The effect of income and wealth inequality on economic growth

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ABSTRACT

Inequality has shown a rising trend the past decades, where the richest centesimal has captured a large part of the economic growth. The effect of income inequality on growth has been researched to a large extent, while wealth inequality has remained in the shadows because of data unavailability.

With a dataset from the World Inequality Database, covering both inequality measurements, it is now possible to compare the effects of both on growth to evaluate discrepancies. A short dataset covering the years of 1970-2015 for China, France, Russia, U.K., and the U.S. compiles a total of 167 observations. An attempt to create a new instrument variable is made because of inferior instruments used earlier, but the proposed instrument turned out weak. Thus, a fixed effects model controlling for time-trends and addressing stationarity, is employed.

The results when controlling for spurious regression is that neither inequality variable is significant across all regressions. When significant, wealth inequality shows a negative relationship to growth, while income inequality shows a positive coefficient, emphasising the complex relationship between inequality and economic growth. The findings show wealth to likely be a more important measure of inequality in connection to growth.

Keywords: income inequality, wealth inequality, economic growth, transition dynamics, panel data, fixed effects,

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1. INTRODUCTION

The opening section of this thesis contributes with an understanding of the research area's importance and a brief upbringing of its historical context. Starting with the background, it continues with stating the purpose and research objective which is follow by the scope of limitation of the study and ends with an elaboration of the paper's contribution.

1.1 Background

"[..] inequality didn't just happen. It was created."

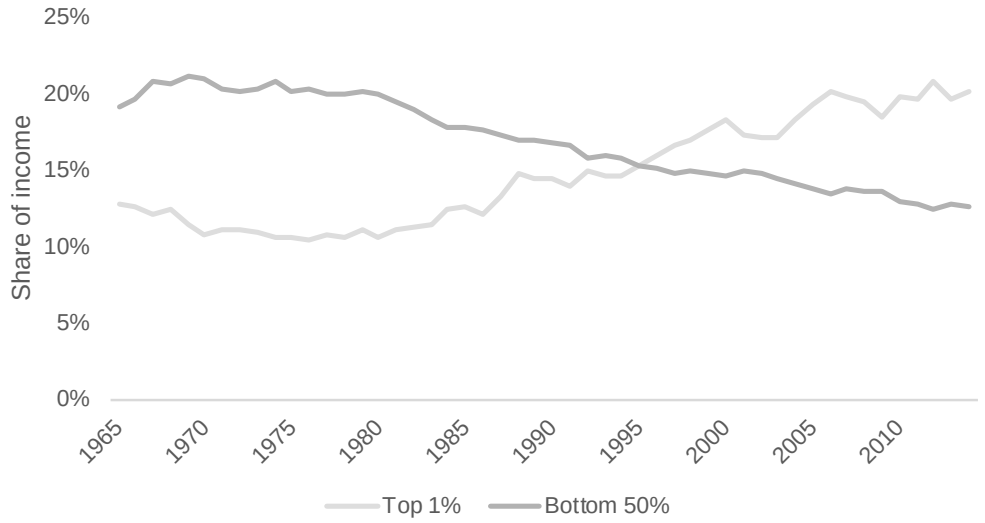
(Stiglitz, 2013, p. 34)

Economic inequality has risen on a global level during the past four decades. The top 1% earners' income share of total income was 16.2% in 1980, increasing to 20,4% in 2016 (World Inequality Database, 2018d). As divergence increases around the globe, the richest centesimal of the people have captured more than double of the growth compared to the poorest 50% (Facundo, Chancel, Piketty, Saez, & Zucman, 2017), which is alarming news in terms of inequality. In countries where education is not free, it creates large divergence within societies as children of the poorest families cannot be sent to school. This in turn affects the country's human capital negatively, which harms the economic growth (Banerjee & Newman, 1991; Galor & Zeira, 1993; Madsen & Ang, 2016).

Economic inequality can be measured in many different ways, but the vantage point is often in income or wealth. When looking at inequality in a historical perspective, much has changed over the years. In the early stage of the 20th century, income inequalities were generally high in e.g. U.K. and France, but with a slightly declining trend, until World War 1 where it dropped quickly (World Inequality Database, 2018d). According to Piketty (2014) in his book 'Capital in the twenty-first Century', this can be attributed to e.g. large capital stocks being destroyed in the war, decreasing wealth and also income possibilities of the richest people in the society, thus decreasing inequality. In the subsequent years, inequality was kept relatively low, of course also affected by World War 2, but has been on a rising trend since around the 1980's (World Inequality Database, 2018d).

Figure 1- Percentile shares of income in the U.S.

This figure shows percentile shares of income for the top 1% of income takers in the U.S., and the bottom 50%. It illustrates the ongoing income divergence stressed above.



(World Inequality Database, 2018a)

The German philosopher and economist, Karl Marx, predicted a world where the capitalist system would trap the working class, exploiting the people for the benefit of the richest (Srivastava, 2015). Interesting from this perspective is the rapid upsurge of income inequality in Russia after the fall of the Soviet. In the same political playing field, another giant economy has been growing rapidly since shifting from a centrally planned economy to a market based one, namely China (The World Bank, 2018a). Many people have been lifted out of poverty and the poorest 50% of the population has experienced a significant income increase, but inequalities are also increasing (Facundo et al., 2017; The World Bank, 2018a; World Inequality Database, 2018c). The relationship of inequality and economic growth increasing simultaneously in China is also evident in many other countries and has been researched heavily with ambiguous results over the years.

Especially critical is the rise in the relative income and wealth of the top of the population as this potentially undermines the democracy within the society. As economic inequality is rising on a global level, and does not seem like an isolated trend, e.g. started by an economic crisis in the U.S., nor is there any indications of a dampening effect. It is more relevant than ever to investigate how it affects the economic growth of countries. Choosing countries for this study with different features, geographical location, political ideologies, and history, can hopefully

contribute to a versatile discussion and provide understanding on the subject. Since former studies have focused their research primarily on income inequality, this study emphasises the importance of wealth inequality, inspired by Piketty among others.

1.2 Purpose and research objective

National wealth inequality has increased on a global scale. Individuals in the top 10% bracket are rapidly increasing their wealth whilst the middle and lower income classes are either seeing stagnating wealth levels or an increase at a very slow rate. In a recent study from Piketty (2014), a new wealth dataset is compiled and analysed, enabling further research on the field where data has been scarce previously.

Previous research has almost constantly proxied wealth inequality with income inequality (Bagchi & Svejnar, 2015). As wealth inequality data evolves, there is an opportunity to validate income inequality as a proxy, but also to discover differences in how they affect the economy. An important difference is that income inequality is a snapshot in time, that can be subject of change from year to year, while wealth is often transferred between generations (Corneo, 2015; Naguib, 2017; Saez, 2017)[1]. To give a concrete example, if an individual easily travels through income classes, income inequality as an inequality proxy may perform poorly. On the other hand, wealth inequality could possibly provide new interesting insights through its rigidity. Hence, counting for the differences between the wealth and income inequality should bridge the differentiations in how they impact economic growth.

As growth develops countries and societies, it could be argued that economic inequality is enhancing, in terms of the aggregate well-being. That is, of course, only if inequality and growth have a positive relationship, becoming the first research question for this paper to answer:

- Does income and wealth inequality effect economic growth?

Wealth inequality is also argued to be a more important measurement, but the scarcity of data has hindered research (Ravallion, 2012). With new data available, it is relevant to see if the

[1] Saez confirms the intergenerational transfer of wealth, while Naguib and Corneo confirms that the income inequality is a snapshot in time. However, high income could potentially be transferred through family business contacts.

measurements differ in their relation to economic growth. Thus, the research will progress to investigate:

- Do any differences appear in how income and wealth inequality affect economic growth?

1.3 Limitations of the study

To answer the research question of this paper, several limitations have been forced and delimitations selected, with the purpose to increase focus and remove ambiguity. The different restrictions of the study are important to consider when reading and understanding the study as there is always more one would like to add, but constraints must be made to stay consistent and concentrate on answering the research objective.

A distinct problem in the research of economic inequality is the validity of data. In many cases, variables have the same name but are represented by different underlying data points. In other cases, there are internal inconsistencies in the data variables between countries, which could lead to apples being compared to pears (Barro, 2000; Forbes, 2000). In an attempt to avoid this issue, data has been picked only if consistent across countries, heavily limiting the study on the latter, as the available macroeconomic data has been scarce for a few crucial variables. In many articles on the effect of inequality on growth, the writers have created their own datasets from new data made available to them. As no such opportunity has been presented for this paper, another important limitation is that only publicly available data has been used.

To control for the potential data inconsistencies, it was important for this paper to not mix inequality sources. The dataset made available on the World Inequality Database, is the only one found handling both income and wealth inequality. Thus, it became a natural data source for this paper. However, aligning wealth and income inequality, it is restricted in its coverage including only France, U.K., U.S., China, and Russia. With this comes other limitations, e.g. the lack of historical data on Russia as it would not give meaning to merge the dataset with any findings from the substantially larger Soviet Union.

Further, the study has been delimited in the use of control variables, to the most commonly used ones in previous literature, where consistent data was available, or a cross-sectional approach used. The data source used for gathering variable data has been The World Bank database and

the World Inequality Database. Once again, the study is limited to the reasonable availability of data from e.g. Russia where wealth inequality data only stretches back to the year of 1995. From the number of different variables identified in previous literature, seven control variables are used due to relevance for this particular study and due to accessibility of data. Intuitively, growth is affected by thousands of global and national variables. Thus, inequality is likely to affect economic growth indirectly through these unobserved factors. This will affect the result of this study, but the downside should be limited compared to the upside of using well renowned variables. Hence, this study handles a total of 147 observations from 5 different nations in the baseline regression.

With the type of data and methodological approach used, the conclusions to be drawn from this study will be general, and not country-specific. This is limited by the data available and could of course be argued to be delimited by us as well.

1.4 Contribution to knowledge

Wealth inequality has for long been proxied in different ways, through e.g. income inequality, land ownership, and billionaires' wealth (Bagchi & Svejnar, 2015). New data was made available at the World Inequality Database in December 2015 (World Inequality Database, 2018g) which enables additional research. No previous study, that has come to our knowledge, has previously compared and analysed the effect of wealth and income inequality on growth to this extent, or tried to determine whether the different inequality measurements affect growth in different ways. We emphasise this comparison by looking at the exact same time-period across both inequality proxies. However, Naguib (2017) includes both income Gini and wealth Gini in her study, but does not address their differences and is limited to only four years of data in the wealth Gini variable. This study is more comprehensive, and adds a broader analysis.

The approach of H. Li & Zou (1998) is used, and extended through the investigation of both wealth and income inequality in how they affect economic growth and if any dissimilarities can be found. Further, this study will update the control variables as to increase the relevance for the countries of this study. Additionally, when applying a similar methodology, this study also finds a weakness when not controlling for spurious regression, which is added by us.

This paper also contributes to existing literature with a thorough analysis of previous literature, summarizing and explaining differences in results depending on methodological approach as well as highlighting problems with previous datasets etc. We examine the findings and summarize other's critics, to a comprehensive literature review aiming to provide a section including more angles and points of view on previous research than what exist today in similar studies. Growth theories are explained and made relevant for the topic using input from various sources. It gives laymen interested in the subject a possibility to be introduced in an understandable way, hopefully sparkling the interest further. The main focus will not be to provide the most in-depth review of either previous literature or growth theories. The aim is however to include as many of the most relevant aspects as possible, to a comprehensive review of how inequality affects growth.

The final contribution is the attempt of finding a new instrument variable. It shows low explanatory power for wealth inequality, but higher for the income measurement. Even though not used in our regressions because of this, thorough discussion on the instrument as well as the finding that it has explanatory for income inequality can be used for future research.

2. ECONOMIC INEQUALITY

In this section, a deeper understanding of economic inequality is provided, likewise an explanation of the specific inequality measurements used within this study. The latter is important since there are several ways to measure national economic inequality. The differences do not end with a division between wealth and income, but earlier researchers have used various measures when aiming to define inequality within one proxy. Further, different measurements are used to highlight different aspects of inequality. This study proceeds to use the top 10% income and wealth share to capture how capital concentration in the top bracket affects the economy. Income and wealth inequality is handled separately, as they have different features and may therefore affect growth in different ways.

2.1 Definition and history of inequality

In the beginning of 19th century, the wheels of economic growth had yet to start rolling for most countries, and the majority of the world population lived in what would be described today as extreme poverty. Through industrialization and development, some countries came to experience tremendous growth, and by 1975 there were distinct differences between what we call developed-, emerging-, and third world economies (Roser, 2018). Clearly, global inequality had risen between countries.

