq 0$; the opposite holds for higher equity, $\rho_\omega \leq 0$. To ease notation we assume that the success of each project is controllable for the entrepreneur such that, in equilibrium, each credit is paid back.

individuals. Thereby, he is limited by the borrowing constraint

$$\rho(k, \omega)\,(k - \omega) \leq I(k), \tag{1}$$

stating that the repayment obligation cannot exceed the pledgeable income $I(k)$. When (1) holds, each project is paid back, hence the interest rate is the same for individuals in equilibrium, $\rho(k, \omega) = \rho$. For each endowment level $\omega$ there exists a unique level of maximal investment $\overline{k}(\omega)$, implicitly defined by equation (1) when holding with equality.

**Lemma 1** *Let $\rho > I'(\infty) \equiv \lim_{x\to\infty} I'(x)$. Then, the maximum firm size $\overline{k}(\omega)$ is strictly increasing and concave in the capital endowment, $\omega$.*

***Proof.*** *Equation $\rho\,(k - \omega) = I(k)$ defines a unique $\overline{k}(\omega)$ with $\rho + \rho_k(\overline{k} - \omega) > I'(\overline{k})$. Implicit differentiation gives $d\overline{k}/d\omega = \rho/\left(\rho - I'(\overline{k})\right) > 0$, $d\overline{k}/d\omega$ is decreasing since $I'(\overline{k})$ is falling.* ■

To understand the intuition, we calculate the credit multiplier. We write the derivative of $\overline{k}$ with respect to initial capital as

$$\frac{d\overline{k}}{d\omega} = 1 + \frac{I'(\overline{k})}{\rho - I'(\overline{k})}. \tag{2}$$

The investment size rises in $\omega$ via two channels. The first term on the right-hand side captures simply that – for a given amount of credit – the feasible level of investment increases one-to-one in the entrepreneur's capital endowment. The second term mirrors the higher borrowing capacity of richer investors. Intuitively, since punishment is a fraction of total output (which is produced from borrowed funds and own capital), richer individuals can offer more "collateral." But since the technology exhibits decreasing returns, the positive impact of an additional endowment unit on the entrepreneur's borrowing capacity falls in $\omega$.

We turn to the individuals' decision problem. We refer to $\widetilde{k}$ as the investment that equates the marginal product of capital and the interest rate

$$f'(\widetilde{k}) = \rho. \tag{3}$$

An agent with endowment $\omega \geq \widetilde{k}$ invests $\widetilde{k}$ capital units in his own firm and lends the rest, $\omega - \widetilde{k}$, on the credit market. Otherwise, if $\omega < \widetilde{k}$, the agent borrows as much as he can in order to close the gap between $\widetilde{k}$ and $\omega$. Denote by $\widetilde{\omega}$ the level of $\omega$ allowing to invest exactly $\widetilde{k}$ capital units and thus separating *credit-constrained* entrepreneurs from entrepreneurs being able to implement the unconstrained optimum.[3] Inserting equation (3) into the borrowing constraint (1) and rearranging terms yields $\widetilde{\omega} = \max\{0, \widetilde{k} - I(\widetilde{k})/\rho\}$.

[3]Here, an entrepreneur is said to be credit-constrained if and only if the amount he would optimally like to raise exceeds his credit limit.

Taken together, the optimal *incentive-compatible* firm size, $k(\omega)$, is given by

$$k(\omega) = \begin{cases} \overline{k}(\omega) & \text{if } \omega < \widetilde{\omega} \\ \widetilde{k} & \text{if } \omega \geq \widetilde{\omega} \end{cases} \tag{4}$$

for a given interest rate and with $\widetilde{k}$ determined trough (3). According to Lemma 1, $k(\omega)$ increases in $\omega$ if $\omega < \widetilde{\omega}$ and stays constant thereafter.

**Aggregate Equilibrium.** The interest rate has to equate aggregate (gross) capital supply, $K^S$, and aggregate (gross) capital demand. $K^S$ is exogenously given and equals $K \equiv \int_0^\infty \omega dG(\omega)$. Aggregate capital demand, $K^D \equiv \int_0^\infty k(\omega)dG(\omega)$, is obtained by adding up the individual investments, $k(\omega)$. Using equation (4), $K^D$ reads $K^D(\rho) = \int_0^{\widetilde{\omega}} \overline{k}(\omega)dG(\omega) + (1 - G(\widetilde{\omega}))\,\widetilde{k}$. The equilibrium borrowing rate is uniquely determined with $K^S = K^D(\rho^*)$.[4]

## 2.1 Inequality and Output

What is the effect of redistribution on output? Consider a redistributive program "taxing" a positive mass of poorer individuals and distributing the proceeds among a set of richer individuals. Assume further that the poorer (i.e., "taxed") individuals are credit-constrained while the richer (i.e., "subsidized") individuals may or may not be.

**Lemma 2** *A regressive redistribution decreases the equilibrium interest rate, $\rho$.*

**Proof.** From Lemma 1 and equation (4) we know that $k(\omega)$ is strictly concave for $\omega < \widetilde{\omega}$. Hence, for a given $\rho$, taxing credit-constrained agents and redistributing the proceeds towards richer entrepreneurs decreases capital demand, and the claim immediately follows. ■

To understand the intuition of Lemma 2 we look at equations (2) and (4). An additional unit of own capital increases a beneficiary's maximum amount of investment only to a low extent while a poor individual's maximum investment decreases strongly ($d^2\overline{k}/d\omega^2 < 0$). Moreover, given the interest rate, rich agents already investing $\widetilde{k}$ units do not invest more in response to an increase in own resources and a higher borrowing limit. As a result, the borrowing rate has to fall in order to restore the equality of capital demand and capital supply.

The fall of the interest rate in response to regressive redistribution is the reason why an unambiguous prediction with respect to output is in general not possible. The only exception is when the poorest individuals are affected. To see this, consider a regressive redistributive program

[4] This can be seen as follows. We have $\lim_{\rho \to f'(\infty)} K^D = \infty$ because $\lim_{\rho \to f'(\infty)} \widetilde{k} = \infty$. Note further that $\widetilde{k}$ (and thus $\widetilde{\omega}$) go to 0 as $\rho$ approaches $f'(0)$. Hence, $\lim_{\rho \to f'(0)} K^D = 0$. To determine the slope of the $K^D-$schedule we have to calculate $d\overline{k}(\omega)/d\rho$. Implicit differentiation of $\rho\,(k - \omega) = I(k)$ gives $d\overline{k}(\omega)/d\rho = -\left(\overline{k} - \omega\right) / \left(\rho - I'(\overline{k})\right) < 0$. Combining this with $d\widetilde{k}/d\rho < 0$ (from equation 3) we have $dK^D/d\rho < 0$. Thus, since $K^S$ is perfectly inelastic, there must be a unique equilibrium interest rate $\rho^* > f'(\infty) \geq I'(\infty)$.

involving a positive measure of the *poorest agents* in the economy. Specifically, assume that these agents are *equally endowed* with capital and that they are all taxed by the same amount. Then, according to Lemma 2, the interest rate must fall, and since $d\overline{k}(\omega)/d\rho < 0$ and $d\widetilde{k}/d\rho < 0$, the individuals belonging to the remaining part of the population (i.e., the subsidized agents and those not directly affected) increase their amount of capital invested; because aggregate gross capital supply has not risen, the taxed individuals must invest less in the new equilibrium. Finally, since each of the downsized firms had (and has) a higher marginal productivity of capital than each of the other firms, aggregate output falls.

However, the empirical prediction is unclear for all other types of regressive redistributive programs. If we redistribute away from a set of credit-constrained agents not belonging to the poorest part of the population, aggregate output may well increase. Due to the lower interest rate, the poorest agents (who are not involved into the transfer by assumption) have better access to credit and will run larger firms. Put differently, redistribution from individuals with higher marginal returns to individuals with lower marginal returns does not necessarily reduce output because the lower interest rate softens the borrowing constraint for other high-return firms. To summarize,

**Proposition 1** *Let a positive measure of individuals be endowed with $\underline{\omega} > 0$. Taxing each of these poorest agents by an equal amount and distributing the proceeds to richer agents unambiguously reduces aggregate output, $Y$. Other types of regressive redistributive programs may increase $Y$.*

***Proof.*** *The first part of the proposition has been proven in the text. The second part can be proven by means of an example (see Foellmi and Oechslin (2008))* ■

Proposition 1 states a *sufficient* but not necessary condition for a negative relationship between relative poverty and output. The relationship remains negative in case we redistribute away from the set of the, say, $\gamma$ poorest – but not necessarily equally poor – agents if the differences in endowments within this set are sufficiently small.

The theoretical model underlines that an empirical specification should account separately for inequality arising from different parts in the distribution: Holding the wealth shares of the middle quantiles constant, the model suggests a monotonically positive link between output and the share of the lowest quantile while, holding the bottom-end constant, it predicts a hump-shaped relationship between output and each of the quantile shares in the middle.

# 3 Data and Estimation Method

## 3.1 Income Inequality Data

As is suggested in Section 2, income inequality should be measured directly by quantile shares instead of single income inequality statistics like the Gini coefficient. However, as is well documented in the literature (see for example Deininger and Squire (1996)) data for income inequality often has quality problems. Moreover, comparisons between and within countries cause problems because of wide variations in definitions.

Having this in mind, a database for quintile shares is constructed that is as consistent as possible. For that purpose first the World Income Inequality Database (WIID release 2c, UNU-WIDER (2009)) is merged with the database constructed by Deininger and Squire (1996), from which only observations of the quality category "accept" are included. Interestingly, the WIID2c contains an update by Deininger and Squire (D&S) from the year 2004. Only observations between 1960 and 2005, if the area covered by the survey is the whole country (e.g., not only the capital, main cities or rural areas) and if the population covered is the whole population (e.g., not only the employed) are considered.

As a 5-year dynamic panel data model is estimated (see Section 3.2), income inequality is generally measured at the beginning of a period. However, for many countries and years, more than one observation is available. Therefore, observations from the Luxembourg Income Study (LIS) are preferred over observations from the update by D&S from the year 2004, over observations from the original D&S database (1996) over all other sources under the constraint that the WIID quality rating is either 1 or 2 (thus deleting quality 4, which is the lowest, and quality 3). The three favored sources are even preferred (in the order mentioned) if they are measured in the previous period. Thereby, the consistency of the data is increased and it is ensured that no dubious observations are included. The main advantage of the LIS is that the measurement of income inequality is the same over all years and countries (income-based measure). Furthermore, almost all countries contained in the LIS are different from the ones in the D&S update. Only Hungary, Mexico, Romania and the Slovak Republic appear in both sources. Furthermore, good over bad quality is preferred (according to the WIID rating), income-based over expenditure-based measures[5], and net income values over gross income values. Finally, this results in a 5-year panel data set with 498 observations of quintile shares from 124 countries. 87 observations are from the LIS, 126 from the D&S update, 198 from the D&S database from 1996 and 87 observations from the other sources

[5]Opting for income-based over expenditure-based measures will reduce the number of adjustments to be made between these two categories.

in the WIID2c.

To make comparability across observations more consistent, Deininger and Squire (1996) suggest to add 6.6 to expenditure-based measures of the Gini coefficient to diminish the difference to income-based measures.[6] Similarly, expenditure-based quantile shares have to be corrected in order to make them comparable to the income-based quantile shares. Looking at the whole dataset reveals only small differences between income-based and expenditure-based quintile shares (see Table 1). The difference in the Gini coefficient is only 1.18 and the difference in the quintiles is between $-0.59$ and 0.45 percentage points. However, this is mainly due to the fact that richer countries have almost only income-based measures, and also lower income inequality (at least in our data set). Reducing the sample by eliminating the rich countries (according to the World Bank World Development Indicators (WDI) country classification from the year 2000), reveals a difference in the Gini coefficient of 6.07 points. The difference for the quintile shares are now between $-1.41$ and 4.76 percentage points.

**Table 1:** Correction for Expenditure-Based Quintile Shares

**Only upper middle, lower middle and low income countries (320 observations)**

| | Gini | Q1 | Q2 | Q3 | Q4 | Q5 | Obs. |
|---|---|---|---|---|---|---|---|
| **Consumption-based** | 39.75 | 6.49 | 10.60 | 14.80 | 21.18 | 46.95 | 78 |
| **Income-based** | 45.82 | 5.07 | 9.21 | 13.59 | 20.41 | 51.71 | 242 |
| **Difference** | 6.07 | -1.41 | -1.38 | -1.20 | -0.77 | 4.76 | |
| **Difference in %** | | -0.22 | -0.13 | -0.08 | -0.04 | 0.10 | |
| **x (Income/Consumption)** | | 0.78 | 0.87 | 0.92 | 0.96 | 1.10 | |

**All countries (498 observations)**

| | Gini | Q1 | Q2 | Q3 | Q4 | Q5 | Obs. |
|---|---|---|---|---|---|---|---|
| **Consumption-based** | 39.29 | 6.55 | 10.71 | 14.95 | 21.30 | 46.51 | 83 |
| **Income-based** | 40.47 | 5.96 | 10.58 | 14.99 | 21.52 | 46.96 | 415 |
| **Difference** | 1.18 | -0.59 | -0.13 | 0.04 | 0.22 | 0.45 | |
| **Difference in %** | | -0.09 | -0.01 | 0.00 | 0.01 | 0.01 | |
| **x (Income/Consumption)** | | 0.91 | 0.99 | 1.00 | 1.01 | 1.01 | |

Note: Based on data set described in Section 3.1.