After that until now, several interesting phenomena have occurred, e.g. the strong growth of the Asian Tiger-economies, along with a significant income growth for the poorest individuals globally. Thus, it could be argued that the world has become a bit more equal (Roser, 2018). However, Alvaredo et al. (2018), states that inequality has risen internally in many nations during the same time. This would mean global convergence, but national divergence. Since the financialization, the increase ratio of the financial sector to GDP, inequality growth has been seen to fasten as the top income segment experienced a rapid growth of their wealth (Stiglitz, 2013).

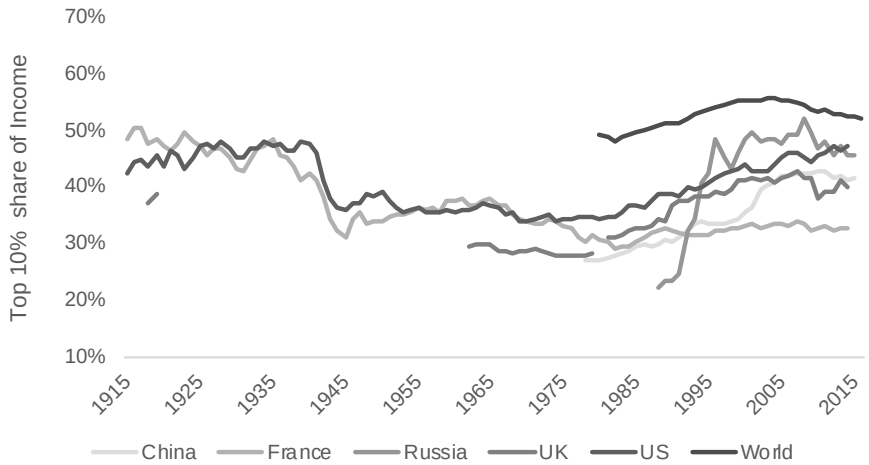
Economic inequality is investigated through income and wealth accumulation among the top 10% in this paper. Piketty (2014, pp. 1-35) explains the interdependence between the two, as wealth generates income through e.g. dividends, interest, and capital gains. Part of this income will then likely turn into wealth.

2.2 Income inequality

Income inequality is based on disproportional division of wages and capital gains among the population. It is a popular measure in previous research as its effect on different variables is channelled to economic growth in ambiguous ways. Income inequality is on a rising trend, as visualised in Figure 2 below. It has increased at a high pace in Russia, China, and U.S., while at a slower rate in Europe. Further, the figure shows heterogeneity among the sample countries in terms of income inequality mainly divided between developed and developing countries. The western countries; U.K., U.S., and France, tend to move closely and follows the same pattern. The movements of China and Russia also have similarities in that they tend to have an increasing pattern throughout the sample period. When comparing the U.S. to Western Europe, the top 1% income share was approximately 10% in both regions in 1980 but has developed differently since. Western Europe rose to approx. 12% in 2016, while the US demonstrates a rate of 20%. The large differences in how inequality has developed can be derived from e.g. education inequality differences.

Figure 2 - Historical top 10% income share

This figure presents the historical income share of the top 10% earners in the countries covered by this study, as well as the world, for reference. The sample for each country does not cover all years displayed, due to data constraints. The curve representing the relationship in the world is very high, and should be interpreted as the share of global income accounted for by the top 10% richest. Thus, the curve is not an average



(World Inequality Database, 2018e)

When comparing the US to Western Europe, the top 1% income share was approximately 10% in both regions in 1980 but has developed differently since. Western Europe rose to approx.

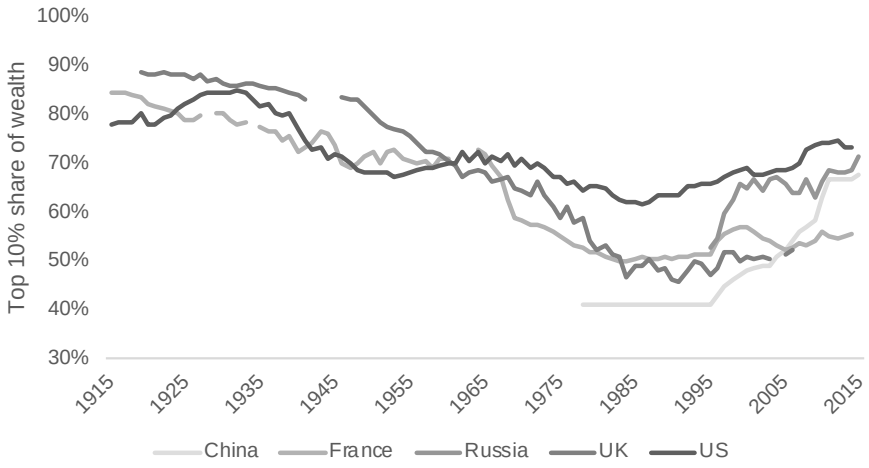
12% in 2016, while the US demonstrates a rate of 20%. The large differences in how inequality has developed can be derived from e.g. education inequality differences (Facundo et al., 2017).

2.3 Wealth inequality

Wealth inequality is another broad measure, essentially showing how much of the nation's total wealth a certain fraction of the richest individuals in a society holds. Economic inequality can in many cases be derived from wealth inequality, as holding capital creates opportunities to earn a larger income as well, via capital gains. Since 1980, a lot of public capital has become private (Facundo et al., 2017), potentially accelerating economic inequalities as the public capital was shared among 'the public' which should imply that is was more equally distributed than after becoming private. China and Russia have experienced large increases in private wealth, when leaving the communist ideology, reaching towards level close to the U.K., France, and the US (Novokmet, Piketty, & Zucman, 2017; Piketty, Yang, & Zucman, 2017). Even though rising, wealth inequality when looking at the top 10% share of wealth has yet to reach early 1900 levels, and may not rise to the same, due to property wealth accumulated by the middle class (Facundo et al., 2017).

Figure 3 - Historical top 10% share of wealth

This figure presents the historical share of net personal wealth, of the top 10% wealthiest individuals in the countries covered by this study. The sample for each country does not cover all years displayed, due to data constraints.



(World Inequality Database, 2018f)

3. THEORETICAL FRAMEWORK

"*All theory depends on assumptions which are not quite true. That is what makes in theory*."

-Solow (1956, p.65)

To critically evaluate the relationship between inequality and economic growth, it is a necessity to understand how economic growth develops over time. Through that, to find which determinants that drive the economy, particularly in conjunction with both income and wealth inequality. In other words, to carefully establish facts concerning through which channels inequality affects growth. As can be seen throughout the works of earlier scholars, the nexus is far from simple, resulting in ambiguous consensus (see Cingano, 2014; and Table 1). However, the extensive amount of research on the subject and its diverse results, can add a layer of clearance when carefully assessed, as it will bring a new layer on how methods and theoretical frameworks skews the conclusion.

Below we list important theories on economic growth, starting with the neoclassical models of Solow, and Ramsey including the extensions by Cass and Koopmans. Further the section describes the endogenous growth model by Romer, and a description of how balanced growth is distinguished from adjustment to growth paths. The neoclassical theories of growth are restricted to contain revised versions of the Solow followed by the Ramsey model. As these models do not model for inequalities in their simple application, additions in form of external theories and elaborations are extending the authors original models to increase the explanatory power and relevance for the topic of the study.

3.1 Neoclassical models of economic growth

The neoclassical growth theories presented within this section are interesting in terms of their transitionary dynamics but leaves the long-run growth rate exogenous. In transition, moving to the steady-state equilibrium, the savings and investments are determining the speed of the growth rate. When in steady-state, all growth factors are constant along with the growth rate.

3.1.1 Solow

The Solow growth model, sometime referred to as the Solow-Swan model, is a framework of neoclassical economics suggesting an explanation to cross country differences in GDP per

capita. It has been the fundament for studies on growth, and other models profoundly different can many times be interpreted and comprehended through comparison with this model (D. Romer, 2012). The world it frameworks exhibits the structure of a perfect market with no failures in the capital market, free capital flows, and homogeneity among agents and products. Further, the model ignores government inflictions like subsidies and taxes, and financial markets are not considered. The model describes a decreasing marginal return to capital, and a diminishing growth rate of the capital stock over time, ultimately reaching the steady state of growth driven exogenously by technology. No matter where the starting point of the economy is, it will converge to a steady-state growth path, leading to cross-country convergence in output per capita levels. In steady state, only variation in technological advancement - increasing the effectiveness of labour - will affect the growth rate (Solow, 1956). Accordingly, the growth rate is determined exogenously in steady state by the technological rate of progress (Jones & Vollrath, 2013, p.38).

The model is expressed as following, assuming a production function reliant on capital (K) and labour (L) input, and technological efficiency (A).

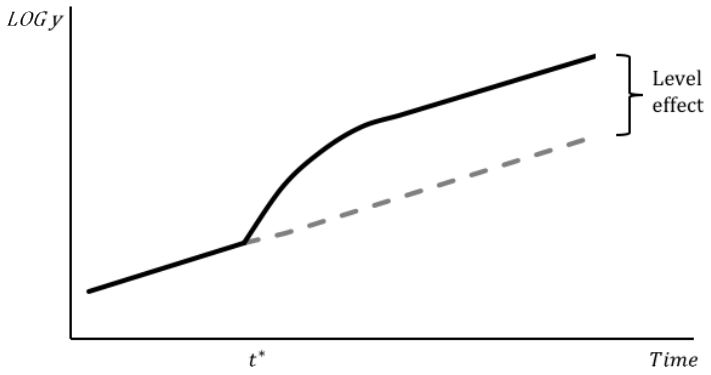
$$Y_t = F\ (K_t, A_t L_t) \tag{1}$$

Solow's (1956) growth model is highly emphasising the importance of savings, as the model describes how it, via investments, impacts the capital stock and the economic growth in transitions between the different steady-states. An alteration in the investment rate would have a level effect but will not have a growth effect. Hence, the transition dynamics is important as it explains how countries behave when deviating from their steady-state growth. Even if the transition period per definition is temporary, it can stretch over very long time-periods, why deviations from steady-state growth is as important as the actual long-run growth rate. Thus, the long-run growth rate, or the steady-state, is a theoretical notion for simplicity that might not be applicable to reality.

Different from technology, changes in population and investment ratios implies changes in the level of the economy, but not the growth rate. For example, if the investment-ratio increase to be higher than the ratio needed to keep the capital stock constant, there will be a temporary increase in growth until the new level is reached, at a new steady-state, in accordance with the figure below.

Figure 4 - Effect from a rise in savings

The figure shows the effect of a rise in savings, consequently increasing the growth rate in the short run. After the temporary growth effect, it returns to the steady state growth rate, with a permanent level effect in GDP.

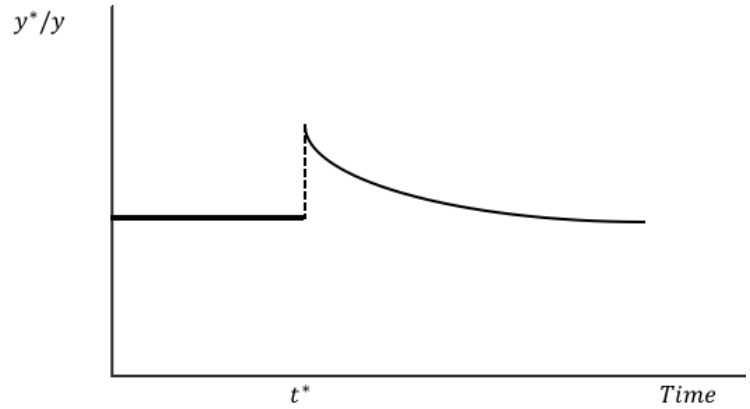


(D. Romer, 2012, p. 20)

Since savings equals investments, the final capital stock outcome of the model is affected by the savings rate, as exemplified in the figure above. An upsurge in the model's constant savings rate, driven by e.g. increased interest rates, would correspondingly raise investments and result in a higher capital stock per capita in steady state, while a higher growth rate in population would decrease the same diluting the capital stock per worker (Solow, 1956; Whelan, 2015). Consequently, as further emphasised in Figure 5, the growth rate flattens out after the initial stimulus. Alterations in factors not affecting the productivity of workers have a level effect but not a growth effect. Since long-run growth is exogenous in the model, its driving factors remain unknown.

Figure 5 - Growth effect by increased investments

In this figure, solely the effect on the growth rate through increased investments is shown. This figure is connected to Figure 4, only showing the isolated change in growth rate.



(D. Romer, 2012, p. 20)

An implication of diminishing returns on capital is that countries with lower capital per worker should have higher rate of return on capital, which in an open economy would imply capital flow from rich to poor countries (D. Romer, 2012, p. 32). Thus, a global economic convergence among countries should be ongoing. If a rising capital stock rapidly increases growth in less developed countries, the effect from factors influencing savings and investments could be amplified in these countries compared to countries with higher capital stock per capita. Further, if growth from an increasing the capital stock is exhausted in developed countries, the effects from factors related to the capita stock, could differ vastly in comparison to poor countries.

The conclusion of growth that Solow and Swan outlines is that capital accumulation cannot account for long-term growth, but it has a significant effect on the speed of adjustment to steady-state. Furthermore, inequalities in income and wealth should affect transition dynamics via population, savings and investments, or indirectly via other factors connected to the three mentioned.

Hence, the Solow-Swan growth model appears not to be able to answer the central question of long-run economic growth but is appealing in terms of transition dynamics. Other theories must be explored to explain what drives long-run economic growth and cross-country differences. Nevertheless, the Solow-Swan exogenous growth model is deep-rooted as one central theory about economic growth and makes a valid comparison when studying the subject (Solow, 1956; Swan, 1956).

3.1.2 Ramsey

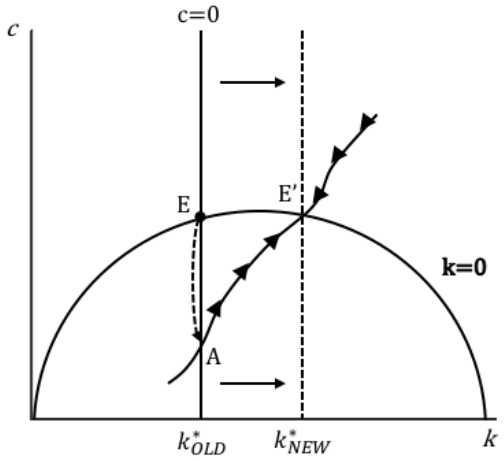
Different from Solow, Ramsey (1928) is looking to maximize utility – subject to expenditure derived from capital and labour which results in that the model endogenizes savings. An assumption in the model is that labour is fixed. Thus, to increase aggregate utility, capital needs to grow.

The Ramsey-Cass-Koopmans model is an extension of Ramsey's work, where David Cass and Tjalling Koopmans made important contributions. Cass (1965) particularises on the optimum savings problem discussed by Ramsey (1928), that it is a centralised, closed economy, also discussed by Solow (1956). Hence, Cass and Koopmans' extension tied together Solow's capital accumulation with Ramsey's infinite horizon maximization, where savings is determined endogenously by the interaction between households that maximize their utility (D. Romer, 2012, p. 49).

The behaviour in the Ramsey-Cass-Koopmans model is explained by the dynamics of consumption and investments and the motions of this relationship must follow the balanced growth path in accordance with Figure 6. No matter the initial value of k, there will be a corresponding value of c on this saddle path which will gradually move towards point E'. The model explains how savings affects the economy long-term with absence of imperfections such as various short-term disturbances. Hence, the conclusion is that growth channels remain similar compared to Solow, regardless of whether savings are assumed to be constant**.** But the main source of long-term growth remains to be the effectiveness of labour.

Figure 6 - The effect of a fall in the discount rate

The figure displays the effect of a fall in the discount rate. Consumption, c, falls initially to a new balanced growth path, adjusting consumption progressively until the new equilibrium E' is reached. At the new equilibrium, E', a higher capital stock, k, is also observed for the economy.



(D. Romer, 2012, p. 12)

In the Ramsey-Cass-Koopmans model, the intertemporal rate of preferences is a key factor in how the economy behaves in the transition between steady states. In every period, agents always set their consumption level so to maximize their life-time consumption. As an example, falling discount rate would result in an immediate drop followed by a phase effect on the consumption, and adjust to a new balanced growth path until steady- state is reached as visualized in Figure 6

It can be understood from the above model that if the budget of poor individuals is relatively constrained, they will be forced to save at a non-optimal level derived from basic consumption needs. This could have direct effect on the economic growth, since a higher rate of poor individuals would increase aggregate consumption and reduce savings. In fact, Bertola, Foellmi & Zweimüller (2006, p. 39) show that elasticity of the intertemporal substitution grows in consumption. Thus, in a growing economy, wealthier people are inclined to save more compared to poorer people since the latter are constrained to a specific minimum consumption level in order to survive. In addition, since the current savings rate is based upon the life-time income, large income inequalities will have large effect on the relative savings rate between poor and rich agents.

Further, because of the maximization constraint, in a democratic society, agents will use their vote to increase their own consumption (Bertola et al., 2006, p. 79). If the income distribution is skewed towards the upper 49%, the lower share will vote in favour of a progressive tax system to gain a larger share of the country's wealth and income (Esarey, Salmon, & Barrilleaux, 2012). In the framework where income reflects productivity, an increased tax burden on the wealthiest could arrive with negative implications for future growth since it creates disincentives among agents, but also since redistribution constitutes a negative externality.

There are extensions of the model where the utility maximization problem is altered in a way that there is a trade-off between income and leisure (Romer, 2012, p.195). The altered maximization is interesting in the perspective of economic inequalities since it problematizes the concept of utility. Thus, low labour income does not necessarily imply a lower utility within this framework.

3.3 Endogenous growth theory

The difficulty of explaining the mechanisms of long-run economic growth appears clearly in exogenous growth models such as Solow (1956) and Swan (1956), where an increase in capital accumulation only causes short-run growth and the only variable explaining growth is the indistinct exogenous variable of effectiveness of labour. Turning to endogenous growth theories can further deepen the understanding of through which channels an economy grows. Based on Solow's model on economic growth, Lucas (1993) and Romer (1992) extended the model by endogenizing growth.

In endogenous models, the definition of capital is widened compared to the neoclassical view, to include both human and physical capital (Solow, 2007). Thus, demonstrating the key point of endogenous models, which outlines the reason for why diminishing returns on capital does not necessarily occur: capital includes the stock of ideas and grows with new knowledge. Ideas are different from physical goods in that they are characterised by increasing returns to scale due to their non-rivalry characteristics (Jones & Vollrath, 2013, p. 81). With that said, in contrary to neoclassical models, governmental market interventions with positive impact on technological development can increase growth permanently.

The derivation of the endogenous model begins with a microeconomic foundation, each firm acts in a perfect competitive market (Jones & Vollrath, 2013, pp. 97-111). However, to incentivize R&D investments, patents are restricting the non-rival characteristics of ideas, since otherwise R&D investors would sell at marginal cost and earn negative profits. Thus, the patent holder invests in order to get monopolistic power, sells the new idea above marginal cost and earns a positive profit. Hence, the market will appear to be characterised by imperfection. Contrary to before mentioned neoclassical theories, with the assumption of imperfect market conditions, the model can explain why inequalities occur but also that it is a necessary externality from incentivizing knowledge production and therefore the fundament of continuous growth. Obviously, for incentives to drive growth social mobility must be assumed.

Paul Romer (1990), in his endogenous growth model, ties together the progress of new knowledge with labour engaged in R&D. The theory conditions that technological growth depends upon capital accumulation and population growth. A striking difference to neoclassical growth theory, which advocates that population growth would dilute capital stock per capita and hence decrease the steady state growth of output. Further, different from Solow (1956), output per person is related to the stock of knowledge instead of only physical capital per person. Via externalities such as learn-by-doing and knowledge spill overs, the diminishing return to capital can be reversed and growth continuous. Thus, new knowledge that is generated is a function of older knowledge; new ideas will increase growth since it can build on or ease the discovery of new knowledge. However, this mainly applies to the long-run growth since the monopolistic investors can shout out people from using and copying the new idea to reap benefits.

In the simplest version of Romer's (1990) growth model, excluding capital and thus limiting state variables to only one, there are four main growth drivers all of which direct or indirectly affects R&D (D. Romer, 2012, p. 131). The first one is the discount rate; less patient individuals are less willing to invest for future gains since future cashflows are less valuable. Correspondingly, as R&D is a form of investment, engagement in R&D will be lower. Substitutability between ideas is the second one; as ideas are becoming more similar the inventor of the knowledge loose market power and the ideas have lower contributions to economic growth in their similarity. The third one relates to the productiveness of R&D which directly translates to lower growth. It also influences growth via the attractiveness of the sector as lower productivity implies a lower attraction to the sector, and vice versa. The last factor,

population growth, has a positive relation to growth in two ways. The nonrivalry characteristic of ideas enables more individuals to increase their productivity grounded on the idea. Further, the population is likely to be positively correlated with the generation of new ideas, a larger population creates more knowledge.

When physical capital is included but not related to R&D, factors that affects investments in physical capital will still not cause growth effect on in the long-run, but like the Solow model, it will affect the level of the economy (D. Romer, 2012, p. 133). Benassy (2011, p. 198) develops the Romer model, including fixed capital, showing that the transition dynamics is driven by both the traditional factors of Solow and Ramsey but also all factors that are correlated with changes in endogenous growth.

As individuals in the Romer model strive for increased income, reached by monopolistic power, there is a trade-off between efficiency and inequality. More equal distribution of capital will decrease incentive for engagement in R&D as the benefits of generating new knowledge will decrease accordingly with the increased progressive tax rate. Thus, income inequality is a built-in externality of the system. Within the framework, a slower economic growth is the price to pay for a more equal redistribution of income (Zweimüller, 2000).

The basic Romer theory assumes that frontier research drive economic growth as only new ideas drive growth, thus presenting a framework for how developed countries can achieve sustained growth (Jones & Vollrath, 2013, p. 140). Jones & Vollrath further build upon the Romer theory with a basic extension of technological transfer to explain differences in total factor productivity between countries. The idea is that poor countries can copy technological development from more advanced countries and fasten their economic growth. However, to absorb advanced information and apply it required that the country already have a sufficient knowledge stock and/or capital stock (Jones & Vollrath, 2013, p. 148). In this setting can a low of school enrolment hamper the economic development of a country. Following the same logic, if individuals are restricted to attain a certain educational degree due to budget constraint the country will not reach their full potential.

3.4 Balanced growth and transition dynamics

As outlined in the chapter, the balanced growth path is essential in macroeconomic growth theories. However, it is important to remember that the steady-state might be a theoretical concept not always applicable in theory and that transition dynamics are relevant when analysing the growth of an economy. Hence, the explanatory factors of the economy are dynamic, and drivers of the economic growth may shift over time. Growth factors are likely to not stay constant and the theoretical notion of the balanced growth path refers to the situation where all variables grow at a constant rate.

Although, the definition of the economic long-run growth rate varies with the theoretical framework. Solow (1956), outlines this growth rate to be the growth of the exogenous variable technological development, of which capital and labour productivity increases at. Differently in the Romer (1990) model, all long-run growth is derived from the endogenous technological progress variable when on the balanced growth path, i.e. the production of knowledge and growth of labour engaged in research. Combining Solow, Ramsey, and Romer, it appears that drivers of growth include factors that affects either the capital stock or the knowledge stock in the short-run, whereas the latter is the only driver in the long-run.

From a short-term perspective, there are important behaviours to address in the transition between different balanced growth paths or in deviations from the initial growth path. The transition from a balanced growth path to a new balanced growth path cause a temporary growth rate that can last from a short period to several decades. Thus, transitionary behaviour can have significant effects on the income of an economy and the speed of adjustment between balanced growth paths. This level effect interrupts the notion of a balanced growth path since it deviates from the definition of all variables growing at a constant rate. Due to diminishing returns on investments in neoclassical models, variables such as investments, education and subsidies are variables that cause level effects, but no permanent economic growth. Further, since the long-run effect is driven by technological change and knowledge is non-rival, it follows that countries should be characterized by having the same long-run growth rate in equilibrium. However, the variation of the growth rates across countries can be explained by transition dynamics thus permanent or temporary shocks changing the size of the capital stock within a country (Jones & Vollrath, 2013, p. 171). A country with a smaller capital stock has more potential to utilize investments of increasing the capital stock because of diminishing returns in

more developed economics, why catching up is an important growth driving factor. The similar analysis appears in the endogenous Romer model, since the new knowledge is conditioned upon the current knowledge stock.

Moreover, the rate of growth in transition depends on the adjustment speed from one growth path to another, which is conditioned upon the country's capability to mobilize production factors. Given the historical capital or knowledge stock within a country, the adjustment speed should vary across countries and depend on nation-specific characteristics. A lower knowledge stock should make a country less able to reproduce new knowledge, e.g. adapt new ideas from countries with more advanced knowledge. Following the argument, a high enrolment in primary education might be extremely important in less developed countries if the knowledge stock is low. This is because the country must uncover more basic ideas and increase the participation of the work force in simpler work. More advanced countries should benefit more from enrolment in higher studies since their knowledge stock is more advanced.