To take account of the difference between the two different methods of measurement, each expenditure-based quintile is multiplied by the ratio between the sample mean of quintile shares for the income-based measures and the sample mean of quintile shares for the expenditure-based measures (factor $x$) from the sample of upper middle, lower middle and low income countries:

$$\begin{aligned}
\overline{Q^s_{inc}} &= \sum_{i=1}^{N}\sum_{t=1}^{T} Q^s_{inc,i,t} \\
\overline{Q^s_{exp}} &= \sum_{i=1}^{N}\sum_{t=1}^{T} Q^s_{exp,i,t} \\
Q^s_{corr,i,t} &= Q^s_{exp,i,t} \cdot \frac{\overline{Q^s_{inc}}}{\overline{Q^s_{exp}}} = Q^s_{exp,i,t} \cdot x
\end{aligned}$$

[6] 6.6 is the mean difference between income-based and expenditure-based Gini coefficients in the D&S 1996 database.

for $s = 1, ..., 5$. However, after this first step, the quintiles do not sum up to 100 anymore, wherefore each corrected expenditure-based quintile is rescaled by the sum of all quintile shares for this unit (divided by 100), which gives then the equivalent income-based measure:

$$\begin{aligned} z_i &= \frac{Q^1_{corr,i,t} + Q^2_{corr,i,t} + Q^3_{corr,i,t} + Q^4_{corr,i,t} + Q^5_{corr,i,t}}{100} \\ Q^s_{inc,i,t} &= \frac{Q^s_{corr,i,t}}{z_i} \end{aligned}$$

With this correction, at least some of the differences can be accounted for that appear if the quantile shares are expenditure-based instead of income-based. For the Gini coefficient, instead of adding 6.07 to the expenditure-based measure, 6.6 is added such that this correction is line with the proposition by Deininger and Squire (1996) and comparable to the literature. Detailed information on the variables, sources and summary statistics can be found in Appendices A and B.

## 3.2 Specification and Estimation Method

The 5-year dynamic panel data model, based on the work by Caselli, Esquivel, and Lefort (1996) and used by Barro (2000), Forbes (2000) and Voitchovsky (2005) in a inequality-growth context, has the following form:

$$y_{it} - y_{it-1} = (\alpha - 1)y_{it-1} + \beta \mathbf{x}_{it} + \zeta_t + \eta_i + \nu_{it} \tag{5}$$

where $i = 1, ..., n$ indicates the country and $t = 1, ...T$ the time period. Because a 5-year panel data model is applied, $t$ and $t - 1$ are 5 years apart. For the variable $y$ the log of real GDP per capita (in 2000 US$) from the World Bank World Development Indicators (WDI) database is used, wherefore the left-hand side is approximately the 5-year growth rate of country $i$. Vector $\mathbf{x}$ contains the inequality measures and additional control variables. As mentioned above, in some of the specifications the income share of the lowest quintile, Q1, is included along with the share of the middle class, MC (which consists of the second, third, and fourth quintile) to measure income inequality. In alternative specifications, it is controlled for the share of the middle class along with the share of the richest quintile, Q5. For comparison purposes, also results using the Gini coefficient instead of the quantile shares will be reported. Following Perotti (1996) and Forbes (2000), the average years of secondary schooling in the male and female population aged over 25 from Barro and Lee (2000) and the price level of investment from Heston, Summers, and Aten (2009) (PWT 6.3) are included as control variables in the baseline model. Because the theoretical model predicts how efficient a given capital stock is allocated (see Section 2), the investment share (gross fixed capital formation (% of GDP)) from the WDI database is used as an additional control variable in an extension of the baseline model. All explanatory variables apart from the investment share are measured at the beginning of a 5-year period. For the investment share the mean over a 5-year period is taken. Finally, $y_{it-1}$ is included to control for convergence, $\eta_i$ for country-specific fixed effects, $\zeta_t$ for time fixed effects common to all countries, and $\nu_{it}$ is an idiosyncratic error term. Focusing on growth from 1965-2005 and due to data availability, the analysis includes 83 countries and 342 observations.

Because income inequality and the other control variables cannot be taken as exogenous, the dynamic panel data model will be estimated by the system GMM estimator developed by Arellano and Bover (1995) and Blundell and Bond (1998). This estimator connects the first-difference GMM estimator, which only uses within-country variation (and thus equation (5) in first-differences, see Arellano and Bond (1991)), together with equation (5) in levels. Therefore, the system GMM estimator makes use also of the cross-country differences and points to the long-run relationship between income inequality and growth (see Halter, Oechslin, and Zweimüller (2011)). As can be seen in Table 2, the between variances of the quantile shares is more important than the within variances, confirming the fact that income inequality only changes slowly over time within countries. Similarly the difference in the adjusted $R^2$ between a regression of the quantile shares on country dummies and on country and time dummies is only small. The adjusted $R^2$ for the first quintile using only country dummies is 0.74 and rises only to 0.76 if time dummies are included as well. The corresponding adjusted $R^2$ for the middle class, fifth quintile or the Gini coefficient is 0.83 and 0.85, respectively. In cases where the time series variation is persistent and the number of time series is small, the first-difference GMM estimator is shown to behave poorly and the system GMM estimator is more adequate (see Bond, Hoeffler, and Temple (2001)). However for completeness and to compare short- and medium- to long-run effects, also results from the first-difference GMM estimator are reported (see Section 4.2).

Suitably lagged values in levels are used as instruments for equation (5) in first-differences, and suitably lagged first-differences as instruments for equation (5) in levels. The quantile shares, the education variables and the price level of investment are considered to be predetermined.[7] However, both the first lag of GDP per capita and the investment share (measured as the average over a 5-year period) are considered as endogenous.

Thus for endogenous variables $E(y_{it-s}\triangle\nu_{it}) = 0$ for $t \geq 3$ and $s \geq 2$ are moment conditions for equation (5) in first-differences, and $E(\triangle y_{it-1}u_{it}) = 0$ for $t \geq 3$ (where $u_{it} = \eta_i + \nu_{it}$) are

[7] Remember that they are measured at the beginning of a 5-year period.

**Table 2:** Within and Between Variances

| Variable | | Mean | Std. Dev. | Min | Max | Observations |
|---|---|---|---|---|---|---|
| Q1 | overall | 5.823575 | 2.499111 | 0.580058 | 11.9 | N = 498 |
| | between | | 2.346445 | 0.789958 | 11.13961 | n = 124 |
| | within | | 1.113551 | 1.101399 | 9.767514 | |
| Middle Class | overall | 46.51889 | 7.735492 | 18.35 | 59.33 | N = 498 |
| | between | | 8.035165 | 18.48407 | 55.91737 | n = 124 |
| | within | | 2.741637 | 33.7859 | 57.49575 | |
| Q5 | overall | 47.65754 | 9.913901 | 29.06 | 80.91 | N = 498 |
| | between | | 10.15573 | 32.99891 | 80.72598 | n = 124 |
| | within | | 3.508304 | 33.24463 | 63.8071 | |
| Gini coefficient | overall | 41.37504 | 11.71564 | 17.83 | 77.3 | N = 498 |
| | between | | 11.96172 | 21.66667 | 76.95 | n = 124 |
| | within | | 4.136141 | 23.57004 | 61.05059 | |

Note: Based on data set described in Section 3.1.

moment conditions for equation (5) in levels. For variables that are considered as predetermined, one more lag is available to construct moment conditions for equation (5) in first-differences: $E(x_{it-s}\triangle\nu_{it}) = 0$ for $t \geq 3$ and $s \geq 1$. For equation (5) in levels, $E(\triangle x_{it-s}u_{it}) = 0$ for $t \geq 3$ and $s \epsilon \{0, 1\}$ can be used as moment conditions. In order to be valid instruments for the equation in levels, the first differences of $y_{it}$ and $x_{it}$ have to be uncorrelated with the country-specific effect $\eta_i$. For the first-difference GMM estimator, only the first-difference of equation (5) is considered, and thus also only the moment conditions that use levels of the explanatory variables as instruments. Note that the system GMM estimation method does allow to include more observations than the first-difference GMM approach.

In applying both first-difference and system GMM estimator, the problem of instrument proliferation that appears as the number of instruments is quadratic in T has to be taken into account (see Roodman (2009)). If too many instruments are used, the instrumented variables are overfitted, and the estimated coefficients biased towards those from non-instrumented estimators. In the case of system GMM, if too many instruments are used, the coefficients estimated are approaching those of an OLS estimation. Another problem that arises by using many instruments is the weakening of the Hansen J-test whether the instruments are valid or not (Roodman (2009)). Also, the Difference-in-Hansen test of exogeneity of instrument subsets is weakened if too many instruments are used. To deal with these problems and to check the robustness of the results, different techniques proposed by Roodman (2009) are employed to reduce the number of instruments. First, the number of instruments is reduced by using just the second lag for endogenous variables and the first lag for predetermined variables (thus using just the first available lag for each variable). Second, a technique called collapsing is applied. This means that not separate moment conditions for each lag and time period $t$ are used, but for each lag only discarding the time dimension. For endogenous variables for example, the moment conditions for equation (5) in first-differences then reduce to $E(y_{it-s}\triangle\nu_{it}) = 0$ for each $s \geq 2$. Third, these two techniques are combined to reduce the set of instruments further.

# 4 Results

## 4.1 System GMM Estimation

To exclude a possible sample selection bias due to the manner the database of quantile shares is constructed and to compare the results with the previous literature (e.g., Perotti (1996), Barro (2000) and Halter, Oechslin, and Zweimüller (2011)), the estimate of the dynamic panel data model is first done with the Gini coefficient. Then quantile shares are introduced instead of the Gini coefficient. As discussed above, the focus is on system GMM estimation results, as this estimation method is more appropriate if explanatory variables are persistent over time. Because the results using the quantile shares differ between poorer and richer countries, these two sub-samples will be investigated separately. For this purpose, the database is split according to the WDI country classification from the year 2000 (see Appendix Table A.2) into two groups consisting of high and upper middle income countries and low and lower middle income countries, respectively.[8] Additionally, the sensitivity of the result to the inclusion of the investment share as another control variable is tested.

As can be seen in Tables 3 through 5, income inequality, measured by the Gini coefficient, in general exerts a negative effect on growth. This corresponds to findings of Perotti (1996) and Barro (2000), who make use of the cross-country variation and Halter, Oechslin, and Zweimüller (2011). However, columns 3, 5 and 7 in Table 3 demonstrates that this relationship is not robust to the reduction of the set of moment conditions if the full sample is employed. Only for the model including the investment share, the coefficient is significant in three out of four cases (columns 2, 4, 6 and 8 in Table 3). Looking at the sample of high and upper middle income countries (see Table 4) does also indicate a negative relationship between income inequality and growth, although the coefficients are not significant with only one exception (column 3). The introduction of the investment share does not change this result and even if the absolute value of the coefficient rises if the number of instruments is decreased (columns 3 through 8), the effect of the Gini coefficient on growth is not significant in this sub-sample. This suggests that inequality measured by the Gini coefficient does not allow to identify a significant effect in the sample of richer countries. In the sample of low and lower middle income countries the impact of income inequality measured by the Gini coefficient is significantly negative and robust to the inclusion of the investment share and

[8] The sensitivity of the results is tested with respect to the choice of the year for the country classification. Using the country classification either from the year 1990 or from the year 2005 does not change the results.

the reduction in the instrument set (see Table 5).

Next the results employing the quantile shares as measures for income inequality are discussed. Thus the only modification in the baseline model is the inclusion of an inequality measure other than the Gini coefficient. By using the first quintile (Q1) and the middle class (MC), the omitted group is the fifth quintile (Q5). This allows to capture top-end inequality, because a change of MC has to be at the expense (or in favor) of Q5 as Q1 is controlled for. Similar, a change in Q1 has to be at the expense (or in favor) of Q5 as MC is controlled for, thus capturing redistributions from the top to the bottom or vice versa. On the other hand, by using Q5 and MC, the omitted group is Q1. This in turn allows to look at bottom-end inequality, as a change of MC has to be at the expense (or in favor) of Q1, because Q5 is controlled for. Again, a change in Q5 (at the expense or in favor of Q1) captures a redistribution from the top to the bottom (or vice versa).

As Table 6 shows, no consistent pattern is revealed for the full sample. The different quantile shares have no significant effect on growth and also the inclusion of the investment share does not change this finding (see Table 7). However, comparing the outcome between using the poorer and the richer countries separately shows that the signs are just opposite. Thus, as the signs are just opposite in the sample of poorer compared to the sample of richer countries, it is no surprise that income inequality measured by the quantile shares seems to have no effect employing the full sample. For the high and upper middle income countries lower bottom-end inequality and a higher Q1 at the expense of Q5 is beneficial for growth (see Table 8). This result is robust to the reduction in the number of instruments used (columns 3 through 8) and to the inclusion of the investment share (see Table 9). Also, evidence is found for a positive effect of higher top-end inequality on growth. Especially if the investment share is controlled for, this effect is robust to the reduction in the instrument set. Hence, less inequality in the lower part of the distribution is good for growth. However, more inequality in the upper part of the distribution also seems to promote growth. This confirms the results from Voitchovsky (2005), although, as mentioned above, her results are based on a relatively small sample of 25 high-income countries. Additionally, as predicted by the theoretical model (see Section 2), a strong and significant impact of a redistribution from the top to the bottom of the distribution is detected. Furthermore, the result for the richer countries offers an explanation why no significant effect of the Gini coefficient on growth is found in this sub-sample of countries. As a redistribution from the middle to the top increases overall inequality (ceteris paribus) and a redistribution from the top and the middle to the bottom reduces overall inequality (ceteris paribus), two opposite effects are at work which can only be distinguished by the quantile shares, but not the Gini coefficient.

In the sample of low and lower middle income countries (see Table 10) the results suggest that lower top-end and higher bottom-end inequality promotes growth, however only lower top-end inequality is significant in two of four cases (and significant at a level of 13.1% in another case). This result is robust to the inclusion of the investment share (see Table 11). One interpretation could be that the middle class in poorer places takes the role of Q1 in richer countries whereas the poorest people in poor countries do neither invest in physical nor human capital (because, for instance, a set-up cost is required which the poor cannot bring up). Under these circumstances, consistent with the empirical findings, the Foellmi-Oechslin framework would predict that an increase in the middle-class share unambiguously promotes economic performance.