If individuals, because of income inequality, are constrained to reach their full potential and invest in human capital, this can hamper the country's capability to mobilize factors of production, harm the transitionary growth and the speed of adjustment. Thus, the country will respond slower to factors that drives growth in transition periods. On the other hand, a degree of inequality could be needed to incentivize research and drive knowledge accumulation. If as savings increase with income, as is suggested by Mayer (Mayer, 1972), then inequality should have a significantly positive effect on the short-term growth. However, again the effect can vary vastly between countries. In a society with increasing inequality of income, money transferred from poor to rich can cause excessive savings and potentially result in a reduction of demand within the country (Summers, 2015). Further, the excessive saving due to unequal distribution is not necessarily invested in productive capital. Increased savings can also result in price bubbles when invested in already existing assets, like stocks or houses, thus not increasing the capital stock of the society but drives wealth inequality in a vicious circle. Again, the characteristic of the country heavily conditions how transitionary growth channels affect the growth and the speed towards the balanced growth path.

4. EMPIRICAL RESEARCH

In this section, empirical research of different kind is presented. The relationship between inequality and economic growth is vastly researched, forming a substantial amount of literature to go through. The different methodological approaches and samples has resulted in ambiguous results which further adds to the complex relationship touched upon in the theoretical chapter.

Firstly, the work of Piketty and Kuznets is presented. Both researchers are highly thought of due to their separate work, and despite it taking ground in empirical findings it has almost been treated as theory by scholars after its publication. They present more holistic research covering general concepts, distinguishing their work from the common structure of a research journal. Secondly, empirical results from the Asian Tiger economies of Hong Kong, Singapore, South Korea, and Taiwan are presented. The remarkable growth era in the region brought important counterfindings to theory and past consensus. Third and finally, journals covering the relationship between inequality and growth are critically presented. One part emphasises through what channels inequality affects growth, to contribute with understandings of the complex relationship. In all, the section should provide a comprehensive compilation of what has been researched earlier, to bring light to what is already known within the field.

4.1 Piketty

In his book "*Capital in the 21st Century*", Piketty (2014, pp. 1-35) concludes that growth is the outcome of knowledge and skill transmission, as well as reduction of inequality, on both national and global basis. He concludes it from his dataset, covering more than twenty countries over years of three centuries. The book and discussions within revolve around the empirical evidence found in the study, rather than creating a theory for growth drivers or optimal input ratios in production. Piketty stays transparent and humble about his results, but still argues that his work has a better foundation in terms of sample, theoretical framework, and understanding of the underlying mechanisms, than earlier work in the field.

Piketty (2014, pp. 1-35) brings essential intuition in the field of economic inequality with his careful elaboration on wealth inequality, not touched upon by anyone else to our knowledge. He argues that wealth allocation has been overlooked by research far too long and must gain more attention to gain a better understanding of the future to come. From his study, Piketty

finds wealth distribution always to be higher than the income distribution, emphasising that the former must not be overlooked analysing the impact of inequality.

4.1.1 Forces of divergence

Piketty identifies the primary force behind divergence to be when rate of return on capital, r[2], is higher that the annual growth of the economy's income or output, g.

$$r > g \tag{2}$$

In this situation, accumulated wealth gets lopsided importance for future wealth. If the state remains over a longer period of time, inequality rises as divergence in wealth distribution will be excessive. Individuals with high wealth will get relatively wealthier in the future, as their assets will yield income of disproportional amount compared to other individuals without the same magnitude of savings solely relying on traditional income from work. This does however not come from any market imperfection (Piketty, 2014, pp. 1-35).

Piketty (2014, pp. 1-35) shows evidence of private wealth value increasing rapidly in e.g. France and Britain, reflecting increasing prices in real estate and financial capital. Piketty's evidence could be explained by e.g. housing bubbles, and the UBS Global Real Estate Bubble Index (Holzhey & Skoczek, 2017) supports this suggestion. The UBS Index states London real estate prices to be in a bubble risk, while assessing the price levels in Paris as overvalued. In London, prices are up 15% since the financial crisis 10 years ago, while real incomes are down 10%. These findings emphasize the importance of Piketty's primary force of divergence and gives further intuition to why wealth inequality is a problem of magnitude. A bursting bubble could potentially bring wealth inequality, and hence income inequality, down slightly. However, it can only be speculated in the extent of that effect.

4.1.2 Other divergence and convergence mechanisms

Wealth inequality takes stance in several mechanisms, and how they are treated will be a determinant for future inequality rates, both on a national and global level. Piketty (2014, pp. 39-71) finds human capital to play a vital role for convergence. Investing in training to empower people though increasing their skill level, as well as transferring skills from one to another, are

[2] Piketty's exact explanation of r is "the average annual rate of return on capital, including profits, dividends, interests, rents, and other income from capital, expressed as a percentage of its total value" (Piketty, 2014, p. 25)

two pillars in the building of a more equal society from an economic point of view. The absence of investment into training could decline some individuals and groups access to the economic growth of their nation because of their small human capital, making the society progressively more unequal. Knowledge transmission is not only important within societies, but also between countries, in order to increase convergence. On a global level, emerging economies adapting existing technologies will allow them to catch up faster economically, closing the inequality gap between countries gradually.

Piketty (2014, pp. 1-35) does however acknowledge that the distribution of wealth is only partly affected by economic determinants, claiming political policies regarding taxation and finance to be two major factors. Another mechanism, that allows economic inequality to shoot in the sky is that top earners often sit on high positions in companies, allowing them to set their own remuneration, thus capturing more of the growth than workers.

4.1.3 Piketty's second law of capitalism

Connected to the primary force of divergence identified by Piketty (2014, pp. 164-198), is the formula describing the capital to income ratio in a nation[3].

$$\beta = \frac{s}{g} \tag{3}$$

(Piketty, 2014, p. 166)

Depending on how saving rates and growth rates change relative to each other, the long-run capital to income ratio will change. When s is kept constant, the beta will transition towards s / g over time. This is linked to the divergence mechanism through how the increase in capital is allocated. If it is useful to the entire population, it should be a national benefit. On the other hand, when wealth is distributed unevenly, only a few individuals will benefit from the change, resulting in an inequality surge (Piketty, 2014, pp. 164-198).

4.1.4 Predictions of the future

Piketty's concern for the future is inequality levels to be as high as during the 19th century in Europe, due to skewed growth in wealth. This as he sees a large likelihood of return on capital to once again exceed the rate of growth. The situation back then was that inherited money gave people power in the society, not their knowledge. The predictions are backed by findings in e.g.

[3] Beta denotes the capital/income ratio, s represents the savings rate and g the growth rate

data from the U.S. showing rising inequalities again, partially due to higher pay among top earners but also declining top marginal tax rates. This is in line with an earlier paper from Piketty, Saez, & Stantcheva (2014) based on data from 18 OECD countries, showing a strong negative correlation between top tax rates and the top 1% income share. In addition, the increases in top income share has not increased growth, implying that inequalities do not benefit economic growth. It is also discussed that optimal tax rates might be higher than assumed and realised, due to the bargaining effects on tax rates that come with increased wealth and consequently power in decision making.

4.1.5 Critics to Piketty's work

Piketty's discussions revolving the primary force of divergence and the second law of capitalism has been criticised for being highly unlikely, if not unbelievable, by Krusell & Smith Jr (2015). Regarding the latter, they argue that if the growth rate would get close to zero, the cumulative savings of a nation would need to be 100% of the GDP, which is very hard to put into context in reality. Madsen, Minniti & Venturini (2018) investigate the second law partly with another dataset, finding the wealth to income ratio to indeed be significantly linked to the savings rate and growth rate ratio. However, they find coefficients of the savings/growth ratio to range from 0.05 to 0.18, while Piketty argues it to be 1 in the long run.

Regarding the divergence, Krusell & Smith Jr (2015) argue that inequality would in fact rise only a small fraction if growth approached zero, when looking at U.S. data. Thus, what Piketty claims to be the primary force of divergence, may have low future effect in reality. They instead discuss that education, technical change, and capital markets may be more important.

4.2 Kuznets

Simon Kuznets' hypothesis about the inverted U was introduced in The American Economic Review 1955 (Kuznets, 1955), and has been used as a source of theory by many scientists in the field of economic growth and income inequality since. Kuznets tries to explain income inequalities through looking at its distribution, taking ground in the industrialisation era. In the initial phase of industrialisation when the economy grows, inequalities rise as urbanisation proceeds. Factories in urban areas will offer high wage, but it will not be matched by other professions within the city, leading to economic inequalities. People living in rural areas will generally have lower average income than their peers in the city, but with less divergence

among themselves. This phenomenon is denominated as the rural-urban difference. As the society progresses during the industrialisation, inequalities increase with a diminishing rate, eventually turning negative even though growth continues to rise, thus shaping the inverted U. There are several determining factors why inequality changes from a rising trend to declining. Legal and political decisions based on the society not tolerating great inequalities, in many cases connected to reducing the economic value of accumulated wealth, e.g. rent controls and government-controlled interest rates. The demographic change occurring during the industrialisation was another affecting factor, as the total population grew the richest would be diluted into an even smaller percentage, thus reducing inequalities. The third factor of rising equality is identified as the individual opportunities in a society embossed by technological change. Prosperous entrepreneurs of tomorrow are seldom the offspring of today's innovators, thus implying a greater chance of social mobility which decreases inequality. The importance of service income is also discussed as a factor by (Kuznets, 1955), suggesting that lower income brackets should have larger relative incentives to increase their income from their professions, thus reducing income inequalities step by step.

To summarize the study, the rapid growth in the start of industrialisation leading to increased inequality eventually flattens out at a high level, to eventually start decreasing again, creating an inverted U. Kuznets himself was critical to the study, identifying the data as a major flaw, both regarding income unit inadequacy and small sample size, resulting in the findings to be titled informed guesses by himself (Kuznets, 1955). However, when Piketty & Saez (2003) later looked and the same period for USA but with different data, they found the same relation, thus giving further credibility to Kuznets' hypothesis in the context of economic growth and inequality. The article has been a fundamental part of many research journals, and according to Barro (2000), the Kuznets curve was widely acknowledged as an empirical fact in the 1970s, as Ahluwalia (1976a, 1976b) found a statistically significant relationship, confirming Kuznets' idea. A few years later, Papanek & Kyn (1986) confirmed the same but criticised the hypothesis's ability to explain deviations over time in different countries. Li, Squire, & Zou (1998) also argued that the hypothesis may be useful at a specific time but is less useful when observing a longer time period. Further, several studies in the later 1990's used fixed effect modelling techniques, resulting in statistically insignificant results (Deininger & Squire, 1998; Ravallion, 1995; Ravallion, Squire, & Bruno, 1999; Schultz, 1998). The hypothesis was also used by Greenwood & Jovanovic (1990), who connected the idea to financial markets

inefficiency. The income gap between rich and poor will be large in the beginning of economic development, as the rich will have the advantage of using financial markets for optimal yield on their holdings. Through economic growth, financial markets can get more accessible to the population, flattening out inequalities again and reaching an inverted U relationship on the curve. Similar are the results in studies concerning income inequality related to technological progress. The poor has disadvantages from technological inaccessibility in the beginning which leads to lower returns and thus inequalities, but will eventually get access and flatten out the differences (Aghion & Howitt, 1992; Galor & Tsiddon, 1997). Once again, an inverted U relationship of inequality can be seen.

In later studies, it is suggested that the Kuznets' hypothesis should be extended, whereas inequality rises with growth again once hitting low levels, thus forming a figure closer to an inverted, laying, S-shape. Early indications of the S-curve were found both in research covering the U.S. (Tribble, 1999), but also in a larger sample of more than 70 countries (List & Gallet, 1999). Galbraith, Conceição & Kum (2000) also address the extension, arguing that high income countries, e.g. the U.S., the U.K., and Japan, will experience rising inequality when facing high economic growth. Their work is in line with a theoretical model later established by Gangopadhyay & Bhattacharyay (2015), who also find empirical evidence from ASEAN countries, China, and India, for the U-shape to be extended to a S-shape. When Yang & Greaney (2017) estimates the short-term and long-term relationship between inequality and growth for China, Japan, South Korea, and the U.S., further support for the S-shaped curve is found. It is obvious that the S-curve includes the dimension of transitioning from a manicuring economy to a service economy, a transition progress which occurred after the work of Kuznets. Yang & Greaney argues that a main factor to the rising inequality is due to capital concentration, explaining both income and wealth inequality. This is in line with Piketty's (2014) primary force of divergence.