**Table 3:** System GMM: Gini Coefficient, Full Sample

| SYSTEM GMM: Full sample | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Dependent variable: 5-year growth rate of real GDP p.c. | | | | | | | |
| | All possible instruments | | Only first lag as instrument | | Moment conditions collapsed | | Moment conditions collapsed and only first lag as instrument | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| $\log(\text{GDP})_{t\text{-}1}$ | -0.0103 | -0.0215** | -0.0033 | -0.0254** | -0.0043 | -0.0297 | -0.0069 | -0.0298 |
| | (0.436) | (0.032) | (0.812) | (0.045) | (0.881) | (0.203) | (0.879) | (0.347) |
| Gini coefficient | -0.0025* | -0.0027** | -0.0023 | -0.0030** | -0.0031 | -0.0037* | -0.0008 | -0.0028 |
| | (0.066) | (0.010) | (0.129) | (0.012) | (0.239) | (0.074) | (0.792) | (0.246) |
| Investment share | | 0.0085*** | | 0.0103*** | | 0.0108*** | | 0.0113*** |
| | | (0.000) | | (0.000) | | (0.000) | | (0.000) |
| Female schooling | -0.0696** | -0.0381* | -0.0673* | -0.0259 | -0.0851 | -0.0379 | -0.1007 | -0.0485 |
| | (0.015) | (0.056) | (0.060) | (0.318) | (0.152) | (0.370) | (0.154) | (0.350) |
| Male schooling | 0.0836*** | 0.0563*** | 0.0866** | 0.0468** | 0.1102* | 0.0687* | 0.1553** | 0.0874* |
| | (0.003) | (0.003) | (0.015) | (0.049) | (0.053) | (0.085) | (0.018) | (0.083) |
| Price level of investment | -0.0013*** | -0.0007* | -0.0018*** | -0.0008 | -0.0013 | -0.0003 | -0.0027*** | -0.0010 |
| | (0.008) | (0.079) | (0.005) | (0.128) | (0.178) | (0.646) | (0.006) | (0.262) |
| Number of countries | 83 | 81 | 83 | 81 | 83 | 81 | 83 | 81 |
| Number of observations | 342 | 335 | 342 | 335 | 342 | 335 | 342 | 335 |
| Number of instruments | 199 | 234 | 94 | 108 | 44 | 52 | 14 | 16 |
| M1 | -4.47 | -4.06 | -4.36 | -4.04 | -4.32 | -3.89 | -4.08 | -3.88 |
| M2 | -0.77 | -0.60 | -0.84 | -0.63 | -0.64 | -0.43 | -1.06 | -0.60 |
| Hansen | 1 | 1 | 0.86 | 1 | 0.27 | 0.15 | 0.082 | 0.22 |

Note: p-values in parentheses; *, **, and *** indicate, respectively, significance of the parameter estimates on the 10%, 5%, and the 1% level; all regressions include period dummies; M1 and M2 are the t-values of the tests for, respectively, first-order and second-order serial correlation in the differenced error terms; Hansen denotes the p-value of the Hansen test of over identifying restrictions.

**Table 4:** System GMM: Gini Coefficient, Richer Countries

**SYSTEM GMM: High and upper middle income countries**

| | Dependent variable: 5-year growth rate of real GDP p.c. | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | All possible instruments | | Only first lag as instrument | | Moment conditions collapsed | | Moment conditions collapsed and only first lag as instrument | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| $\log(GDP)_{t-1}$ | -0.0170 | -0.0260* | -0.0366* | -0.0392** | -0.0279 | -0.0147 | 0.0015 | -0.00302 |
| | (0.292) | (0.056) | (0.082) | (0.029) | (0.679) | (0.740) | (0.991) | (0.960) |
| Gini coefficient | -0.0010 | -0.0009 | -0.0019** | -0.0015 | -0.0024 | -0.0023 | -0.0024 | -0.0012 |
| | (0.156) | (0.215) | (0.027) | (0.129) | (0.462) | (0.456) | (0.523) | (0.716) |
| Investment share | | 0.0073*** | | 0.0087*** | | 0.0082*** | | 0.0060 |
| | | (0.000) | | (0.000) | | (0.002) | | (0.239) |
| Female schooling | -0.0312 | -0.0086 | -0.0404 | -0.0083 | -0.0727* | -0.0344 | -0.1324* | -0.0964 |
| | (0.134) | (0.607) | (0.139) | (0.708) | (0.093) | (0.436) | (0.065) | (0.182) |
| Male schooling | 0.0544** | 0.0331* | 0.0705** | 0.0371 | 0.1245*** | 0.0642 | 0.1913*** | 0.1452** |
| | (0.026) | (0.095) | (0.020) | (0.156) | (0.010) | (0.142) | (0.006) | (0.034) |
| Price level of investment | -0.0015*** | -0.0010* | -0.0016*** | -0.0009 | -0.0026*** | -0.0014** | -0.0028*** | -0.0020** |
| | (0.003) | (0.077) | (0.005) | (0.129) | (0.001) | (0.040) | (0.003) | (0.014) |
| Number of countries | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 |
| Number of observations | 213 | 212 | 213 | 212 | 213 | 212 | 213 | 212 |
| Number of instruments | 192 | 203 | 94 | 108 | 44 | 52 | 14 | 16 |
| M1 | -3.22 | -3.42 | -3.26 | -3.52 | -3.12 | -3.36 | -2.49 | -3.15 |
| M2 | -1.16 | -0.77 | -1.05 | -0.65 | -1.05 | -0.79 | -1.12 | -0.91 |
| Hansen | 1 | 1 | 1 | 1 | 0.96 | 0.99 | 0.85 | 0.96 |

Note: p-values in parentheses; *, **, and *** indicate, respectively, significance of the parameter estimates on the 10%, 5%, and the 1% level; all regressions include period dummies; M1 and M2 are the t-values of the tests for, respectively, first-order and second-order serial correlation in the differenced error terms; Hansen denotes the p-value of the Hansen test of over identifying restrictions.

**Table 5:** System GMM: Gini Coefficient, Poorer Countries

| SYSTEM GMM: Low and lower middle income countries | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Dependent variable: 5-year growth rate of real GDP p.c. | | | | | | | |
| | All possible instruments | | Only first lag as instrument | | Moment conditions collapsed | | Moment conditions collapsed and only first lag as instrument | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| $\log(\mathrm{GDP})_{t-1}$ | -0.0360* | -0.0369** | -0.0397 | -0.0334 | 0.0015 | -0.0015 | 0.1718 | 0.0347 |
| | (0.091) | (0.047) | (0.114) | (0.130) | (0.977) | (0.969) | (0.206) | (0.619) |
| Gini coefficient | -0.0036* | -0.0042*** | -0.0043* | -0.0047*** | -0.0085** | -0.0065** | -0.0126** | -0.0083*** |
| | (0.052) | (0.004) | (0.057) | (0.002) | (0.013) | (0.010) | (0.024) | (0.002) |
| Investment share | | 0.0072** | | 0.0098*** | | 0.0100*** | | 0.0119*** |
| | | (0.027) | | (0.009) | | (0.004) | | (0.006) |
| Female schooling | 0.0023 | 0.0036 | 0.0255 | -0.0059 | -0.0051 | -0.0254 | -0.1977 | -0.0721 |
| | (0.952) | (0.905) | (0.524) | (0.873) | (0.943) | (0.665) | (0.275) | (0.505) |
| Male schooling | 0.0330 | 0.0253 | 0.0108 | 0.0247 | -0.0249 | 0.0019 | 0.0260 | 0.0030 |
| | (0.409) | (0.441) | (0.786) | (0.509) | (0.532) | (0.967) | (0.781) | (0.965) |
| Price level of investment | -0.0006 | -0.0004 | -0.0006 | -0.0003 | -0.0005 | 0.0002 | 0.0019 | 0.0012 |
| | (0.242) | (0.452) | (0.335) | (0.528) | (0.417) | (0.747) | (0.191) | (0.122) |
| Number of countries | 43 | 41 | 43 | 41 | 43 | 41 | 43 | 41 |
| Number of observations | 129 | 123 | 129 | 123 | 129 | 123 | 129 | 123 |
| Number of instruments | 116 | 113 | 87 | 89 | 44 | 52 | 14 | 16 |
| M1 | -2.76 | -2.08 | -2.75 | -1.96 | -2.50 | -1.89 | -2.25 | -1.78 |
| M2 | -1.49 | -1.57 | -1.49 | -1.53 | -1.67 | -1.49 | -1.03 | -1.39 |
| Hansen | 1 | 1 | 1 | 1 | 0.79 | 0.99 | 0.05 | 0.21 |

Note: p-values in parentheses; *, **, and *** indicate, respectively, significance of the parameter estimates on the 10%, 5%, and the 1% level; all regressions include period dummies; M1 and M2 are the t-values of the tests for, respectively, first-order and second-order serial correlation in the differenced error terms; Hansen denotes the p-value of the Hansen test of over identifying restrictions.

**Table 6:** System GMM: Quantile Shares, Full Sample

| SYSTEM GMM: Full sample | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Dependent variable: 5-year growth rate of real GDP p.c. | | | | | | | |
| | All possible instruments | | Only first lag as instrument | | Moment conditions collapsed | | Moment conditions collapsed and only first lag as instrument | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| $\log(\text{GDP})_{t\text{-}1}$ | -0.0085 | -0.0104 | 0.0003 | -0.0014 | -0.0095 | -0.0021 | 0.0050 | 0.0064 |
| | (0.520) | (0.434) | (0.983) | (0.926) | (0.760) | (0.944) | (0.905) | (0.872) |
| Q1 | 0.0010 | | 0.0070 | | -0.0014 | | 0.0104 | |
| | (0.878) | | (0.246) | | (0.870) | | (0.260) | |
| Middle Class | 0.0037 | 0.0010 | 0.0006 | -0.0060 | 0.0053 | 0.0063 | -0.0015 | -0.0065 |
| | (0.223) | (0.919) | (0.873) | (0.582) | (0.287) | (0.682) | (0.759) | (0.694) |
| Q5 | | -0.0022 | | -0.0064 | | 0.0010 | | -0.0065 |
| | | (0.762) | | (0.412) | | (0.923) | | (0.597) |
| Female schooling | -0.0570** | -0.0579** | -0.0588** | -0.0667** | -0.0723 | -0.0809 | -0.0978 | -0.0987 |
| | (0.025) | (0.026) | (0.046) | (0.033) | (0.188) | (0.153) | (0.139) | (0.132) |
| Male schooling | 0.0668** | 0.0704*** | 0.0756** | 0.0825*** | 0.1003* | 0.1020* | 0.1368** | 0.1335** |
| | (0.010) | (0.007) | (0.011) | (0.006) | (0.052) | (0.051) | (0.022) | (0.026) |
| Price level of investment | -0.0012*** | -0.0012*** | -0.0017*** | -0.0016*** | -0.0012 | -0.0011 | -0.0024*** | -0.0022*** |
| | (0.008) | (0.007) | (0.005) | (0.005) | (0.145) | (0.197) | (0.003) | (0.003) |
| Number of countries | 83 | 83 | 83 | 83 | 83 | 83 | 83 | 83 |
| Number of observations | 342 | 342 | 342 | 342 | 342 | 342 | 342 | 342 |
| Number of instruments | 240 | 240 | 114 | 114 | 53 | 53 | 17 | 17 |
| M1 | -4.35 | -4.37 | -4.40 | -4.41 | -4.26 | -4.28 | -4.39 | -4.35 |
| M2 | -0.98 | -0.94 | -0.87 | -0.88 | -0.82 | -0.88 | -0.84 | -0.92 |
| Hansen | 1 | 1 | 0.99 | 1 | 0.18 | 0.13 | 0.079 | 0.054 |

Note: p-values in parentheses; *, **, and *** indicate, respectively, significance of the parameter estimates on the 10%, 5%, and the 1% level; all regressions include period dummies; M1 and M2 are the t-values of the tests for, respectively, first-order and second-order serial correlation in the differenced error terms; Hansen denotes the p-value of the Hansen test of over identifying restrictions.

**Table 7:** System GMM: Quantile Shares, Full Sample, Including Investment Share

| **SYSTEM GMM: Full sample, including investment share** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Dependent variable: 5-year growth rate of real GDP p.c. | | | | | | | |
| | All possible instruments | | Only first lag as instrument | | Moment conditions collapsed | | Moment conditions collapsed and only first lag as instrument | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| $\log(\text{GDP})_{t-1}$ | -0.0197** | -0.0204* | -0.0221* | -0.0252** | -0.0324 | -0.0305 | -0.0236 | -0.0243 |
| | (0.045) | (0.054) | (0.088) | (0.049) | (0.164) | (0.191) | (0.437) | (0.424) |
| Q1 | 0.0053 | | 0.0117* | | 0.0028 | | 0.0085 | |
| | (0.359) | | (0.068) | | (0.737) | | (0.323) | |
| Middle Class | 0.0024 | -0.0036 | 0.0009 | -0.0087 | 0.0052 | -0.0015 | 0.0020 | -0.0102 |
| | (0.332) | (0.651) | (0.767) | (0.385) | (0.207) | (0.915) | (0.657) | (0.552) |
| Q5 | | -0.0058 | | -0.0099 | | -0.0057 | | -0.0114 |
| | | (0.321) | | (0.191) | | (0.580) | | (0.348) |
| Investment share | 0.0084*** | 0.0083*** | 0.0109*** | 0.0110*** | 0.0113*** | 0.0112*** | 0.0118*** | 0.0118*** |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Female schooling | -0.0199 | -0.0225 | -0.0169 | -0.0157 | -0.0264 | -0.0334 | -0.0440 | -0.0459 |
| | (0.305) | (0.284) | (0.465) | (0.495) | (0.500) | (0.413) | (0.371) | (0.354) |
| Male schooling | 0.0377* | 0.0416** | 0.0346* | 0.0355* | 0.0563 | 0.0636* | 0.0729 | 0.0753 |
| | (0.051) | (0.040) | (0.094) | (0.085) | (0.136) | (0.094) | (0.118) | (0.103) |
| Price level of investment | -0.0008* | -0.0008* | -0.0008 | -0.0007 | -0.0002 | -0.0002 | -0.0008 | -0.0008 |
| | (0.071) | (0.061) | (0.161) | (0.206) | (0.694) | (0.749) | (0.311) | (0.285) |
| Number of countries | 81 | 81 | 81 | 81 | 81 | 81 | 81 | 81 |
| Number of observations | 335 | 335 | 335 | 335 | 335 | 335 | 335 | 335 |
| Number of instruments | 272 | 272 | 128 | 128 | 61 | 61 | 19 | 19 |
| M1 | -4.06 | -4.05 | -4.00 | -4.01 | -3.89 | -3.90 | -3.92 | -3.83 |
| M2 | -0.70 | -0.70 | -0.70 | -0.67 | -0.59 | -0.57 | -0.63 | -0.61 |
| Hansen | 1 | 1 | 1 | 1 | 0.18 | 0.19 | 0.16 | 0.15 |

Note: p-values in parentheses; *, **, and *** indicate, respectively, significance of the parameter estimates on the 10%, 5%, and the 1% level; all regressions include period dummies; M1 and M2 are the t-values of the tests for, respectively, first-order and second-order serial correlation in the differenced error terms; Hansen denotes the p-value of the Hansen test of over identifying restrictions.