4.3 The Asian Tigers

The Asian Tigers are economies in Southeast Asia, namely Hong Kong, Singapore, South Korea, and Taiwan that experienced around 6% growth rate per year of real GDP, between 1960 and 1995 (Barro, 1998). Adding the empirical perspective of what drove growth in the region

contradicted established theories, and the relationship to inequality challenged the consensus at the time drawn from empirical evidence, bringing a deeper understanding of the complexity.

4.3.1 'Reverse causation' of savings and economic growth

The 'Reverse causation' refers to the relationship where an increased rate of savings was caused by growth, not vice versa. This relation contravenes general economic theories saying that savings and investments drive growth. Some of these theories claim savings to be a substantial part of economic development, and that wealth must be accumulated among few, as they will save more (Hertzman & Siddiqi, 2000). It appears however, that the Tiger economies are a contradictory case (Birdsall, Ross, & Sabot, 1995). It could be derived from the absence of large manufacturers, as several small producers would lead to more equal incomes across the society, enabling many people to start saving money as economic growth would increase their incomes. That growth causes savings, but not the adverse, is in line with a study conducted by Carroll & Weil (1994), concluding that households with higher growth prediction will save more. Savings were also made available to the small and rural savers in the population through the governments ensuring bank security, through regulations and supervision as well as reforms (Birdsall et al., 1993, p. 16). The reverse causation is further argued by Birdsall et al. (1993, p. 245) as past value of growth indeed was found to be a good predictor of savings in the region, but savings was not found to be a good predictor of growth.

4.3.2 Inequality and growth in the region

What is even more interesting in the scope of this thesis is the relationship between inequality and growth in the Asian Tiger economies, which also contradicted the general view at the time that inequality and growth has a positive relationship. In traditional western economies, inequalities have increased as economies started to grow rapidly, implying that growth and equality are incompatible, whereas the development among the Asian Tigers have been the opposite.

The rapid economic development was considered as a growth miracle in a World Bank Report written by Birdsall et al. (1993)[4], as the income distribution was thoroughly very equal. It was derived partially to low inequality in land ownership compared to other less-developed

[4] The data set used by Birdsall et al. (1993) to describe the East Asian Miracle was criticised by Galbraith et al. (2000), who uses a UTIP dataset contradicting a widespread equality. Taiwan and South Korea had low income inequality, but Singapore had quite high inequality

countries by Rodrik (1994). Siddiqi & Hertzman (2001) extend the view, finding evidence that inequality even decreased during the period of rapid growth. They argue that income distribution parity determines the average health status of a society, thus making population health a substitute for equality and a good measurement to set in relation to economic growth. They discovered that equality indeed increased in the Tiger economies during the rapid economic growth between 1969 and 1980, consistent with the findings of Chiang (1999) and Birdsall et al. (1995). This counter the findings of health and growth correlation by Wilkinson (1992) looking at OECD countries, and Ross et al. (2000) using data from the U.S. and Canada. Wolfson (2000) claims that a wider income gap between rich and poor worsens the overall health of the society, in line with Siddiqi and Hertzman's argument. Thus, country-specific factors are evidently of high importance when analysing the growth-inequality relationship. As the comparison between the Asian tigers and OECD suggests vastly different conclusions.

4.3.3 Other explanations to the high regional growth

Birdsall et al. (1993) explained the high growth through accumulation of human and physical capital, leading to increased productivity. Other factors identified were e.g. successful export policies through the governments' ability to compete and cooperate simultaneously. Effective monetary politics also helped sustain macroeconomic stability (Sengupta, 2011). Lucas (1993) attributed the economic growth to R&D spill over effects and the up-scaling in production that took place through it.

The Tiger economies also show that policies can improve growth and equality. Education proved to be a successful factor, as both quantity and quality of schooling improved, first targeting primary school and then expanding secondary school availability (Birdsall et al., 1993, 1995). Birdsall et al. (1995) also find trade policies to be an important factor, increasing labor demand thus leading to growth. Government influences to maintain the prosperity of the agricultural sector through land reform policies reduced inequalities (Berry & Cline, 1979; Squire, 1981), leading to growth as crop yield and labour intensity decreases when farm sizes increase. Especially in Korea and Taiwan, output and demand increased due to policies on land holding (Birdsall et al., 1995). Barro's (2015) findings for the 'Iron law of convergence'[5] agrees

[5] Barro describes the term 'Iron law of convergence' as the fact that the gap in real GDP per capita between countries decrease for every year. It is an important measurement as it can provide understanding of fast less developed countries should catch up with the developed world.

with the above explanations for the rapid growth of the Tiger economies. In his study, evaluating long-run cross-sectional data on economic development, he finds statistical significant evidence for faster growth in poor countries compared to rich, if they have quality institutions and human capital, as well as well working governmental policies.

Young (1995) provides additional insights to the Asian Tigers' growth. While not arguing with the remarkable growth of output in the economies, he concludes that the growth in total factor productivity has not been extraordinary[6]. Thus, the additional input in work force and capital is concluded to constitute for most of the growth, not technological progress (Collins, Bosworth, & Rodrik, 1996; Krugman, 1994), setting them apart from industrialized countries (J. Il Kim & Lau, 1994). This would also imply that the rapid growth of the Tiger economies is not any sensation, rather an ordinary outcome of the vast accumulation of physical and human capital (Sarel, 1996). In modern times however, the Asian Tigers are in the front end of high-tech domains (Dumont & Cuyvers, 2000) making the argument that technological progress had no effect on growth hard to accept. Dowling & Summers (1998) argue for this, agreeing with resource accumulation being a crucial component, but adding that it could not have led to consistent growth over three decades without technological advances.

4.4 Critical survey of empirical studies

In the debated field of income inequalities, numerous theories and studies have been conducted to evaluate its relation to economic growth. The ultimate purpose has been to identify whether inequalities are good, bad or insignificant for different economies and hence use the research for a wide range of purposes. Important to understand is that this research aims to establish the effect of inequalities on growth, not vice versa.

Early studies up until the turn of the millennium many times used a cross-section data structure (see Table 1), which observe numerous countries but neglects the differences in time. Hence, the analysis becomes focused in differences between the variables, but no conclusions can be drawn on dynamics over time. In 1998, H. Li & Zou (1998) conducted a cross-country study

[6] Young's result was criticised by Hsieh (1999) for showing data flaws in the Singaporean estimation of national accounts. Additional problems were pointed out by Sarel (1996), as several assumptions had to be made for the depreciation rate of the (different parts of the) capital stock as well as investment inflow

with panel data, bringing more depth into the analysis as the time perspective was included. Using panel data has after that become standard when measuring the effects of inequalities on growth.

This section aims to provide a comprehensive review of the previous literature, from different points of views. Firstly, the actual sign of the inequality variable in different studies is considered, which evolves into an examination of through what channels inequality could affect growth. The discussions proceed to a conclusion of the many ways inequality may affect growth, based on findings in previous papers. Next, a more technical evaluation is undertaken, looking into possible trends in result depending on what method is used, as well as possible dataset and sample implications.

4.4.1 Ambiguous effects of inequalities on growth

Previous studies suggest that income inequalities can have both a positive and negative relation to growth. Early studies, conducted with cross-sectional data starting year 1960, found evidence of a negative relationship between inequality and growth (see Alesina & Rodrik, 1994; Deininger & Squire, 1996; Perotti, 1996[7]; Persson & Tabellini, 1994). However, shortcomings with these early studies were identified by Barro (2000), stating that the studies seem to only handle the average relationship with aggregation bias. To avoid the problem identified, later studies used panel data.

Despite changing data structure, several journals keep finding the same negative correlation between inequality and growth. Deininger & Olinto (2000) uncover asset but not income inequality to effect growth negatively, and Knowles (2005) discover the same relationship when using expenditure data in developing countries. Cingano (2014) confirms these findings through establishing a negative relationship between inequalities and growth when looking at OECD countries between 1975 and 2011. His results show that the growing income gap between low income households and the rest of the population is much more concerning than the richest people in the society increasing their incomes relatively faster. For the latter, no indication is found that it would impair economic growth. Ostry, Berg, & Tsangarides (2014)

[7] Perotti questions income distribution data in earlier studies, as it was typically computed from surveys. This computation may result in measurement errors. It is further argued that quintile shares across countries are hard to compare because of; different definitions of the recipient unit, the income concept, and the coverage.

is talking about the lack of investments in education and health as a consequence of inequality to hinder growth. To us, it seems to imply that the low-income households are the most exposed, in line with Cingano's results. Madsen, Islam, et al. (2018) find the same negative relationship analysing the Gini coefficient and the top 10% income share, suggesting a new instrument when regressing inequality on growth channels. They find inequality to be significantly negative across all four growth channels identified, thus adding another analytical perspective to research.

Partly contradicting the research evaluated so far on how inequality effects economic growth, Barro (2000) postulates inequality to negatively affect growth in poor countries while rich countries might even benefit from slight inequality. Voitchovsky (2005) confirms the conclusion, suggesting that inequality on the top end of the income distribution is beneficial for growth, while inequality on the lower end is negatively related[8]. Halter, Oechslin, & Zweimüller (2014) finds different effects of inequality on growth over time, stating that it may increase economic performance in the short-run, but leads to reduced growth in the future. Naguib (2015) extends the finding that inequalities and growth go hand in hand, as the economies would grow with a ratio of 1.2 to 1.5 in the following ten years of a 1% increase in inequality. The findings are in line with earlier studies by Forbes (2000)[9], H. Li & Zou (1998) and Li, Lai, Wang & Zhao (2016) suggesting a positive relationship between inequality and economic growth. Yang & Greaney (2017) stays on the same track, finding evidence of increasing income inequality to stimulate economic growth in China, Japan, and the U.S. When Naguib (2017) imposes a new wealth Gini variable, the relationship to growth also seems to be positive, but is not robust.

4.4.2 Different channels through which inequality affects growth

Identification of the transmission channels of how inequality affects growth has been a popular approach in previous research, reasonably as conclusions can be drawn from the use of control variables. Even though this study does not separate inequality channels, but rather how income

[8] Voitchovsky (2005) criticises earlier studies not looking at inequalities in different distributions, arguing that they might mask the underlying complexity of the relationship, thus only capturing an average effect. The profiles suggested are (1) Savings and investments, (2) Incentives, effort, and innovation, (3) Crime, rent seeking, and Balance of Power, (4) Taxation and redistribution

[9] Forbes (2000) argue that the negative relationship between inequality and growth in previous studies is because of exogenous factors, e.g. aggregate wealth, political institutions, and country development

and wealth inequality as broad measurements affect the main channels of growth, this section provides an important understanding of the numerous channels through which inequality can affect growth.

Fiscal policy

As inequality grows, the democratic society could begin voting for stricter regulations and higher taxation to redistribute incomes, leading to a tougher business climate reducing incentives to invest (Bénabou, 1996; Perotti, 1996). The people will also try to change wealth distribution policies when the median income is below average (Esarey et al., 2012). Gründler & Scheuermeyer (2018) finds evidence that inequality negatively affects growth. They add that redistribution of wealth also affects growth negatively, mainly due to a decrease in investment, offsetting the positive growth effect from reduced inequality, making the impact of fiscal policies insignificant. Yang & Greaney (2017) find supporting evidence for a negative effect of fiscal redistribution on growth in Japan, South Korea, and the U.S., but not in China. This is partly in line with Ostry et al. (2014) who argues that taxes and redistributions may be the wrong answer to declining growth due to inequalities. This argument is presented with the findings that bulky redistributions, despite the positive effect of lower inequality on growth, is approximately growth neutral because of undercutting effects in the work of redistributing incomes. Nevertheless, they conclude that this is only in extreme cases, otherwise redistribution tend to increase growth. Even though literature finding redistribution to increase both inequality and growth is scarcer than the growth neutral evidence, e.g. Bénabou (2000) finds that redistributed incomes distributed to social welfare may increase both. If the money is used to improve health and education benefiting the poor, it could also give counterweight to market imperfections (Saint-Paul & Verdier, 1993).

Socio-political instability

In the same spectrum, but in a slightly different domain, Hibbs Jr (1973) argues that the concentration of economic resources can lead to political corruption, as high-income individuals will seek to affect rulers to keep low taxes and a favourable business climate. In extension, an escalating situation may lead to an instable political climate and social unrest, affecting growth negatively (Keefer & Knack, 2000). Bagchi & Svejnar (2015) is arguing for a similar relationship, namely how political connections affect growth when connected to wealth. They unravel a relationship of wealth inequality affecting growth negatively, but only when it has been acquired through political connections.

Incentives

From a perspective of incentives, inequality may however have a positive effect on growth (Katz, 1986). According to him, equality differences create incentives to work harder, but also encourage individuals to take the financial risk of educating themselves with the purpose of higher future returns. The individuals are also encouraged to switch to more productive industries, enhancing economic growth (Cingano, 2014). If taking a step away from individual incentives, to the societal level, Stevans (2012) found no empirical evidence that redistribution through taxes – which would be de-incentivizing – would lower growth channels like investments and entrepreneurship in the U.S. between 1970 and 2006[10]. This is an important contradiction to the studies presented above, claiming inequality to incentivise the population and enhance growth.

Savings and financial development

Physical capital is partly gathered through savings, enabling investments in tangible assets, but also other important channels of growth like education which affects human capital, and R&D that affects technology. As savings is an important channel, financial development becomes an important factor to take into account, as access to credit is possibly the most important sub-channel (Aghion & Bolton, 1997; Banerjee & Newman, 1993; Piketty, 1997). Financial development is found to be a major driver of growth, as investments in education and R&D are enabled through financial markets (Madsen & Ang, 2016). When the ability to invest is different depending on individuals' income, financial markets are said to be imperfect. In this situation, important investments in e.g. education cannot be made by individuals with lesser income, even though it would likely be profitable for both the individual and the society in the long-run (Galor & Zeira, 1993). Thus, inequality would lead to a lower economic growth (Banerjee & Newman, 1991) . Perotti (1996) finds a similar relationship between inequality and growth, but attributes it to lower fertility rates in more equal societies, enabling additional investment in education per capita. Kennedy, Smyth, Valadkhani, & Chen (2017) agree to this, suggesting that income inequality can be addressed by politicians through supporting increased human capital accumulation. The importance of investment in education is however contradicted by Domenéch & Castelló-Climent (2014) as human capital inequality has been reduced in the

[10] Stevans (2012) makes another interesting finding, that inequality shows hysteresis. When a positive shock occurs, it may lead to a permanent rise in inequality.

world while income inequality has hardly changed, making education an insufficient condition to reduce income inequality.

Persson & Tabellini (1994) finds that equality promotes investment in democratic countries through policies protecting property rights, while the relationship is insignificant in non-democracies. An interesting addition is the work of Li et al. (2016), proving private capital investments to be a driver of long-term growth in China. Savings increase from inequality as richer people tend to save a larger percentage of their salary, thus the possibilities for investments also increase as capital becomes available (Bourguignon, 1981; Kaldor, 1957). This in turn would lead to increased growth. According to Barro (2000) and Ostry et al. (2014), this phenomenon is even more important for countries with low average income, as it would enable at least a part of the population to invest in education. This is also in line with Kuznets' (1955) curve, stating that higher inequality increases per capita income at low levels.

4.4.3 The interdependence between country-specific factors and growth

As can be concluded from the readings of previous literature and the Asian Tigers, the relationship between income distribution and economic growth is far from easy to derive. What needs to be kept in mind is that there is an extensive set of variables that can potentially affect economic growth in different countries, that may not be captured by the models when explaining.

Many theories claim savings to drive economic development, and for that to work the wealth must be accumulated among a few, as they will save more (Siddiqi & Hertzman, 2001). Counter-evidence can be found when examining the Asian Tigers, as income inequalities were low or even reduced during the high growth (Birdsall et al., 1995). This is in line with North American findings, showing that southern U.S. have higher inequality because of historical slavery and incomes accumulating among a few, compared to northern U.S. and Canada where income has been fragmented historically for collective prosperity and led to higher equality but also higher economic growth (N. A. Ross et al., 2000). Theories suggest that equality increases savings, societal stability, incentivizes low wage workers, and enables domestic multiplier effects - allowing simultaneous growth in rural and urban sectors (Barro, 2000; Birdsall et al., 1995) leading to synergized growth. The North American study indicate that a society's economic origin effects growth no matter what public policies are in effect.

The access to oil might be a factor affecting both economic inequality and GDP growth. If taking the Russian economy as an example, it is exposed towards the oil price and less fluctuating prices lately has increased the economic stability and affected demand positively (The World Bank, 2017). Perhaps surprising, it is found that oil abundance decreases income inequality as the less privileged gain more from oil booms (D.-H. Kim & Lin, 2017). A common belief is also that mineral rich countries fail to distribute the incomes, leading to high inequality. This is addressed by Papyrakis & Parcero (2016) finding that it is indeed true, while other research finds income inequality to be uncorrelated with a country's access (M. Ross, 2007). Gylfason & Zoega (2002) applies an endogenous growth model and finds that natural resources can diminish growth and increase income inequality through drawing workers from industries with higher technology.

An overviewing article published by the World Bank concludes infrastructure to be fundamental for economic growth but only find vague evidence for decreasing inequality (Calderon & Serven, 2014). The authors say that improved infrastructure should increase the poor's accessibility to cheap services, but are limited in their conclusion due to data insufficiency. Another study covering urban China finds ambiguous evidence in the relationship of infrastructure and growth, where e.g. public transit systems and internet access was positively correlated with income inequality, while e.g. waste treatment facilities, power efficiency, and water efficiency was negatively correlated (Miguel & Mendoza, 2005). The latter findings emphasise how complex the interdependence is between infrastructure, income inequality, and growth. However, we are sceptical of the findings that public transportation would increase divergence within a city and stay cautious to the result as it might indicate heterogeneity and endogeneity, despite the authors' claim of dealing with it.

As understood, there is a huge range of variables that can affect growth, some general and other country-specific. Thus, there are also numerous variables that inequality affect growth through. The point with this clarification is that this study will not be able to cover them all, neither directly nor indirectly.

4.4.4 Method connection to empirical results

Earlier researchers acknowledge that the inequality coefficient most likely is biased, and because of the complex nexus of potential control variables, the direction of the bias is impossible to definitely predict. Forbes (2000), when performing an OLS regression, suggests

that income inequality is negatively biased via time-invariant country-specific factors such as the corruption level and the ratio of government spending targeted healthcare and basic education. Forbes GMM estimations, which she argues to be unbiased, provides the same significant result of a positive effect of income inequalities on growth as the OLS estimator when controlled for fixed effects, suggesting that within country fixed effects are the most crucial and that a fixed effects method should be preferred (Naguib, 2017).

A summarizing table on earlier research is presented below, with following discussions on econometrical methods used and dataset implications.

Table 1 – Overview of previous literature

In this table, previous literature is summarized to give an overview of what has been concluded by researchers. 25 articles are listed, and have been chosen as they are conducting the same test as this study, namely the effect of inequality on growth. The articles denoted * have been inspired by Cingano (2014) with content and layout, while articles denoted ** have been inspired by Naguib (2017). Just like the mentioned researchers, we have added the latest relevant articles ourselves, to present a table as up to date as possible. The Authors column describes who wrote the articles, while Time and Country shows what their sample consists of. Data structure shows how said data is compiled while Relationship describes what relationship is found between inequality and growth. When the relationship is ambiguous, it means different relationships are found depending on what model is used. Econometrical method refers to the statistical approach used.

Authors	Time	Country	Data structure	Relationship	Econometrical method
Alesina & Rodrik (1994)*	1960-1985	46/70 countries	Cross-section	Negative	OLS, 2SLS
Persson and Tabellini (1994)*	1960-1985	67 countries	Cross-section	Negative	OLS, 2SLS
Clarke (1995)*	1970-1978	74/81 countries	Cross-section	Negative	OLS, 2SLS
Perotti (1996)*	1960-1985	67 Countries	Cross-section	Negative	OLS, 2SLS
Birdsall and Londono (1997)*	1960-1992	43 countries	Cross-section	Negative	OLS
Deininger and Squire (1998)*	1960-1992	66/87 countries	Cross-section	Negative	OLS
Li and Zou (1998)*	1960-1990	46 Countries	Panel	Positive	FE, RE
Barro (2000)*	1965-1995	84 countries	Panel	Ambigious	3SLS
Deininger and Olinto (2000)*	1966-1990	31/60 countries	Cross-section, Panel	Ambigious	System GMM
Forbes (2000)*	1966-1995	45 countries	Panel	Positive	Difference GMM, FE
Panizza (2002)	1940-1980	48 U.S. states	Panel	Positive	FE, Difference GMM

Banerjee and Duflo (2003)*	1965-1995	45 countries	Panel	Ambigious	Difference GMM, FE, RE
Knowles (2005)**	1960-1990	40/30(+5) countries	Cross-section	Negative	OLS
Voitchovsky (2005)	1975-2000	21 (developed)	Panel	Ambigious	System GMM
Easterly (2007)**	1960-1998	100 countries	Cross-section	Negative	OLS, 2SLS
Barro (2008) **	1960-2000	47/70 countries	Panel	Negative	OLS
Cingano (2014)	1975-2012	22 countries	Panel	Negative	System GMM
Halter, Oechslin, and Zweimuller (2014)	1965-2005	106 countries	Panel	Ambigious	System GMM
Bagchi and Svejnar (2015)	1987-2002	41 countries	Panel	Negative	IV, FE, RE
Babu, Bhaskaran, and Venkatesh (2016)	1980-2010	29 Emerging Markets	Panel	Negative	System GMM
Li et al. (2016)	1984-2012	27 Chinese Provinses	Panel	Positive	Dynamic panel regression
Yang and Greaney (2017)	1975-2013	U.S., Jpn, Kor, Chn	Time-series	Ambigious	Engle–Granger two-step
Kennedy et al. (2017)	1942-2013	Australia	Panel	Negative	GMM, RE, OLS
Naguib (2017)	1990-2014	146/154 countries	Panel	Positive	Difference GMM
Madsen et al. (2018)	1870-2011	21 OECD countries	Panel	Ambigious	OLS, 2SLS

* Cingano (2014)
** Naguib (2017)

As theory does not find any direct connections via inequality and economic growth, the most emphasised problem in terms of econometrical method is the endogeneity problem. The problem of endogeneity is not only derived from omitted variables but also reversed causality and measurement errors. Thus, given the complexity in the task of results from earlier research regarding the relationship between growth and inequality is heavily conditioned upon the choice of econometrical model.

From Table 1 it is clear that almost every researcher using the simple OLS approach estimates a negative relationship between income inequality and economic growth, which is in line with Forbes' (2000) prediction that inequality is endogenously negatively biased due to heterogeneity among countries. Together with an OLS approach, instruments have commonly been used to avoid simultaneity and sometimes omitted variable bias is addressed in conjunction. However, the instruments have met heavy criticism for their questionable exogeneity. For example, Bagchi & Svejnar (2013) instrument inequality with the exchange rate, which Naguib (2017) argues is endogenous since it is correlated with the economic performance of a country via the monetary policy. Further she argues that Easterly's (2007) instrument of agriculture endowment is limited in time, as its relevance is decreasing with the development of a country. In accordance, previously suggested instrument variables lack power to convince that the inequality variable is unbiased in the second stage.

Panizza (2002) estimates the effect of inequality on growth across American states using both a dynamic fixed effect estimator and a generalized method of moments (GMM) estimator. She finds that the Gini coefficient is negative across all 10-year growth episodes, but that its significance varies, especially within the FE estimator whereas the GMM estimator is more robust. Forbes (2000) mentions that Panizza's inclusion of a lagged dependent variable can bias the fixed effect estimator, causing inconsistency and accounts for the shifts in coefficient. With inspiration from Alesina & Rodrik (1994), H. Li & Zou (1998) uses five-year lags of the Gini variable, GDP, and primary school enrolment in a fixed effect estimator arguing that the five-year lag mitigates the endogeneity problem from simultaneity. Lagging more than one period avoids endogeneity per construction, which Forbes, and Halter et al. (2014) among others, point out as the main endogeneity problem from a dynamic fixed effect estimator when T is small. However, H. Li & Zou, does not comment on the omitted variable bias, which the dynamic estimator not necessarily remove.

Models most commonly used throughout the last couple of decades includes two steps least square-regression (2SLS), fixed effect and random effect panel estimations (FE and RE), and different variations of the (GMM)[11]. Whereas the system GMM is more frequently applied in later research. FE and 2SLS exhibits benefits in terms simplicity and understanding as both are relatively easy to perform and should be well-known as they are included in the majority of econometrical university text books but can be problematic when handling serial correlation in the error term. Thus, both methods are questionable in terms of endogeneity and consistency and the direction of the bias remains ambiguous. On the other hand, the GMM, and the inclusion of numerous instrument variables should be more efficient in terms of serial correlation, but is coupled with other implications such as overfitting, especially for small samples, and sometimes difficulties to interpret the result and setting up the model.