**Table 8:** System GMM: Quantile Shares, Richer Countries

| SYSTEM GMM: High and upper middle income countries | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Dependent variable: 5-year growth rate of real GDP p.c. | | | | | | | |
| | All possible instruments | | Only first lag as instrument | | Moment conditions collapsed | | Moment conditions collapsed and only first lag as instrument | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| $\log(GDP)_{t\text{-}1}$ | -0.0101 | -0.0101 | -0.0160 | -0.0121 | 0.0145 | -0.0010 | 0.1156 | 0.0441 |
| | (0.568) | (0.568) | (0.375) | (0.541) | (0.810) | (0.987) | (0.353) | (0.684) |
| Q1 | 0.0112** | | 0.0186*** | | 0.0239*** | | 0.0254*** | |
| | (0.026) | | (0.006) | | (0.007) | | (0.002) | |
| Middle Class | -0.0028 | -0.0140** | -0.0048* | -0.0203** | -0.0091 | -0.0359** | -0.0150** | -0.0505*** |
| | (0.150) | (0.036) | (0.061) | (0.036) | (0.215) | (0.010) | (0.047) | (0.004) |
| Q5 | | -0.0112** | | -0.0157** | | -0.0266*** | | -0.0344*** |
| | | (0.026) | | (0.024) | | (0.007) | | (0.007) |
| Female schooling | -0.0310 | -0.0310 | -0.0362 | -0.0445* | -0.0621 | -0.0583 | -0.1244* | -0.1246* |
| | (0.130) | (0.130) | (0.146) | (0.070) | (0.130) | (0.182) | (0.067) | (0.068) |
| Male schooling | 0.0567** | 0.0567** | 0.0657** | 0.0705** | 0.1014** | 0.1068** | 0.1585** | 0.1803*** |
| | (0.022) | (0.022) | (0.017) | (0.013) | (0.038) | (0.039) | (0.027) | (0.009) |
| Price level of investment | -0.0017*** | -0.0017*** | -0.0018*** | -0.0017*** | -0.0026*** | -0.0026*** | -0.0027*** | -0.0026*** |
| | (0.001) | (0.001) | (0.001) | (0.002) | (0.000) | (0.000) | (0.002) | (0.001) |
| Number of countries | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 |
| Number of observations | 213 | 213 | 213 | 213 | 213 | 213 | 213 | 213 |
| Number of instruments | 204 | 204 | 114 | 114 | 53 | 53 | 17 | 17 |
| M1 | -3.20 | -3.20 | -3.20 | -3.19 | -3.20 | -3.18 | -2.90 | -2.97 |
| M2 | -1.06 | -1.06 | -0.95 | -1.01 | -0.91 | -0.82 | -1.02 | -0.79 |
| Hansen | 1 | 1 | 1 | 1 | 1 | 1 | 0.83 | 0.97 |

Note: p-values in parentheses; *, **, and *** indicate, respectively, significance of the parameter estimates on the 10%, 5%, and the 1% level; all regressions include period dummies; M1 and M2 are the t-values of the tests for, respectively, first-order and second-order serial correlation in the differenced error terms; Hansen denotes the p-value of the Hansen test of over identifying restrictions.

**Table 9:** System GMM: Quantile Shares, Richer Countries, Including Investment Share

**SYSTEM GMM: High and upper middle income countries, including investment share**

| | Dependent variable: 5-year growth rate of real GDP p.c. | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | All possible instruments | | Only first lag as instrument | | Moment conditions collapsed | | Moment conditions collapsed and only first lag as instrument | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| $\log(GDP)_{t-1}$ | -0.0178 | -0.0178 | -0.0179 | -0.0162 | 0.0084 | -0.0022 | 0.0447 | 0.0394 |
| | (0.199) | (0.199) | (0.271) | (0.356) | (0.853) | (0.959) | (0.455) | (0.516) |
| Q1 | 0.0128*** | | 0.0183*** | | 0.0203** | | 0.0240*** | |
| | (0.010) | | (0.003) | | (0.012) | | (0.001) | |
| Middle Class | -0.0035** | -0.0163*** | -0.00524** | -0.0228*** | -0.0070 | -0.0319*** | -0.0150** | -0.0463*** |
| | (0.024) | (0.009) | (0.015) | (0.006) | (0.307) | (0.007) | (0.019) | (0.002) |
| Q5 | | -0.0128*** | | -0.0173*** | | -0.0237*** | | -0.0305*** |
| | | (0.010) | | (0.004) | | (0.005) | | (0.003) |
| Investment share | 0.0076*** | 0.0076*** | 0.0074*** | 0.0074*** | 0.0091*** | 0.0092*** | 0.0063 | 0.0051 |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.001) | (0.259) | (0.371) |
| Female schooling | -0.0066 | -0.0066 | -0.0105 | -0.0155 | -0.0244 | -0.0208 | -0.0857 | -0.0943 |
| | (0.697) | (0.697) | (0.590) | (0.442) | (0.554) | (0.617) | (0.246) | (0.229) |
| Male schooling | 0.0347* | 0.0347* | 0.0387 | 0.0417* | 0.0468 | 0.0524 | 0.1265 | 0.1403* |
| | (0.090) | (0.090) | (0.104) | (0.087) | (0.285) | (0.244) | (0.101) | (0.078) |
| Price level of investment | -0.0012** | -0.0012** | -0.0012** | -0.0011* | -0.0013** | -0.0013** | -0.0017* | -0.0020** |
| | (0.035) | (0.035) | (0.040) | (0.054) | (0.037) | (0.047) | (0.081) | (0.028) |
| Number of countries | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 |
| Number of observations | 212 | 212 | 212 | 212 | 212 | 212 | 212 | 212 |
| Number of instruments | 203 | 203 | 128 | 128 | 61 | 61 | 19 | 19 |
| M1 | -3.35 | -3.35 | -3.38 | -3.41 | -3.34 | -3.31 | -3.18 | -3.23 |
| M2 | -0.74 | -0.74 | -0.72 | -0.72 | -0.74 | -0.67 | -0.70 | -0.72 |
| Hansen | 1 | 1 | 1 | 1 | 1 | 1 | 0.93 | 0.98 |

Note: p-values in parentheses; *, **, and *** indicate, respectively, significance of the parameter estimates on the 10%, 5%, and the 1% level; all regressions include period dummies; M1 and M2 are the t-values of the tests for, respectively, first-order and second-order serial correlation in the differenced error terms; Hansen denotes the p-value of the Hansen test of over identifying restrictions.

**Table 10:** Results: Quantile Shares, Poorer Countries

| SYSTEM GMM: Low and lower middle income countries | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Dependent variable: 5-year growth rate of real GDP p.c. | | | | | | | |
| | All possible instruments | | Only first lag as instrument | | Moment conditions collapsed | | Moment conditions collapsed and only first lag as instrument | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| $\log(GDP)_{t\text{-}1}$ | -0.0366 | -0.0366 | -0.0389 | -0.0388 | 0.0291 | 0.0035 | 0.1180 | 0.0803 |
| | (0.103) | (0.103) | (0.131) | (0.128) | (0.594) | (0.952) | (0.189) | (0.427) |
| Q1 | -0.0056 | | -0.0106 | | -0.0143 | | -0.0058 | |
| | (0.715) | | (0.535) | | (0.542) | | (0.839) | |
| Middle Class | 0.0069 | 0.0125 | 0.0092 | 0.0195 | 0.0152** | 0.0277 | 0.0186* | 0.0403 |
| | (0.196) | (0.536) | (0.131) | (0.389) | (0.037) | (0.391) | (0.057) | (0.421) |
| Q5 | | 0.0056 | | 0.0104 | | 0.0126 | | 0.0192 |
| | | (0.715) | | (0.545) | | (0.624) | | (0.627) |
| Female schooling | 0.0014 | 0.0014 | 0.0144 | 0.0171 | -0.0551 | -0.0149 | -0.1435 | -0.1065 |
| | (0.969) | (0.969) | (0.719) | (0.669) | (0.460) | (0.841) | (0.293) | (0.411) |
| Male schooling | 0.0340 | 0.0340 | 0.0223 | 0.0200 | 0.0175 | 0.0014 | 0.0259 | 0.0256 |
| | (0.365) | (0.365) | (0.561) | (0.605) | (0.683) | (0.972) | (0.745) | (0.724) |
| Price level of investment | -0.0006 | -0.0006 | -0.0004 | -0.0004 | -0.00008 | -0.0001 | 0.0015 | 0.0012 |
| | (0.272) | (0.272) | (0.459) | (0.451) | (0.904) | (0.828) | (0.131) | (0.239) |
| Number of countries | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 |
| Number of observations | 129 | 129 | 129 | 129 | 129 | 129 | 129 | 129 |
| Number of instruments | 119 | 119 | 95 | 95 | 53 | 53 | 17 | 17 |
| M1 | -2.48 | -2.48 | -2.38 | -2.39 | -2.07 | -2.13 | -1.84 | -1.75 |
| M2 | -1.26 | -1.26 | -1.18 | -1.20 | -1.19 | -1.20 | -0.92 | -1.00 |
| Hansen | 1 | 1 | 1 | 1 | 0.97 | 0.97 | 0.11 | 0.094 |

Note: p-values in parentheses; *, **, and *** indicate, respectively, significance of the parameter estimates on the 10%, 5%, and the 1% level; all regressions include period dummies; M1 and M2 are the t-values of the tests for, respectively, first-order and second-order serial correlation in the differenced error terms; Hansen denotes the p-value of the Hansen test of over identifying restrictions.

**Table 11:** Results: Quantile Shares, Poorer Countries, Including Investment Share

| SYSTEM GMM: Low and lower middle income countries, including investment share | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Dependent variable: 5-year growth rate of real GDP p.c. | | | | | | | |
| | All possible instruments | | Only first lag as instrument | | Moment conditions collapsed | | Moment conditions collapsed and only first lag as instrument | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| $\log(\text{GDP})_{t-1}$ | -0.0369* | -0.0369* | -0.0370* | -0.0369* | 0.0005 | -0.0179 | 0.0345 | 0.0063 |
| | (0.059) | (0.059) | (0.091) | (0.093) | (0.989) | (0.654) | (0.599) | (0.931) |
| Q1 | 0.0011 | | 0.0003 | | -0.0076 | | 0.0004 | |
| | (0.932) | | (0.982) | | (0.673) | | (0.985) | |
| Middle Class | 0.0059 | 0.0048 | 0.0065 | 0.0071 | 0.0104* | 0.0103 | 0.0117* | 0.0265 |
| | (0.177) | (0.771) | (0.164) | (0.686) | (0.095) | (0.631) | (0.086) | (0.514) |
| Q5 | | -0.0011 | | 0.0004 | | 0.0009 | | 0.0121 |
| | | (0.932) | | (0.975) | | (0.958) | | (0.708) |
| Investment share | 0.0070** | 0.0070** | 0.0085** | 0.0083** | 0.0097*** | 0.0095*** | 0.0116*** | 0.0107*** |
| | (0.029) | (0.029) | (0.018) | (0.019) | (0.007) | (0.008) | (0.007) | (0.006) |
| Female schooling | 0.0019 | 0.0019 | 0.0064 | 0.0072 | -0.0451 | -0.0127 | -0.0713 | -0.0433 |
| | (0.949) | (0.949) | (0.856) | (0.838) | (0.424) | (0.820) | (0.462) | (0.648) |
| Male schooling | 0.0265 | 0.0265 | 0.0158 | 0.0169 | 0.0348 | 0.0141 | 0.0101 | 0.0102 |
| | (0.413) | (0.413) | (0.636) | (0.622) | (0.430) | (0.741) | (0.873) | (0.863) |
| Price level of investment | -0.0003 | -0.0003 | -0.0004 | -0.0004 | 0.0004 | 0.0004 | 0.0013** | 0.0009 |
| | (0.483) | (0.483) | (0.449) | (0.490) | (0.544) | (0.523) | (0.027) | (0.165) |
| Number of countries | 41 | 41 | 41 | 41 | 41 | 41 | 41 | 41 |
| Number of observations | 123 | 123 | 123 | 123 | 123 | 123 | 123 | 123 |
| Number of instruments | 114 | 114 | 96 | 96 | 61 | 61 | 19 | 19 |
| M1 | -1.85 | -1.85 | -1.80 | -1.80 | -1.60 | -1.73 | -1.52 | -1.42 |
| M2 | -1.33 | -1.33 | -1.32 | -1.31 | -1.10 | -1.20 | -1.12 | -1.19 |
| Hansen | 1 | 1 | 1 | 1 | 1 | 1 | 0.20 | 0.15 |

Note: p-values in parentheses; *, **, and *** indicate, respectively, significance of the parameter estimates on the 10%, 5%, and the 1% level; all regressions include period dummies; M1 and M2 are the t-values of the tests for, respectively, first-order and second-order serial correlation in the differenced error terms; Hansen denotes the p-value of the Hansen test of over identifying restrictions.