The, in recent time, more commonly used system GMM estimator developed by Arellano & Bond (1991) aims to reduce the constructed endogeneity in the lagged GDP variable which is often introduced in order to control for convergence. In short, it employs a vast number of lagged instruments to reduce autocorrelation in the error term. The model is applicable when there is a large number of countries and a short time period and is more efficient in relation to a dynamic fixed effect or random effect estimator (Halter et al., 2014). Most common is that the researchers rely on lagged differences of dependent variables as instrument, however, very rarely is the relevance or the exogeneity of the instruments elaborated on. Roodman (2009) further elaborate on this concern for the GMM approach when he refers to the black box, meaning that commonly used statistical programs are difficult to comprehend as they lack transparency in the performance of GMM estimation. In addition, the large number of instruments produced in the GMM estimator overfits the endogenous variable and weakens the Hansen test. The benefit of GMM in terms of dynamic bias from fixed effect regressors, comes at a cost of invalid estimates when using many and weak instruments.

As presented in Table 1, results vary a lot across articles using the system GMM. Although, there is a tendency of literature to find that inequality has a negative impact on growth, especially within a cross-section setting. Thus, measurement error which depends on data set, different lag lengths of instruments and different sample in terms of countries and time are main

[11] Commonly used variations of GMM are summarised in Roodman (2009) and based upon the original method from the paper of Arellano & Bond (1991)

factors in producing the inconsistency. Voitchovsky (2005) postulates that the bias is referred to whether one should rely on cross-country differences or within-country information, and that the system GMM should be preferred as the former remove relevant information.

4.4.5 Inequality dataset implications on result

The dataset produced by Deininger & Squire (1996) and used in their study, has been used by many researchers after its emergence[12]. Their 'high quality dataset' is based on several criteria, claiming that inequality data should be gathered from household surveys, cover every source of income or expenditure, and characterise the full population in the country (Neves & Silva, 2014). Despite its seemingly careful gathering of data, it has also been criticised. Galbraith et al. (2000) claim the dataset to be defect in terms of inaccuracy and unbalanced coverage. Inaccuracy is claimed due to questionable coefficients, while the latter is also acknowledged by Forbes (2000), as poor countries are underrepresented in early time periods. Atkinson & Brandolini (2001) confirms this in their study of OECD countries, showing that the data set is plagued by data comparability- and quality problems. They further refer to Székely & Hilgert (1999), stating that seasonality problems may arise due to reference periods shorter than a year.

In many studies after the turn of the millennium, the WIID or SWIID datasets have been used for inequality data, possibly affecting their results in different directions. As discussed above, the Deininger & Squire (1996) dataset has been criticized by several researchers after its release. As the SWIID is based on the WIID dataset, that in turn uses data from e.g. the D&S dataset, problems discussed regarding the earlier sources remain. High quality data in accessible for a smaller number of developed countries, thus the benefit of a larger data sample is affected by lower quality data to be included in the sample. The SWIID also has a problematic imputation model, and the data provided becomes incorrect (Jenkins, 2015). The datasets employed utilizes the benefits of cross-country approaches as it increases the number of observations, however it is important to understand that this comes with a cost. Forbes (2000) argues that cross-country data have measurement errors since there is a general lack of alignment in the reporting inequality numbers between countries, the problem is especially problematic if the errors are correlated with inequality or growth.

[12] In Table 1, 10 articles are listed through the year of 2000 and 6 of them use Deininger & Squire's dataset for income inequality. This describes the importance of the dataset for the research back then, but also the possible implications of a faulty dataset

5. RESEARCH DESIGN

Based on the theoretical and empirical literature review, the research design is optimized to analyse the research question as effective as possible. The chapter begins with the research approach. Followed by the specific hypothesis that answers the research question. After that a subchapter on data sample and construction follows. In the variables and proxy selection part, we explain the variables in the econometrical method and why they are included based on theory and earlier empirical studies. The method subsection thoroughly walks through which econometrical method that is applied, and why it is the most relevant. The chapter ends with an elaboration on the reliability, replication and validity of the method.

5.1 Research approach

This study takes ground in a deductive approach, where theory guides research (Bryman & Bell, 2015). This is determined as growth theories combined with the formed hypotheses has steered the work and its progression. We make an attempt to follow the deduction process fully, but instead of revising theory, a discussion is held regarding how inequality could reasonably be incorporated. A quantitative research strategy is used, as numerical secondary data is used to quantify empirical evidence. The quantitative research strategy is in general not only deductive, but also positivistic in an epistemological sense, and takes on objectivism as an ontological orientation. Epistemology refers to what should be considered adequate information, and positivism makes a clear difference of theory and empiricism as only what can be found through empirical proof is considered (Bryman & Bell, 2015, p. 38-73). The natural science epistemology is found in this paper as the collected data is used to make a generalized research analysis and conclusion, from our small sample, on how inequality affects growth channels. This paper is also characterized by explanations being backed by data, e.g. as evidence for what growth channels that are affected by inequality, and not speculated in from a general conclusion from only that economic growth indeed is affected. Thus, fulfilling the positivism criteria. Ontology handles how reality is approached, and objectivism tells the conclusions should be free from individual perception and prejudices (Bryman & Bell, 2015, p. 38-73). This paper aims to be as free of writer-subjective influence as possible, through only making conclusions out of regression results and well backed reasoning.

5.2 Hypotheses

This paper hypothesises that income and wealth inequality affect economic growth. The null-hypotheses are formed after what we believe to find, and have been developed with guidance from Sreejesh, Mohapatra, & Anusree (2014) with the purpose of clearly creating a question to be answered, within the scope of the paper. All hypotheses presented are null-hypotheses and have been formed to not give ambiguity it its acceptance or rejection.

5.2.1 Effect of economic inequality on economic growth

This section outlines the question on which the paper finds foundation: whether income and wealth inequality affects economic growth. Four hypotheses are formulated below, two each regarding income and wealth inequality. The first hypothesis of each inequality measurement aims to answer if it affects economic growth, the other what sign it will affect with.

As have been shown in previous literature, the effect of inequality on economic growth is ambiguous. Thus, there is no clarity in what results should be found from our dataset. Nevertheless, a significant result is often found. Yang & Greaney (2017) finds evidence of a positive relationship of income inequality and economic growth for two of our five sample countries, U.S. and China. Voitchovsky (2005) also finds that income inequality in the top end of the distribution has a positive relationship to growth, using a similar inequality measurement. The econometrical method also needs to be taken into account, where research with similarities to this paper, e.g. H. Li & Zou (1998), find a positive relationship between inequality and growth. The main argument for why income inequality affects growth is via capital accumulation and the assumption that rich individuals save more than poor individuals. Further, many scholars argue that income inequality is needed for economic growth, since it incentivizes the workers. Madsen, Islam et al. (2018) among many others, argue that inequality has an enhanced negative effect in undeveloped countries compared to developed countries. As our sample has an overweight of the latter this further indicates that a positive relationship should be found. Thus, the first hypotheses are formulated in the following way:

H 1.0 Income inequality affect GDP growth

H 2.0 Income inequality has a positive relationship to GDP growth

Explained by Piketty (2014), income and wealth inequality is tightly connected, as wealth embodies income accumulation. However, wealth inequality has not been researched to any

extent near the income equivalent. Thus, the reasoning behind the predicted null-hypothesis is only brief. Naguib (2017) tests how wealth inequality affects GDP growth and receive weak, insignificant evidence of a positive relationship. While Piketty claims wealth to have a negative impact on growth, we believe that wealth inequality will not have the opposite sign to income. Thus, through the reasoning for income inequality and the findings of Naguib, we expect to find a positive relationship between inequality and growth. Thus, the hypotheses are formulated in the following way:

H 3.0 Wealth inequality affect GDP growth

H 4.0 Wealth inequality has a positive relationship to GDP growth

5.3 Data and sample construction

There is no lack of macroeconomic information, but finding secondary data with full internal consistency across the sample is a challenge. Previous research has continuously criticised preceding papers, mainly for the inequality dataset as the calculations often hold internal issues. Learning from previous research, we tried to get as reliable data as possible in general, but for the inequality measurements in particular. Several data sources were evaluated before deciding upon the World Inequality Database. Not because it seems to have any superiority in data quality, but because the data was published recently and is yet to be included in any journals.

The different variables were collected in sequential steps, to determine that the selection of our most relevant data, the inequality measures, would not be affected by any of the control variables. Once wealth and income inequality information was downloaded, control variables were assessed from previous literature do decide upon the most appropriate ones for our study. This procedure was ongoing, where control variables were switched multiple times due to newly acquired knowledge. This constant evaluating process identified the most crucial control variables of which most were included. A few of the identified variables are however missing in our regression due to unavailability of data. The growth variable, along with all control variables except one, were downloaded from the World Bank. Household savings was downloaded from Oxford Economics, a prominent company within quantitative analysis.

Table 2 – Data sources

This table presents the sources from where the variable data has been collected. A total of 10 variables have been gathered from three different sources, and the denotation in the source has been included to ease any wishes to replicate our tests.

Variable name	Denotation in source	Data source
Growth	GDP growth (anually %)	World Bank (WDI)
Wealth inequality	Net personal wealth top 10%	World Inequality Database (WID)
Income inequality	Pre-tax income top 10%	World Inequality Database (WID)
Population growth	Population growth (anually %)	World Bank (WDI)
Urbanisation	Urban population (% of Total)	World Bank (WDI)
Openness	Exports of goods and services (% of GDP)	World Bank (WDI)
Tertiary education	School enrolment, tertiary (% Gross)	World Bank (WDI)
Household savings ratio	Household savings	Oxford Economics
GDP per capita	GDP per capita	World Bank (WDI)
Capital formation	Gross capital formation (% of GDP)	World Bank (WDI)

5.3.1 Sample composition

In the best of worlds, the research sample displays the same characteristics as the whole population, enabling general conclusions to be drawn. Errors in sample composition hinders such inferences, limiting the study (Sreejesh et al., 2014). With the awareness of this, no global conclusions can be drawn from our limited sample. The conclusions are likely not even applicable to our sample countries one-by-one because of their different characteristics. On the other hand, the result perhaps become more general because of the distinctions getting smoothed out.

The five countries in our sample are: China, France, Russia, U.K., and U.S. The data collected differ in time because of availability issues. In general, the inequality measures have been the scarce data, deciding the yearly ranges. In total, 167 observations are included in the dataset, covering U.S. between 1980-2014, France between 1971-2014, United Kingdom between 1971-2012, China between 1980-2015, and Russia between 1995-2015. Occasionally there are

variables missing for one year, but it should not bias the result significantly (see Appendix E for missing variables). Once again, this inconsistency was forced due to unavailability of data, but a desire to maximize the number of observations. As all years are not covered by all countries, time dummy variables are not included as the interpretation would be different for different dummies. It also gives different weights to the different countries, which has been attempted to control for with country-dummies. Since the period is restricted in time, effects from business cycles can cause problems within our estimation. We have argued that to maximize the dataset is more beneficial than trying to define a whole business-cycle and reduce observations. Further, as the countries are very heterogenous, e.g. according to the growth statistics China did not get seriously hit by the financial crisis of 2007/2008, to remove a business-cycle from the dataset would be problematic.

Table 3 - Variable overview per country

In this table, each variable is presented per country, to show weight differences in the sample as well as how mean, standard deviation, and possible outliers differ. The denotations are as follows: INC is income inequality, WE are wealth inequality, GR is GDP growth, GDP is GDP per capita, URB is urbanisation, PG is population growth, TE is tertiary gross enrolment, OPE is openness, CF is capital formation, and HHS is household savings.