As can be seen from the results reported, the p-value of the Hansen test of over identifying restrictions is indeed weakened if many instruments are used relative to the number of observations and thus is mostly near or exactly 1. However, if both methods to reduce the number of moment conditions are applied simultaneously, the p-value substantially drops in the sample of poorer countries and also in the full sample (see columns 7 and 8 in Tables 6, 7, 10 and 11). Only in the sample of high and upper middle income countries the p-value remains above 0.8 (see columns 7 and 8 in Table 8 and 9).

To further examine the exogeneity of instrument subsets, Table 12 reports several Difference-in-Hansen tests for the case where both methods to reduce the number of instruments are used. If both methods are combined, the number of over identifying restrictions is just equal to the number of moment conditions from equation (5) in levels, because the number of moment conditions from equation (5) in first-differences is identical to the number of unknowns. The p-value for the Difference-in-Hansen test excluding all instruments for the level equation is thus the same as the p-value reported in columns 7 and 8 in Tables 6 through 11. Also, the differentiation between moment conditions from endogenous variables and from predetermined variables indicates that the instrument set for equation (5) in levels is presumably not exogenous in the full sample and in the sample of low and lower middle income countries. Therefore, the results for these two groups have to be taken with caution. However, it seems as the instruments used for the sample of high and upper middle income countries are indeed exogenous. Thus, these results suggest that in the sample of low and lower middle income countries the country-specific fixed effect $\eta_i$ is probably not uncorrelated with the first differences of $y_{it}$ and $\mathbf{x}_{it}$ and that this is carried over to the full sample. A possible explanation is that institutions (captured by the country-specific fixed effects) do not play such an important role for growth in the richer countries but that differences in institutions indeed partly explain differences in growth rates (and changes in the predetermined variables) in poorer countries.

A further robustness check along with the reduction of the number of instruments and the inclusion of the investment share is to control for the square of the middle class to capture decreasing or increasing marginal effects (thus to test whether the relationship between inequality and growth is linear or not). According to Tables 13 and 15 for the system GMM estimation method, the results for the whole sample and the poorer countries are not altered by this extension. The coefficients for Middle Class and its square are never jointly significant at acceptable levels. Also for the richer countries, no nonlinearities are present (see Table 14). Here, the coefficients for Middle Class and its square are jointly significant at least at the 10% level in all specification. Further, the turning points (if they exist) are higher than 59.8 in all specifications and thus not

**Table 12:** Overview Hansen Tests

**Difference-in-Hansen tests of exogeneity of instrument subsets**

**Baseline specification: Moment conditions collapsed and only one lag as instrument**

| | p-value for null hypothesis = exogenous | | | | | |
|---|---|---|---|---|---|---|
| Excluded group of instruments for: | Full sample | | High and upper middle income countries | | Low and lower middle income countries | |
| Level equation: all variables | 0.079 | 0.054 | 0.831 | 0.968 | 0.109 | 0.094 |
| Level equation: only predetermined variables | 0.005 | 0.016 | 0.688 | 0.835 | 0.125 | 0.268 |
| Level equation: only endougenous variables | 0.054 | 0.044 | 0.832 | 0.972 | 0.076 | 0.068 |
| Q1 | yes | no | yes | no | yes | no |
| Middle Class | yes | yes | yes | yes | yes | yes |
| Q5 | no | yes | no | yes | no | yes |

**Including investment share: Moment conditions collapsed and only one lag as instrument**

| | p-value for null hypothesis = exogenous | | | | | |
|---|---|---|---|---|---|---|
| Excluded group of instruments for: | Full sample | | High and upper middle income countries | | Low and lower middle income countries | |
| Level equation: all variables | 0.157 | 0.153 | 0.931 | 0.982 | 0.200 | 0.154 |
| Level equation: only predetermined variables | 0.055 | 0.065 | 0.824 | 0.584 | 0.656 | 0.721 |
| Level equation: only endougenous variables | 0.132 | 0.102 | 0.937 | 0.974 | 0.236 | 0.165 |
| Q1 | yes | no | yes | no | yes | no |
| Middle Class | yes | yes | yes | yes | yes | yes |
| Q5 | no | yes | no | yes | no | yes |

Note: Table shows p-values for Difference-in-Hansen tests of exogeneity of instrument subset. The underlying regressions are as before and include, besides the inequality measures, female and male schooling, the price level of investment and time dummies and if indicated, the investment share. Only regression with moment conditions collapsed and one lag as instrument are considered.

reached by any country as the highest share of MC is 58.47 (see Table A.1 in Appendix A). Thus, lower bottom-end inequality, higher top-end inequality and a higher Q1 at the expense of Q5 still seem to increase growth in this sub-sample.

**Table 13:** System GMM: Full sample, Including Square of Middle Class

**SYSTEM GMM: Full sample,**
**including investment share and square of middle class**

Dependent variable: 5-year growth rate of real GDP p.c.

| | All possible instruments | | Only first lag as instrument | | Moment conditions collapsed | | Moment conditions collapsed and only first lag as instrument | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| $\log(\mathrm{GDP})_{t\text{-}1}$ | -0.0168* | -0.0165* | -0.0201* | -0.0227* | -0.0279 | -0.0298 | -0.0239 | -0.0244 |
| | (0.064) | (0.074) | (0.086) | (0.063) | (0.237) | (0.201) | (0.424) | (0.420) |
| Q1 | 0.0075 | | 0.0122** | | 0.0058 | | 0.0078 | |
| | (0.133) | | (0.029) | | (0.474) | | (0.363) | |
| Middle Class | 0.0134 | 0.0060 | 0.0076 | -0.0044 | 0.0196 | 0.0100 | 0.0157 | 0.0043 |
| | (0.198) | (0.592) | (0.570) | (0.776) | (0.266) | (0.617) | (0.401) | (0.837) |
| Q5 | | -0.0076 | | -0.0125** | | -0.0075 | | -0.0123 |
| | | (0.122) | | (0.047) | | (0.440) | | (0.191) |
| $(\text{Middle Class})^2$ | -0.0001 | -0.0001 | -0.00009 | -0.00009 | -0.0002 | -0.0002 | -0.0002 | -0.0002 |
| | (0.236) | (0.222) | (0.575) | (0.578) | (0.381) | (0.452) | (0.496) | (0.418) |
| Investment share | 0.0077*** | 0.0076*** | 0.0109*** | 0.0110*** | 0.0112*** | 0.0112*** | 0.0117*** | 0.0117*** |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Female schooling | -0.0227 | -0.0205 | -0.0204 | -0.0129 | -0.0352 | -0.0318 | -0.0438 | -0.0468 |
| | (0.254) | (0.301) | (0.354) | (0.558) | (0.365) | (0.442) | (0.366) | (0.336) |
| Male schooling | 0.0428** | 0.0415** | 0.0387* | 0.0307 | 0.0640* | 0.0622 | 0.0715 | 0.0757* |
| | (0.034) | (0.038) | (0.060) | (0.125) | (0.087) | (0.108) | (0.117) | (0.093) |
| Price level of investment | -0.0006 | -0.0006 | -0.0006 | -0.0005 | -0.0001 | -0.0001 | -0.0006 | -0.0006 |
| | (0.125) | (0.117) | (0.233) | (0.276) | (0.832) | (0.891) | (0.449) | (0.387) |
| Number of countries | 81 | 81 | 81 | 81 | 81 | 81 | 81 | 81 |
| Number of observations | 335 | 335 | 335 | 335 | 335 | 335 | 335 | 335 |
| Number of instruments | 301 | 300 | 148 | 148 | 70 | 70 | 22 | 22 |
| M1 | -4.06 | -4.06 | -3.95 | -3.97 | -3.95 | -3.90 | -3.95 | -3.92 |
| M2 | -0.56 | -0.55 | -0.62 | -0.62 | -0.49 | -0.52 | -0.59 | -0.58 |
| Hansen | 1 | 1 | 1 | 1 | 0.30 | 0.25 | 0.28 | 0.27 |

Note: p-values in parentheses; *, **, and *** indicate, respectively, significance of the parameter estimates on the 10%, 5%, and the 1% level; all regressions include period dummies; M1 and M2 are the t-values of the tests for, respectively, first-order and second-order serial correlation in the differenced error terms; Hansen denotes the p-value of the Hansen test of over identifying restrictions.

**Table 14:** System GMM: Richer Countries, Including Square of Middle Class

| SYSTEM GMM: High and upper middle income countries, including investment share and square of middle class | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Dependent variable: 5-year growth rate of real GDP p.c. | | | | | | | |
| | All possible instruments | | Only first lag as instrument | | Moment conditions collapsed | | Moment conditions collapsed and only first lag as instrument | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| $\log(GDP)_{t-1}$ | -0.0181 | -0.0181 | -0.0163 | -0.0194 | 0.0058 | -0.0037 | 0.0577 | 0.0406 |
| | (0.193) | (0.193) | (0.330) | (0.204) | (0.883) | (0.927) | (0.326) | (0.514) |
| Q1 | 0.0132** | | 0.0156*** | | 0.0174** | | 0.0195** | |
| | (0.010) | | (0.005) | | (0.031) | | (0.011) | |
| Middle Class | -0.0007 | -0.0138 | -0.0082 | -0.0218 | -0.0359** | -0.0539*** | -0.0321 | -0.0620** |
| | (0.963) | (0.325) | (0.584) | (0.107) | (0.040) | (0.003) | (0.190) | (0.010) |
| Q5 | | -0.0132** | | -0.0152*** | | -0.0211** | | -0.0256** |
| | | (0.010) | | (0.008) | | (0.024) | | (0.014) |
| $(\text{Middle Class})^2$ | -0.00003 | -0.00003 | 0.00004 | 0.00002 | 0.0003 | 0.0003 | 0.0002 | 0.0003 |
| | (0.842) | (0.842) | (0.810) | (0.885) | (0.127) | (0.126) | (0.509) | (0.333) |
| Investment share | 0.0075*** | 0.0075*** | 0.0077*** | 0.0079*** | 0.0098*** | 0.0091*** | 0.0061 | 0.0051 |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.271) | (0.333) |
| Female schooling | -0.0066 | -0.0066 | -0.0038 | -0.0026 | -0.0322 | -0.0225 | -0.0873 | -0.0891 |
| | (0.695) | (0.695) | (0.831) | (0.886) | (0.389) | (0.559) | (0.228) | (0.243) |
| Male schooling | 0.0349* | 0.0349* | 0.0334 | 0.0319 | 0.0563 | 0.0556 | 0.1261 | 0.1332* |
| | (0.087) | (0.087) | (0.141) | (0.157) | (0.167) | (0.193) | (0.102) | (0.089) |
| Price level of investment | -0.0011* | -0.0011* | -0.0012** | -0.0011** | -0.0014** | -0.0015** | -0.0018* | -0.0021** |
| | (0.056) | (0.056) | (0.040) | (0.049) | (0.026) | (0.021) | (0.053) | (0.010) |
| Number of countries | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 |
| Number of observations | 212 | 212 | 212 | 212 | 212 | 212 | 212 | 212 |
| Number of instruments | 203 | 203 | 147 | 147 | 70 | 70 | 22 | 22 |
| M1 | -3.36 | -3.36 | -3.40 | -3.39 | -3.19 | -3.29 | -3.10 | -3.21 |
| M2 | -0.76 | -0.76 | -0.70 | -0.69 | -0.60 | -0.56 | -0.72 | -0.70 |
| Hansen | 1 | 1 | 1 | 1 | 1 | 1 | 0.87 | 0.97 |

Note: p-values in parentheses; *, **, and *** indicate, respectively, significance of the parameter estimates on the 10%, 5%, and the 1% level; all regressions include period dummies; M1 and M2 are the t-values of the tests for, respectively, first-order and second-order serial correlation in the differenced error terms; Hansen denotes the p-value of the Hansen test of over identifying restrictions.

**Table 15:** System GMM: Poorer Countries, Including Square of Middle Class

**SYSTEM GMM: Low and lower middle income countries, including investment share and square of middle class**

| | Dependent variable: 5-year growth rate of real GDP p.c. | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | All possible instruments | | Only first lag as instrument | | Moment conditions collapsed | | Moment conditions collapsed and only first lag as instrument | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| $\log(GDP)_{t-1}$ | -0.0290 | -0.0290 | -0.0317 | -0.0325* | -0.0024 | -0.0044 | 0.0178 | 0.0084 |
| | (0.117) | (0.117) | (0.125) | (0.099) | (0.954) | (0.915) | (0.779) | (0.907) |
| Q1 | -0.0021 | | -0.0027 | | -0.0016 | | 0.0048 | |
| | (0.876) | | (0.847) | | (0.919) | | (0.831) | |
| Middle Class | -0.0132 | -0.0111 | -0.0063 | -0.0042 | 0.0067 | 0.0148 | 0.0184 | 0.0247 |
| | (0.440) | (0.541) | (0.747) | (0.841) | (0.802) | (0.647) | (0.519) | (0.606) |
| Q5 | | 0.0021 | | 0.0017 | | 0.0072 | | 0.0029 |
| | | (0.876) | | (0.902) | | (0.660) | | (0.928) |
| $(\text{Middle Class})^2$ | 0.0003 | 0.0003 | 0.0002 | 0.0002 | 0.00002 | 0.00003 | -0.0001 | -0.0001 |
| | (0.307) | (0.307) | (0.527) | (0.546) | (0.946) | (0.939) | (0.755) | (0.706) |
| Investment share | 0.0067** | 0.0067** | 0.0072** | 0.0077** | 0.0098*** | 0.0097*** | 0.0115*** | 0.0114*** |
| | (0.031) | (0.031) | (0.033) | (0.031) | (0.006) | (0.007) | (0.010) | (0.008) |
| Female schooling | 0.0107 | 0.0107 | 0.0123 | 0.0120 | -0.0377 | -0.0334 | -0.0618 | -0.0547 |
| | (0.737) | (0.737) | (0.714) | (0.722) | (0.506) | (0.541) | (0.506) | (0.548) |
| Male schooling | 0.0179 | 0.0179 | 0.0162 | 0.0155 | 0.0298 | 0.0305 | 0.0062 | 0.0077 |
| | (0.542) | (0.542) | (0.617) | (0.629) | (0.513) | (0.482) | (0.918) | (0.897) |
| Price level of investment | -0.0003 | -0.0003 | -0.0003 | -0.0003 | 0.0005 | 0.0002 | 0.0007 | 0.0006 |
| | (0.565) | (0.565) | (0.580) | (0.554) | (0.506) | (0.748) | (0.231) | (0.379) |
| Number of countries | 41 | 41 | 41 | 41 | 41 | 41 | 41 | 41 |
| Number of observations | 123 | 123 | 123 | 123 | 123 | 123 | 123 | 123 |
| Number of instruments | 114 | 114 | 102 | 102 | 70 | 70 | 22 | 22 |
| M1 | -1.81 | -1.81 | -1.78 | -1.78 | -1.63 | -1.62 | -1.53 | -1.43 |
| M2 | -1.30 | -1.30 | -1.28 | -1.31 | -1.17 | -1.19 | -1.16 | -1.15 |
| Hansen | 1 | 1 | 1 | 1 | 1 | 1 | 0.25 | 0.22 |

Note: p-values in parentheses; *, **, and *** indicate, respectively, significance of the parameter estimates on the 10%, 5%, and the 1% level; all regressions include period dummies; M1 and M2 are the t-values of the tests for, respectively, first-order and second-order serial correlation in the differenced error terms; Hansen denotes the p-value of the Hansen test of over identifying restrictions.

## 4.2 Comparison to First-Difference GMM

In this section, the results using the first-difference GMM estimation method are discussed for comparison purposes. Concentrating on the within-country variation, the first panel of Tables 16 through 18 reveals a positive relationship between the Gini coefficient and growth. This is in line with Forbes (2000), who only uses time-series variation, and Halter, Oechslin, and Zweimüller (2011). In the full sample, income inequality has a positive impact on growth, however this result is not robust to the reduction of the instrument set. Also the result is only robust to the introduction of the investment share if the full set of possible instruments is used. In the sample of richer countries the significant positive effect is not robust to the reduction of the numbers of instruments or the inclusion of the investment share. The effect of the Gini coefficient is never significant at acceptable levels in the sample of poorer countries.

Next, quantile shares are considered instead of the Gini coefficient. As can be seen in the second and third panel of Tables 16 and 18, the quantile shares have no significant effect on growth in the full sample and in the sample of low and lower middle income countries. These results are not altered by the inclusion of the investment share. However, as Table 17 shows, higher top-end inequality increases the growth rate concentrating on the within-country variance in the sample of richer countries. This result is relatively robust to the reduction in the instrument set and to the inclusion of the investment share (see third panel of Table 17), although higher top-end inequality is only significant at a level of 15% if the investment share is included and all possible instruments are used. Only if both methods to reduce the instrument set are applied, the coefficients turn out to be insignificant.

In light of the findings by Halter, Oechslin, and Zweimüller (2011), the results here suggest that, at least for the sample of high and upper middle income countries, in the short- to medium-run, higher (top-end) inequality increases growth. Moving to the long-run, this effect survives, however in addition, also lower bottom-end inequality and especially a higher Q1 at the expense of Q5 boosts growth.

**Table 16:** First-Difference GMM: Full Sample

| **First-difference GMM: Full sample** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Dependent variable: 5-year growth rate of real GDP p.c. | | | | | | | |
| | All possible instruments | | Only first lag as instrument | | Moment conditions collapsed | | Moment conditions collapsed and only first lag as instrument | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Gini coefficient | 0.0038** | 0.0028* | 0.0056** | 0.0036 | 0.0044 | 0.0040 | -0.0290 | -0.0748 |
| | (0.037) | (0.056) | (0.029) | (0.170) | (0.249) | (0.255) | (0.912) | (0.920) |
| Investment share | no | yes | no | yes | no | yes | no | yes |
| Number of countries | 62 | 62 | 62 | 62 | 62 | 62 | 62 | 62 |
| Number of observations | 226 | 222 | 226 | 222 | 226 | 222 | 226 | 222 |
| Number of instruments | 140 | 169 | 35 | 42 | 35 | 42 | 5 | 6 |
| M1 | -3.74 | -3.52 | -3.79 | -3.20 | -4.09 | -3.66 | -0.16 | -0.094 |
| M2 | -0.30 | -0.20 | -0.15 | -0.055 | -0.62 | -0.30 | -0.39 | 0.010 |
| Hansen | 1 | 1 | 0.024 | 0.21 | 0.20 | 0.18 | . | . |
| Q1 | -0.0064 | | -0.0090 | | -0.0049 | | 0.0245 | |
| | (0.269) | | (0.395) | | (0.665) | | (0.851) | |
| Middle Class | -0.0027 | -0.0008 | -0.0025 | 0.0065 | -0.0039 | -0.0021 | 0.0131 | -0.0115 |
| | (0.339) | (0.912) | (0.547) | (0.625) | (0.417) | (0.881) | (0.858) | (0.850) |
| Q5 | | 0.0027 | | 0.0090 | | 0.0023 | | -0.0245 |
| | | (0.640) | | (0.395) | | (0.843) | | (0.851) |
| Investment share | no | no | no | no | no | no | no | no |
| Number of countries | 62 | 62 | 62 | 62 | 62 | 62 | 62 | 62 |
| Number of observations | 226 | 226 | 226 | 226 | 226 | 226 | 226 | 226 |
| Number of instruments | 168 | 168 | 42 | 42 | 42 | 42 | 6 | 6 |
| M1 | -3.87 | -3.86 | -3.83 | -3.83 | -4.36 | -4.36 | -0.61 | -0.61 |
| M2 | -0.22 | -0.16 | -0.14 | -0.14 | -0.42 | -0.52 | -0.78 | -0.78 |
| Hansen | 1 | 1 | 0.14 | 0.14 | 0.20 | 0.17 | . | . |
| Q1 | -0.0045 | | -0.0057 | | -0.0059 | | 0.0727 | |
| | (0.395) | | (0.502) | | (0.560) | | (0.859) | |
| Middle Class | -0.0023 | -0.0008 | -0.0020 | 0.0037 | -0.0029 | -0.0025 | 0.0387 | -0.0340 |
| | (0.336) | (0.913) | (0.616) | (0.731) | (0.494) | (0.841) | (0.864) | (0.858) |
| Q5 | | 0.0020 | | 0.0057 | | 0.0007 | | -0.0727 |
| | | (0.705) | | (0.502) | | (0.945) | | (0.859) |
| Investment share | yes | yes | yes | yes | yes | yes | yes | yes |
| Number of countries | 62 | 62 | 62 | 62 | 62 | 62 | 62 | 62 |
| Number of observations | 222 | 222 | 222 | 222 | 222 | 222 | 222 | 222 |
| Number of instruments | 191 | 191 | 49 | 49 | 49 | 49 | 7 | 7 |
| M1 | -3.64 | -3.71 | -3.37 | -3.37 | -3.88 | -3.96 | -0.20 | -0.20 |
| M2 | -0.18 | -0.25 | 0.033 | 0.033 | -0.19 | -0.35 | -0.44 | -0.44 |
| Hansen | 1 | 1 | 0.32 | 0.32 | 0.28 | 0.16 | . | . |

Note: p-values in parentheses; *, **, and *** indicate, respectively, significance of the parameter estimates on the 10%, 5%, and the 1% level; all regressions include as control variables female schooling, male schooling, the price level of investment and period dummies; M1 and M2 are the t-values of the tests for, respectively, first-order and second-order serial correlation in the differenced error terms; Hansen denotes the p-value of the Hansen test of over identifying restrictions.

**Table 17:** First-Difference GMM: Richer Countries

| First-difference GMM: High and upper middle income countries | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Dependent variable: 5-year growth rate of real GDP p.c. | | | | | | | |
| | All possible instruments | | Only first lag as instrument | | Moment conditions collapsed | | Moment conditions collapsed and only first lag as instrument | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Gini coefficient | 0.0052* | 0.0029 | 0.0102* | 0.0085 | 0.0064 | 0.0057 | 0.0042 | 0.0041 |
| | (0.067) | (0.190) | (0.077) | (0.133) | (0.265) | (0.248) | (0.720) | (0.707) |
| Investment share | no | yes | no | yes | no | yes | no | yes |
| Number of countries | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 |
| Number of observations | 156 | 156 | 156 | 156 | 156 | 156 | 156 | 156 |
| Number of instruments | 131 | 142 | 35 | 42 | 35 | 42 | 5 | 6 |
| M1 | -2.28 | -2.69 | -1.98 | -2.16 | -2.38 | -2.51 | -1.84 | -1.66 |
| M2 | -1.11 | -0.62 | -0.90 | -0.39 | -1.03 | -0.62 | -1.35 | -1.06 |
| Hansen | 1 | 1 | 0.46 | 0.88 | 0.79 | 0.86 | . | . |
| Q1 | -0.0016 | | 0.0044 | | 0.0075 | | 0.0131 | |
| | (0.779) | | (0.661) | | (0.457) | | (0.471) | |
| Middle Class | -0.0089** | -0.0056 | -0.0163* | -0.0207 | -0.0145* | -0.0247* | -0.0167 | -0.0298 |
| | (0.043) | (0.413) | (0.052) | (0.161) | (0.089) | (0.093) | (0.400) | (0.181) |
| Q5 | | 0.0020 | | -0.0044 | | -0.0089 | | -0.0131 |
| | | (0.701) | | (0.661) | | (0.448) | | (0.471) |
| Investment share | no | no | no | no | no | no | no | no |
| Number of countries | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 |
| Number of observations | 156 | 156 | 156 | 156 | 156 | 156 | 156 | 156 |
| Number of instruments | 142 | 142 | 42 | 42 | 42 | 42 | 6 | 6 |
| M1 | -2.32 | -2.36 | -2.11 | -2.11 | -2.73 | -2.69 | -2.24 | -2.24 |
| M2 | -1.01 | -1.07 | -0.71 | -0.71 | -0.91 | -0.92 | -0.90 | -0.90 |
| Hansen | 1 | 1 | 0.87 | 0.93 | 0.93 | 0.95 | . | . |
| Q1 | -0.0017 | | 0.0059 | | 0.0039 | | 0.0135 | |
| | (0.807) | | (0.550) | | (0.680) | | (0.475) | |
| Middle Class | -0.0060 | -0.0041 | -0.0139** | -0.0198 | -0.0133* | -0.0225* | -0.0159 | -0.0294 |
| | (0.147) | (0.639) | (0.048) | (0.135) | (0.068) | (0.094) | (0.394) | (0.212) |
| Q5 | | 0.0014 | | -0.0059 | | -0.0073 | | -0.0135 |
| | | (0.818) | | (0.550) | | (0.491) | | (0.475) |
| Investment share | yes | yes | yes | yes | yes | yes | yes | yes |
| Number of countries | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 |
| Number of observations | 156 | 156 | 156 | 156 | 156 | 156 | 156 | 156 |
| Number of instruments | 147 | 147 | 48 | 48 | 49 | 49 | 7 | 7 |
| M1 | -2.82 | -2.84 | -2.72 | -2.72 | -2.88 | -2.87 | -1.95 | -1.95 |
| M2 | -0.60 | -0.66 | -0.34 | -0.34 | -0.64 | -0.61 | -0.86 | -0.86 |
| Hansen | 1 | 1 | 0.99 | 0.97 | 1 | 0.98 | . | . |

Note: p-values in parentheses; *, **, and *** indicate, respectively, significance of the parameter estimates on the 10%, 5%, and the 1% level; all regressions include as control variables female schooling, male schooling, the price level of investment and period dummies; M1 and M2 are the t-values of the tests for, respectively, first-order and second-order serial correlation in the differenced error terms; Hansen denotes the p-value of the Hansen test of over identifying restrictions.

**Table 18:** First-Difference GMM: Poorer Countries

| First-difference GMM: Low and lower middle income countries | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Dependent variable: 5-year growth rate of real GDP p.c. | | | | | | | |
| | All possible instruments | | Only first lag as instrument | | Moment conditions collapsed | | Moment conditions collapsed and only first lag as instrument | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Gini coefficient | 0.0024 | 0.0022 | 0.0027 | 0.0023 | 0.0013 | 0.0014 | -0.0053 | 0.0224 |
| | (0.210) | (0.246) | (0.226) | (0.285) | (0.660) | (0.553) | (0.679) | (0.891) |
| Investment share | no | yes | no | yes | no | yes | no | yes |
| Number of countries | 26 | 26 | 26 | 26 | 26 | 26 | 26 | 26 |
| Number of observations | 70 | 66 | 70 | 66 | 70 | 66 | 70 | 66 |
| Number of instruments | 63 | 59 | 32 | 34 | 35 | 42 | 5 | 6 |
| M1 | -2.60 | -1.92 | -2.00 | -1.76 | -2.35 | -1.74 | -0.79 | -0.15 |
| M2 | -1.08 | -1.82 | -0.81 | -1.53 | -0.86 | -1.59 | -1.42 | 0.14 |
| Hansen | 1 | 1 | 1 | 1 | 0.96 | 1 | . | . |
| Q1 | -0.0112 | | -0.0070 | | -0.0115 | | 0.0058 | |
| | (0.513) | | (0.739) | | (0.584) | | (0.886) | |
| Middle Class | 0.0006 | 0.0118 | 0.0008 | 0.0079 | 0.0029 | 0.0108 | 0.0046 | -0.0012 |
| | (0.886) | (0.571) | (0.868) | (0.757) | (0.527) | (0.657) | (0.690) | (0.980) |
| Q5 | | 0.0112 | | 0.0070 | | 0.0082 | | -0.0058 |
| | | (0.513) | | (0.739) | | (0.688) | | (0.886) |
| Investment share | no | no | no | no | no | no | no | no |
| Number of countries | 26 | 26 | 26 | 26 | 26 | 26 | 26 | 26 |
| Number of observations | 70 | 70 | 70 | 70 | 70 | 70 | 70 | 70 |
| Number of instruments | 63 | 63 | 36 | 36 | 42 | 42 | 6 | 6 |
| M1 | -2.52 | -2.52 | -2.00 | -2.00 | -2.25 | -2.35 | -0.91 | -0.91 |
| M2 | -1.00 | -1.00 | -0.81 | -0.81 | -0.85 | -1.00 | -1.63 | -1.63 |
| Hansen | 1 | 1 | 0.99 | 0.99 | 1 | 0.99 | . | . |
| Q1 | -0.0100 | | -0.0088 | | -0.0109 | | 0.1287 | |
| | (0.433) | | (0.608) | | (0.489) | | (0.941) | |
| Middle Class | -0.0003 | 0.0097 | 0.0011 | 0.0099 | 0.0005 | 0.0087 | 0.0518 | -0.0770 |
| | (0.940) | (0.534) | (0.818) | (0.645) | (0.920) | (0.646) | (0.939) | (0.944) |
| Q5 | | 0.0100 | | 0.0088 | | 0.0083 | | -0.1287 |
| | | (0.433) | | (0.608) | | (0.582) | | (0.941) |
| Investment share | yes | yes | yes | yes | yes | yes | yes | yes |
| Number of countries | 26 | 26 | 26 | 26 | 26 | 26 | 26 | 26 |
| Number of observations | 66 | 66 | 66 | 66 | 66 | 66 | 66 | 66 |
| Number of instruments | 59 | 59 | 37 | 37 | 49 | 49 | 7 | 7 |
| M1 | -1.75 | -1.75 | -1.37 | -1.37 | -1.56 | -1.70 | -0.086 | -0.086 |
| M2 | -1.71 | -1.71 | -1.48 | -1.48 | -1.46 | -1.51 | 0.067 | 0.067 |
| Hansen | 1 | 1 | 1 | 1 | 1 | 1 | . | . |

Note: p-values in parentheses; *, **, and *** indicate, respectively, significance of the parameter estimates on the 10%, 5%, and the 1% level; all regressions include as control variables female schooling, male schooling, the price level of investment and period dummies; M1 and M2 are the t-values of the tests for, respectively, first-order and second-order serial correlation in the differenced error terms; Hansen denotes the p-value of the Hansen test of over identifying restrictions.

## 5 Conclusion

In this paper we explore how different forms of income inequality affect subsequent economic performance. Using a general equilibrium framework, we show that a specific form of inequality, namely bottom-end inequality is unambiguously bad for economic growth. However, we should not expect inequality to have a consistently negative impact on economic performance. In presence of globally convex technologies and severe credit market imperfections a distortion-free transfer from the top to the middle of the distribution increases the economy-wide demand for capital, and thus raises the borrowing rate, which is detrimental to the poorest people as they can borrow and invest less. This in turn is particularly bad for aggregate output since the poor have the highest marginal returns. The theoretical model thus suggests that an empirical specification should not rely on single income inequality statistics but should account separately for inequality arising from different parts in the distribution.

Relying on a sample that covers 83 countries over the 1965-2000 period (oder bis 2005?), this suggestion is taken up by estimating a 5-year dynamic panel data model of the form used by Barro (2000), Forbes (2000) or Voitchovsky (2005) (and which goes back to Caselli, Esquivel, and Lefort (1996)). However, to measure income inequality, quantile shares are used instead of the Gini coefficient. Using the first quintile (Q1) and the middle class (MC, the sum of the second, third and fourth quintile) and omitting the fifth quintile (Q5) allows to capture top-end inequality, because a change of MC has to be at the expense (or in favor) of Q5 as Q1 is controlled for. Similar, a change in Q1 has to be at the expense (or in favor) of Q5 as MC is controlled for, thus capturing redistributions from the top to the bottom or vice versa. On the other hand, using Q5 and MC (and omitting Q1) allows to look at bottom-end inequality, as a change of MC has to be at the expense (or in favor) of Q1, because Q5 is controlled for. Again, a change in Q5 (at the expense or in favor of Q1) captures a redistribution from the top to the bottom (or vice versa).

As the explanatory variables cannot be considered to be exogenous, the dynamic panel data model is estimated by the system GMM estimator developed by Arellano and Bover (1995) and Blundell and Bond (1998). The problem of instrument proliferation that appears in applying this estimator as the number of instruments is quadratic in T is taken into account by using several techniques proposed by Roodman (2009). First, the number of instruments are reduced by using just the second lag for endogenous variables and the first lag for predetermined variables (thus using just the first available lag for each variable). Second, a technique called collapsing is applied. This means that not separate moment conditions for each lag and time period t are used, but for each lag only discarding the time dimension. Third, these two techniques are combined to reduce the set of instruments further.

The empirical findings are highly consistent with the theoretical predictions in the sub-sample of the high and upper middle income countries (40 out of 83 countries). Countries with a higher Q1 at the expense of both a lower MC and Q5 have significantly higher growth rates. However, countries with a higher MC at the expense of Q5 grow consistently slower. This outcome is very robust to the reduction in the number of instruments. However, concentrating on the sub-sample of the low and lower middle income countries, these results do not hold (and therefore neither in the full sample of 83 countries). It seems that a higher middle-class share (at the expense of a lower Q5) promotes economic growth. One interpretation could be that the middle class in poorer places takes the role of Q1 in richer countries whereas the poorest people in poor countries do neither invest in physical nor human capital. Under these circumstances, consistent with the empirical findings, the Foellmi-Oechslin framework would predict that an increase in the middle-class share unambiguously promotes economic performance.

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# Appendices

## A Summary Statistics

**Table A.1:** Summary Statistics

| Variable | Definition and Source | Year | 1965 | 1970 | 1975 | 1980 | 1985 | 1990 | 1995 | 2000 | 2005 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Q1 | Income share held by | Mean | 6.05 | 5.69 | 5.69 | 5.90 | 6.54 | 5.80 | 4.90 | 5.07 | |
| | the first quintile | Std. Dev. | 1.74 | 2.16 | 1.92 | 1.99 | 2.01 | 2.47 | 2.50 | 2.39 | |
| | (UNU-WIDER WIID2c (2009)) | Min. | 3.50 | 1.60 | 1.94 | 2.25 | 2.74 | 0.58 | 0.69 | 1.05 | |
| | | Max. | 9.87 | 10.10 | 9.90 | 10.81 | 11.28 | 10.87 | 10.55 | 9.62 | |
| Middle Class | Income share held by | Mean | 47.58 | 46.40 | 48.31 | 48.75 | 48.87 | 45.90 | 43.27 | 44.14 | |
| | the second, third and | Std. Dev. | 7.31 | 7.78 | 6.31 | 6.18 | 6.43 | 7.55 | 9.36 | 7.68 | |
| | fourth quintile | Min. | 32.30 | 32.81 | 31.06 | 33.32 | 31.00 | 23.23 | 22.81 | 28.18 | |
| | (UNU-WIDER WIID2c (2009)) | Max. | 56.52 | 56.90 | 58.47 | 56.93 | 57.67 | 57.25 | 56.23 | 54.19 | |
| Q5 | Income share held by | Mean | 46.37 | 47.91 | 46.00 | 45.34 | 44.59 | 48.29 | 51.83 | 50.78 | |
| | the fifth quintile | Std. Dev. | 8.38 | 9.42 | 7.89 | 7.80 | 7.98 | 9.83 | 11.68 | 9.87 | |
| | (UNU-WIDER WIID2c (2009)) | Min. | 34.99 | 33.00 | 33.70 | 32.33 | 31.43 | 32.19 | 34.48 | 36.59 | |
| | | Max. | 64.10 | 65.30 | 66.75 | 64.17 | 65.70 | 76.19 | 76.03 | 70.22 | |
| Gini coefficient | Gini coefficient of the | Mean | 39.88 | 41.43 | 39.58 | 39.55 | 37.76 | 42.09 | 46.26 | 45.00 | |
| | income distribution | Std. Dev. | 8.80 | 10.71 | 8.77 | 8.89 | 9.12 | 11.81 | 13.44 | 11.65 | |
| | (UNU-WIDER WIID2c (2009)) | Min. | 24.30 | 22.91 | 22.80 | 21.54 | 20.70 | 22.40 | 24.10 | 27.00 | |
| | | Max. | 55.50 | 61.88 | 61.94 | 59.70 | 59.90 | 73.40 | 73.10 | 66.60 | |
| Log of GDP pc | ln of the real gdp per | Mean | 7.61 | 7.79 | 7.96 | 8.43 | 8.37 | 8.38 | 8.20 | 8.13 | 8.40 |
| | capita (in 2000 US$) | Std. Dev. | 1.61 | 1.64 | 1.61 | 1.38 | 1.50 | 1.72 | 1.50 | 1.63 | 1.51 |
| | (World Bank, WDI | Min. | 5.26 | 5.37 | 5.35 | 5.42 | 5.07 | 4.88 | 5.37 | 5.09 | 5.48 |
| | Database 2009) | Max. | 9.71 | 9.81 | 9.91 | 10.09 | 10.20 | 10.42 | 10.38 | 10.53 | 10.61 |
| Female schooling | Average years of secondary | Mean | 0.83 | 1.12 | 1.26 | 1.52 | 1.73 | 1.61 | 1.82 | 2.06 | |
| | schooling in the female | Std. Dev. | 0.93 | 1.11 | 1.03 | 1.19 | 1.28 | 1.13 | 1.26 | 1.22 | |
| | population aged over 25 | Min. | 0.04 | 0.02 | 0.05 | 0.03 | 0.05 | 0.06 | 0.06 | 0.27 | |
| | (Barro and Lee (2000)) | Max. | 3.10 | 3.97 | 3.87 | 5.11 | 5.00 | 4.70 | 5.02 | 5.07 | |
| Male schooling | Average years of secondary | Mean | 1.08 | 1.46 | 1.60 | 1.92 | 2.15 | 2.04 | 2.17 | 2.35 | |
| | schooling in the male | Std. Dev. | 0.86 | 1.21 | 1.02 | 1.17 | 1.30 | 1.23 | 1.36 | 1.32 | |
| | population aged over 25 | Min. | 0.18 | 0.12 | 0.43 | 0.33 | 0.13 | 0.19 | 0.18 | 0.40 | |
| | (Barro and Lee (2000)) | Max. | 2.94 | 5.25 | 4.17 | 5.07 | 5.18 | 5.18 | 5.15 | 5.31 | |

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Table A.1 – Continued

| Variable | Definition and Source | Year | 1965 | 1970 | 1975 | 1980 | 1985 | 1990 | 1995 | 2000 | 2005 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Price level of investment | PPP of investment (=national currency value of investments divided by the real value of investment in international dollars) / exchange rate relative to the USD (PWT 6.3) | Mean | 55.38 | 59.44 | 71.68 | 79.30 | 54.05 | 68.99 | 68.45 | 57.75 | |
| | | Std. Dev. | 22.19 | 18.94 | 25.95 | 31.28 | 20.67 | 29.87 | 26.56 | 20.12 | |
| | | Min. | 28.23 | 29.95 | 37.55 | 19.96 | 24.06 | 23.10 | 28.85 | 19.08 | |
| | | Max. | 101.05 | 102.79 | 139.11 | 153.13 | 126.67 | 151.49 | 136.05 | 125.80 | |
| | | Year | 65-70 | 70-75 | 75-80 | 80-85 | 85-90 | 90-95 | 95-00 | 00-05 | |
| Investment share | Gross fixed capital formation in % of GDP (Average over 5-year period) (World Bank WDI Database 2009) | Mean | 21.73 | 22.32 | 23.42 | 22.45 | 22.29 | 23.10 | 21.94 | 20.69 | |
| | | Std. Dev. | 5.14 | 5.85 | 4.98 | 5.84 | 4.23 | 8.06 | 6.21 | 4.15 | |
| | | Min. | 13.97 | 12.93 | 14.44 | 12.25 | 14.68 | 14.53 | 10.36 | 13.26 | |
| | | Max. | 33.74 | 35.09 | 32.80 | 45.83 | 31.82 | 64.73 | 55.65 | 38.60 | |

**Table A.2:** Overview Country Classification

| High and upper middle income countries | | Low and lower middle income countries | |
|---|---|---|---|
| Australia | Korea, Rep. of | Algeria | Lesotho |
| Austria | Malaysia | Bangladesh | Malawi |
| Barbados | Mauritius | Bolivia | Mali |
| Belgium | Mexico | Cameroon | Mauritania |
| Botswana | Netherlands | Central African Rep. | Nepal |
| Brazil | New Zealand | China | Nicaragua |
| Canada | Norway | Colombia | Niger |
| Chile | Panama | Dominican Rep. | Pakistan |
| Costa Rica | Poland | Ecuador | Paraguay |
| Denmark | Portugal | Egypt | Peru |
| Finland | Singapore | El Salvador | Philippines |
| France | South Africa | Fiji | Rwanda |
| Germany | Spain | Gambia | Senegal |
| Greece | Sweden | Ghana | Sierra Leone |
| Hong Kong | Switzerland | Guatemala | Sri Lanka |
| Hungary | Trinidad/Tobago | Guyana | Sudan |
| Ireland | Turkey | Honduras | Thailand |
| Israel | United Kingdom | India | Tunisia |
| Italy | United States | Indonesia | Uganda |
| Japan | Venezuela, RB | Jamaica | Zambia |
| | | Jordan | Zimbabwe |
| | | Kenya | |

Note: According to World Bank Country Classification, year 2000

# B Overview Quintile Shares

**Table B.1:** Overview Quintile Shares

| | First quintile | | | | | | | | Fifth quintile | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1965 | 1970 | 1975 | 1980 | 1985 | 1990 | 1995 | 2000 | 1965 | 1970 | 1975 | 1980 | 1985 | 1990 | 1995 | 2000 |
| Algeria | | | | | | 5.33 | | | | | | | | 51.34 | | |
| Australia | | 6.99 | | 4.60 | 7.48 | 7.06 | 3.60 | 3.80 | | 39.12 | | 43.40 | 40.27 | 40.45 | 47.90 | 48.45 |
| Austria | | | | | | 10.56 | 6.97 | 8.56 | | | | | | 32.19 | 37.92 | 37.76 |
| Bangladesh | 6.90 | 7.90 | 7.00 | 7.36 | 7.60 | 8.04 | 7.47 | 5.79 | 44.50 | 42.30 | 43.80 | 42.92 | 41.76 | 42.14 | 42.66 | 47.95 |
| Barbados | | | | 2.25 | | | | | | | | 51.00 | | | | |
| Belgium | | | | 7.90 | 9.70 | 9.58 | 9.54 | 8.48 | | | | 36.10 | 34.91 | 35.30 | 34.54 | 41.32 |
| Bolivia | | | | | | 4.38 | | 1.05 | | | | | | 52.88 | | 65.56 |
| Botswana | | | | | | 2.74 | | | | | | | | 63.17 | | |
| Brazil | | 3.20 | 2.19 | 2.51 | 2.74 | 2.08 | 2.59 | 2.59 | | 61.70 | 66.75 | 64.17 | 62.85 | 68.28 | 65.03 | 65.10 |
| Cameroon | | | | | | | | 3.03 | | | | | | | | 59.90 |
| Canada | 7.13 | 6.84 | 6.87 | 6.45 | 7.26 | 7.57 | 7.58 | 7.29 | 38.55 | 37.50 | 40.16 | 37.83 | 39.79 | 39.33 | 39.16 | 39.90 |
| Central African Republic | | | | | | | 1.73 | | | | | | | | 68.49 | |
| Chile | | 4.50 | 4.30 | | | 3.59 | 3.84 | 2.91 | | 51.40 | 52.30 | | | 59.26 | 60.06 | 64.38 |
| China | | | | 7.93 | 8.71 | 7.01 | 6.02 | 5.86 | | | | 36.66 | 38.75 | 40.98 | 41.65 | 46.64 |
| Colombia | | 6.98 | 4.70 | 3.10 | | 3.70 | 3.19 | 2.42 | | 60.21 | 53.20 | 58.76 | | 55.90 | 61.42 | 61.48 |
| Costa Rica | 6.20 | | 5.40 | 2.80 | 4.50 | 3.63 | 3.97 | 3.66 | 55.00 | | 50.60 | 55.00 | 51.80 | 51.99 | 52.15 | 54.75 |
| Denmark | | | | 6.99 | 6.67 | 9.20 | 9.57 | 6.19 | | | | 38.06 | 37.21 | 35.89 | 34.81 | 40.66 |
| Dominican Republic | | | | | 5.40 | 4.24 | 3.92 | 4.78 | | | | | 47.80 | 57.23 | 56.85 | 53.14 |
| Ecuador | | | | | | | 2.86 | 3.01 | | | | | | | 60.02 | 60.36 |
| Egypt | | | 4.84 | | | | 6.91 | 3.63 | | | 48.88 | | | | 45.92 | 59.43 |
| El Salvador | | | | 5.00 | | | 3.39 | 2.48 | | | | 53.20 | | | 55.01 | 57.40 |
| Fiji | | | | 4.80 | | | | | | | | 49.60 | | | | |
| Finland | | 7.80 | 8.27 | 6.60 | 6.80 | 10.70 | 10.55 | 9.44 | | 39.60 | 38.10 | 40.00 | 37.00 | 33.14 | 34.81 | 36.67 |
| France | | | 7.10 | 6.70 | 7.68 | 7.18 | 7.95 | 9.09 | | | 42.50 | 41.82 | 38.96 | 40.11 | 40.51 | 37.37 |
| Gambia | | | | | | | 1.17 | | | | | | | | 76.02 | |

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Table B.1 – Continued

| | First quintile | | | | | | | | Fifth quintile | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1965 | 1970 | 1975 | 1980 | 1985 | 1990 | 1995 | 2000 | 1965 | 1970 | 1975 | 1980 | 1985 | 1990 | 1995 | 2000 |
| Germany | | 7.24 | 7.01 | 6.61 | 6.59 | | 8.21 | 8.48 | | 41.14 | 38.00 | 38.95 | 38.88 | | 38.55 | 37.79 |
| Ghana | | | | | | 3.26 | 3.27 | 2.25 | | | | | | 56.24 | 55.28 | 58.43 |
| Greece | | | 5.05 | | 5.37 | 4.89 | 6.00 | 6.93 | | | 46.37 | | 44.79 | 45.78 | 41.00 | 39.60 |
| Guatemala | | | | 5.70 | | 2.53 | | 3.25 | | | | 53.90 | | 59.18 | | 58.65 |
| Guyana | | | | | | | 3.89 | | | | | | | | 59.20 | |
| Honduras | | 1.60 | | | | 2.57 | 2.35 | 3.12 | | 65.30 | | | | 60.93 | 62.22 | 56.70 |
| Hong Kong | | | 4.10 | 6.20 | 4.62 | 6.31 | 4.89 | | | | 47.00 | 46.50 | 50.35 | 49.29 | 49.37 | |
| Hungary | | 10.10 | 9.90 | 10.81 | 11.28 | 10.87 | 7.28 | 8.40 | | 33.00 | 33.70 | 32.33 | 32.24 | 34.43 | 41.10 | 38.90 |
| India | 7.00 | 7.01 | 7.18 | 6.75 | 6.83 | 7.25 | 6.99 | 6.03 | 44.79 | 44.28 | 42.82 | 45.70 | 45.30 | 43.88 | 45.93 | 49.08 |
| Indonesia | | | | 5.76 | 6.57 | 7.11 | 6.47 | 6.71 | | | | 47.02 | 47.80 | 46.54 | 48.97 | 47.04 |
| Ireland | | | 4.80 | 4.90 | | 6.58 | 6.84 | 7.45 | | | 42.20 | 43.60 | | 42.96 | 44.50 | 42.01 |
| Israel | | | | 6.39 | | 6.74 | 6.94 | 6.75 | | | | 42.57 | | 41.38 | 42.26 | 42.55 |
| Italy | | 5.10 | 5.70 | 7.91 | 8.20 | 7.77 | 6.38 | 6.26 | | 44.60 | 45.30 | 39.05 | 38.22 | 40.20 | 41.97 | 42.23 |
| Jamaica | | | 3.17 | | | 4.14 | 5.02 | 4.24 | | | 54.80 | | | 55.24 | 51.24 | 54.26 |
| Japan | 6.62 | 4.55 | 5.97 | 6.26 | 5.90 | | | | 41.89 | 46.39 | 43.31 | 39.57 | 41.82 | | | |
| Jordan | | | | 4.50 | | 5.75 | 5.05 | 5.95 | | | | 55.67 | | 48.67 | 52.44 | 49.25 |
| Kenya | | | | | | | 2.10 | | | | | | | | 68.44 | |
| Korea, Republic of | 5.80 | 7.30 | 7.20 | 5.09 | 6.80 | 7.39 | 6.04 | 4.83 | 41.81 | 41.62 | 43.40 | 45.40 | 41.90 | 42.24 | 38.88 | 41.57 |
| Lesotho | | | | | | 2.18 | 1.23 | | | | | | | 64.14 | 72.56 | |
| Malawi | | | | | 3.30 | | | | | | | | 65.70 | | | |
| Malaysia | | 4.00 | | 3.70 | 3.88 | 4.45 | 4.21 | | | 56.20 | | 55.80 | 56.50 | 54.57 | 55.26 | |
| Mali | | | | | | 5.53 | 0.70 | | | | | | | 48.72 | 75.51 | |
| Mauritania | | | | | | 0.58 | | | | | | | | 76.19 | | |
| Mauritius | | | | 7.07 | | 4.62 | 5.28 | | | | | 39.92 | | 50.39 | 48.11 | |
| Mexico | 3.60 | 2.80 | 2.60 | 2.90 | 3.77 | 3.36 | 3.13 | 3.28 | 64.10 | 63.70 | 66.10 | 54.50 | 55.37 | 57.90 | 60.42 | 60.31 |
| Nepal | | | | 4.60 | 9.11 | | | 2.31 | | | | 59.20 | 39.50 | | | 57.69 |
| Netherlands | | 6.49 | 8.40 | 8.45 | 7.29 | 7.79 | 7.85 | 7.66 | | 42.86 | 37.20 | 36.65 | 40.21 | 39.57 | 38.67 | 38.65 |
| New Zealand | | | 6.46 | 6.02 | 5.52 | 4.58 | 5.50 | 5.44 | | | 35.89 | 40.57 | 41.11 | 44.73 | 44.01 | 46.09 |
| Nicaragua | | | | | | | 3.22 | 2.70 | | | | | | | 59.56 | 59.44 |

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Table B.1 – Continued

| | First quintile | | | | | | | | Fifth quintile | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1965 | 1970 | 1975 | 1980 | 1985 | 1990 | 1995 | 2000 | 1965 | 1970 | 1975 | 1980 | 1985 | 1990 | 1995 | 2000 |
| Niger | | | | | | | 2.13 | | | | | | | | 60.03 | |
| Norway | 4.95 | 5.56 | 4.94 | 10.70 | 8.18 | 10.58 | 9.80 | 9.62 | 40.00 | 39.74 | 43.51 | 32.37 | 36.88 | 34.75 | 35.74 | 37.22 |
| Pakistan | | 7.30 | 7.10 | 6.81 | 6.77 | 6.84 | 6.68 | | | 44.20 | 45.59 | 46.10 | 46.19 | 45.19 | 44.45 | |
| Panama | | 1.80 | | 4.19 | | 1.79 | 2.16 | 2.26 | | 61.30 | | 52.42 | | 59.73 | 60.27 | 61.53 |
| Paraguay | | | | | | | 2.05 | 1.93 | | | | | | | 65.70 | 60.62 |
| Peru | | | | | 6.27 | 4.82 | 3.47 | 3.98 | | | | | 58.19 | 54.54 | 59.47 | 56.18 |
| Philippines | 3.50 | | 3.60 | | 5.20 | 5.20 | 4.21 | 4.51 | 56.00 | | 54.00 | | 52.10 | 52.50 | 58.94 | 55.96 |
| Poland | | | | | | 9.52 | 8.69 | 7.85 | | | | | | 35.72 | 38.11 | 40.04 |
| Portugal | | | 5.75 | 5.53 | | 5.70 | 6.14 | 7.00 | | | 46.41 | 42.50 | | 42.40 | 40.42 | 42.00 |
| Rwanda | | | | | 7.74 | | | | | | | | 43.74 | | | |
| Senegal | | | | | | | 1.37 | | | | | | | | 72.53 | |
| Sierra Leone | | 2.76 | | | | | | | | 61.97 | | | | | | |
| Singapore | | | | 6.52 | | 6.52 | | | | | | 46.59 | | 46.59 | | |
| South Africa | | | | | | | 2.02 | 3.59 | | | | | | | 64.87 | 66.08 |
| Spain | 7.15 | | 6.17 | 6.94 | 7.77 | 7.80 | 5.91 | 7.01 | 36.33 | | 39.48 | 41.69 | 39.00 | 39.80 | 43.46 | 41.82 |
| Sri Lanka | 4.45 | 6.90 | 7.17 | 7.86 | 5.73 | 6.02 | | 2.44 | 52.31 | 44.90 | 43.22 | 36.82 | 51.91 | 48.94 | | 65.12 |
| Sudan | | 8.24 | | | | | | | | 45.95 | | | | | | |
| Sweden | | 4.77 | 7.40 | 7.03 | 10.90 | 9.53 | 9.29 | 9.22 | | 39.62 | 34.13 | 39.45 | 31.43 | 33.23 | 34.48 | 36.59 |
| Switzerland | | | | | 7.26 | | 6.20 | | | | | | 43.40 | | 42.24 | |
| Thailand | 8.00 | 5.13 | 4.92 | | 4.30 | 2.80 | 2.16 | 2.06 | 49.78 | 50.07 | 48.39 | | 53.47 | 58.60 | 62.31 | 61.80 |
| Trinidad & Tobago | | | 1.94 | 2.70 | 3.43 | | 3.20 | | | | 53.49 | 49.40 | 44.86 | | 53.80 | |
| Tunisia | 4.44 | | | | | 4.58 | | | 53.70 | | | | | 51.01 | | |
| Turkey | | 3.00 | 3.50 | | | 5.24 | 4.80 | | | 60.00 | 56.50 | | | 49.94 | 52.70 | |
| Uganda | | | | | | 6.75 | 3.35 | 3.64 | | | | | | 46.76 | 56.55 | 59.93 |
| United Kingdom | 9.87 | 7.89 | 8.73 | 8.65 | 8.90 | 7.07 | 6.27 | 6.57 | 34.99 | 41.93 | 38.90 | 37.77 | 37.85 | 39.84 | 43.09 | 43.85 |
| United States | 5.20 | 5.50 | 5.94 | 6.10 | 4.70 | 5.36 | 5.08 | 5.34 | 41.80 | 40.90 | 42.02 | 40.56 | 43.50 | 42.70 | 44.32 | 45.10 |
| Venezuela | | | 3.60 | 4.30 | 4.73 | 4.71 | 4.14 | 4.27 | | | 52.00 | 52.78 | 50.38 | 49.35 | 52.31 | 50.64 |
| Zambia | | | | 3.70 | | | 1.86 | 1.60 | | | | 56.60 | | | 68.56 | 70.22 |
| Zimbabwe | | | | | | 3.02 | 0.69 | | | | | | | 66.53 | 76.03 | |