Country		INC	WE	GR	GDP	URB	PG	TE	OPE	CF	HHS
China	n	34	34	34	34	34	34	34	34	34	34
	mean	0,359	0,491	0,097	1968	0,359	0,009	0,123	0,194	0,402	0,271
	max	0,429	0,674	0,151	8069	0,556	0,016	0,434	0,359	0,477	0,398
	min	0,272	0,408	0,039	195	0,194	0,005	0,012	0,057	0,337	0,095
	sd	0,054	0,096	0,028	2389	0,109	0,004	0,116	0,088	0,044	0,082
France	n	43	43	43	43	43	43	43	43	43	43
	mean	0,323	0,533	0,023	22416	0,751	0,006	0,416	0,231	0,231	0,139
	max	0,342	0,573	0,063	45413	0,793	0,009	0,644	0,289	0,290	0,223
	min	0,293	0,500	-0,029	3174	0,715	0,001	0,185	0,163	0,193	0,002
	sd	0,012	0,023	0,018	12903	0,021	0,002	0,147	0,036	0,023	0,062
Russia	n	20	20	20	20	20	20	20	20	20	20
	mean	0,473	0,645	0,029	6785	0,735	-0,001	0,660	0,300	0,215	0,100
	max	0,521	0,713	0,100	16007	0,740	0,002	0,804	0,413	0,255	0,204
	min	0,424	0,526	-0,078	1331	0,733	-0,005	0,431	0,229	0,148	-0,023
	sd	0,023	0,046	0,052	5175	0,002	0,002	0,128	0,048	0,030	0,048
United Kingdom	n	36	36	36	36	36	36	36	36	36	36
	mean	0,351	0,525	0,025	18143	0,785	0,003	0,352	0,247	0,209	0,104
	max	0,420	0,660	0,065	44252	0,818	0,008	0,626	0,297	0,275	0,148
	min	0,278	0,456	-0,042	2650	0,770	0,000	0,146	0,202	0,144	0,055
	sd	0,051	0,053	0,022	12382	0,010	0,002	0,180	0,022	0,034	0,022
United States	n	34	34	34	34	34	34	34	34	34	34
	mean	0,413	0,672	0,026	32789	0,777	0,010	0,744	0,101	0,218	0,067
	max	0,471	0,745	0,073	54599	0,815	0,014	0,963	0,137	0,251	0,115
	min	0,342	0,614	-0,028	12598	0,737	0,007	0,535	0,070	0,175	0,026
	sd	0,040	0,040	0,020	13101	0,027	0,002	0,122	0,019	0,018	0,023
Total	n	167	167	167	167	167	167	167	167	167	167
	mean	0,373	0,565	0,040	17572	0,682	0,006	0,439	0,209	0,256	0,139
	max	0,521	0,745	0,151	54599	0,818	0,016	0,963	0,413	0,477	0,398
	min	0,272	0,408	-0,078	195	0,194	-0,005	0,012	0,057	0,144	-0,023
	sd	0,062	0,089	0,040	15174	0,172	0,005	0,259	0,079	0,080	0,089

There are several variables of interest here. One is the GDP per capita of China, which ranges heavily, and where the mean is far from the maximum value. This is however not an outlier per definition, and the relationship is expected because of China's rapid growth in later years. On the other hand, this relationship, where the mean of the GDP per capita is for from the maximum

levels of today, is seen throughout our sample. Another variable we want to highlight is the population growth in Russia that displays a negative mean, setting the country apart from the sample in average. Overall, we can conclude a heterogeneity among the countries, including the inequality variables.

5.3.2 Inequality data

The dataset used in this paper is fetched from World Inequality Database. The team behind it consist of well-known researchers within the field: F. Alvaredo, L. Chancel, T. Piketty, E. Saez, and G. Zucman, and they are in turn backed by a large network of researchers (World Inequality Database, 2018c). Even though the renowned names bring a sense of reliability to the data, we evaluate it critically to not become hypocrites, potentially using data with similar flaws to previous datasets we have criticised.

The income inequality data is computed from income tax data, national accounts, and Pareto interpolation techniques. This calculation technique differs from the traditional way of calculating income inequalities, though household surveys, not properly catching inequality dynamics (World Inequality Database, 2018b). However, the dataset still suffers from heterogeneity, as units, income intercepts, and the interpolation technique could not be reproduced entirely equally across time and nations. Wealth inequalities are computed through income tax data and inheritance tax data (World Inequality Database, 2018g). There might be flaws in the data due to the difficulty to control for cross-border assets and offshore wealth (World Inequality Database, 2018f referring to Zucman, 2013, 2014). The researchers behind the dataset also stay humble about its completeness, claiming it to be provisional and subject to improvement (Alvaredo, Chancel, Piketty, Saez, & Zucman, 2017).

The WID.world dataset used in our regressions suffer from inconsistencies without a doubt, which are impossible to even attempt to control for without the raw data. Thus, we can only acknowledge the flaws and how it may affect the results and discussions. In addition, considering the coverage of wealth inequality being limited to five countries, which is the primary constraint to this paper, our sample suffers remarkably from imbalanced coverage. Thus, our dataset likely suffers from inaccuracy just like previous datasets used by researchers. Since only a few countries are represented in the data, the conclusions and discussions are limited to the sample countries, and cannot be inferred as general truth. The fact that the five countries are significantly different too, where China and Russia are classified as developing

economies by the International Monetary Fund (2017), does perhaps imply that the general results obtained are not representative for the specific sample countries either. However, our results from the data could still provide indications of relationships, to be built on in coming research.

5.4 Model variables and proxy selection

This section explains what variables are used in the econometric model, and what potential substitutes that have been found in previous research. It is argued why the used variables are chosen, but we remain humble to our selection and realize that the wide variety of variables in past work partly is because no perfect ones have been found in a general context. A large part of this section is devoted to the motivation of gender percentage as a new instrument variable. For increased readability, the instrument variable discussion is located last in this section.

5.4.1 Dependent variables

Within previous research in the field, the dependent variable regarding economic growth is very similar in many cases. This paper does not divert from this generally accepted variable of real GDP growth rate.

Real GDP growth rate

The choice of variable proxying for economic growth relies on a consensus that the GDP growth rate is a solid measure. It can be calculated with some variations, e.g. the growth rate of GDP per capita. is used (see e.g. Bagchi & Svejnar, 2015; Barro, 2000, 2008; Deininger & Squire, 1998; T. Li et al., 2016). It is also consensus that real GDP should be used, to control for inflation and deflation. Some earlier research within the field uses the growth rate of GDP denominated to a currency, normally US-dollars. We have however chosen to use the GDP in local currencies, as e.g. the Russian Ruble fluctuates heavily to the US-dollar in our time sample, biasing the growth measurement.

Per definition, there is no natural substitute to real GDP growth rate when measuring economic growth, if not widening the perspective to general progress. If so, the Genuine Progress Indicator (GPI) includes the sustainability aspect[13] and could be a relevant variable. However,

[13] GPI includes e.g. income inequality, costs associated with crime, environmental costs, unpaid work, alteration in leisure time, and public infrastructure (Costanza, Hart, Posner, & Talberth, 2009)

as this paper emphasises the narrow economic growth perspective, which is not to be confused with people's well-being, it is not desirable to look beyond the GDP variable. National income is another measure possibly relevant in the context, consisting of 'GDP minus consumption of fixed capital plus net foreign income'. It is motivated through its inclusion of aspects not generating income e.g. capital depreciation, and capital transferred to foreign capital owners as it does not benefit the country's inhabitants (World Inequality Database, 2018b).

5.4.2 Independent variables

In this subsection, the selection of regressors is discussed. Previous literature has used a variety of measurements for economic inequality, and the benefits and pitfalls are briefly discussed. This paper uses the top 10% share of total income and wealth as independent variables.

Income inequality

The accumulated pre-tax income of the top 10% earners, as a ratio on the total income in the nation, is used in this study as the measurement for income inequality. The fact that it is pre-tax can be argued to be a flaw within the dataset since it does not account for redistribution policies. But for example, in U.S. we see that a progressive tax system appears to not be present and that the top earners are better at avoiding tax, which should limit this negative effect (Stiglitz, 2013). One interesting aspect of the measurement is that top earners drive investments according to neoclassical theory. This measurement was used in a recent study by Madsen, Islam et al. (2018), where they highlight the potential weakness that the variable does not include low income brackets, found to be important by other researchers such as Voitchovsky (2005). As top and bottom measurements of inequality have been found to affect growth differently, it is tempting at first sight to include both to derive any differences in how they affect growth. However, if doing so, there is a risk of the two variables offsetting each other as they intuitively should move in different directions (Voitchovsky, 2005).

There is no consensus that any measurement of income inequality would be better than another, the choice of this paper is based upon the matching data found for wealth inequality, along with the reasoning above. Thus, there is a consistency allowing for comparisons without any subjective interpretations. The measurement is also intuitively easy to understand, inviting a broader audience to read the paper.

The different types of inequality measurements used is research are many. A similar but different percentile shares of total income has been used previously be e.g. Ostry et al. (2014)

and Persson & Tabellini (1994). The main measurement found in the absolute majority of studies is the Gini coefficient (see e.g. Alesina & Rodrik, 1994; Barro, 2000; Easterly, 2007; Halter et al., 2014; H. Li et al., 1998; Naguib, 2015). The Gini is debated though, and different datasets have been used to calculate it.

Wealth inequality top 10% share

An equivalent to the income inequality measurement has been selected for wealth inequality as well: The share of net wealth of the top 10%. This became a natural choice, as data could be collected from the same database as our income inequality measure, thus staying more consistent than if collecting data from different sources.

Wealth inequality is not investigated to any extent near income inequality, thus it is harder to generalize on different variables and datasets used. A few papers use a Land Gini coefficient, measuring inequalities in land distribution (Balisacan & Fuwa, 2003; Birdsall & Londoño, 1997; Deininger & Olinto, 2000; Deininger & Squire, 1998)[14], which we argue could possibly be compared to inequality in wealth. This argument is based on the fact that our wealth inequality measure includes assets. Bagchi & Svejnar (2013) creates a wealth inequality measurement from Forbes list of billionaires and Naguib (2017) creates a wealth Gini coefficient, claiming to cover the full profile of wealth distribution and that Bagchi & Svejnar proxy using the Forbes500 list does not[15].

5.4.3 Control variables

Seven control variables are used in the sensitivity analysis, where tertiary education and GDP per capita are used in the baseline regressions. The selection of variables is motivated by previous research, and data availability. The control variables are included as potential factors to be correlated with both inequality and the economic growth based on earlier research and theoretical knowledge of how the economy behaves when not in the steady-state or on the balanced growth path. Thus, the inclusion aims to decrease the biasedness from the error term

[14] Naguib (2017) argues that land ownership concentration, which the Land Gini coefficient measures, has less impact in industrialised countries, thus becoming irrelevant to this paper

[15] Naguib, in turn, uses the criticized SWIID dataset. What we can conclude is a nexus of datasets, all containing some problem others are eager to point out. Despite trying to cope with the flaws in the best possible way, it will always be possible to criticize the data somehow, also applying to the data set used in this paper

and make the coefficients as consistent as possible. As there is an upper limit in how many variables that can be included, a restriction of the number of variables has been done.

Tertiary education

Education affects knowledge and human capital, which in turn affects the GDP according to endogenous growth theory. Economic inequality affects inequality through education, as income divergence leads to low educational levels (Knowles, 2005). This is in line with Perotti's (1996) reasoning of income distribution affecting the education decision. The education variable has been used widely in previous research, including different levels of education. Primary and secondary school enrolment are common together with tertiary school enrolment (see e.g. Halter, Oechslin, & Zweimüller, 2014; Knowles, 2005; H. Li & Zou, 1998; Ostry, Berg, & Tsangarides, 2014). This paper has chosen tertiary education [16] because of two reasons. First, the countries in our sample all have high enrolment in lower levels of schooling, which should lead to insipid conclusions. Secondly, we intuitively expect tertiary education to have a larger effect on both economic inequality and GDP growth. This approach goes in accordance with (Babu, Bhaskaran, & Venkatesh, 2016). An advanced knowledge stock should drive growth both for developing and developed countries, but slightly different. An advanced knowledge stock increases developing countries ability to absorb new knowledge whereas developed countries must generate new knowledge in order to drive long-run growth in the steady-state. One should emphasise the notion of the steady-state growth rate here, and that the effect from higher education ratios may have a negative impact on the cost base in the short-run while the value-added effect appears when the individuals enter the labour market. We argue that tertiary enrolment has a more direct effect compared to primary and secondary enrolment simply because the students are closer to the labour market.

GDP per capita

The logarithm of GDP per capita is included to control for convergence effect present in less developed countries (Basu & Guariglia, 2007). The convergence is connected to the 'knowledge gap', making it easier for developing countries to raise their GDP through

[16] According to the World Bank, the variable is calculated as the ratio of the total enrolment, based on the number of individuals that are within the right age span for the education. Thus, since all people does not meet the predefined age span for the given education level, e.g. individuals might return to school after they have been working, the ratio can produce values that are above 100%

knowledge transmission and imitating technology developed by stronger economies (Naguib, 2015). GDP per capita could also be a potential factor for socio-political instability, as well as affecting the education possibilities (Perotti, 1996), affecting both inequality and economic growth. Thus, Naguib argues for a negative relationship between GDP per capita and economic growth, as a higher level of should result in a lower growth. The variable is widely used in previous literature due to this relationship (see e.g. Alesina & Rodrik, 1994; Barro, 2000; Yang & Greaney, 2017). Other studies have found that the relationship between GDP per capita and inequality is particularly complex, e.g. Voitchovsky (2005) finds that the effect of inequality is dependent on the development on the country, suggesting that a nonlinear relationship is present.

Urbanisation

Urbanisation ratio[17] drives both GDP growth and inequality according to Kuznets (1955), as urban areas show both a larger income divergence as well as being the frontrunners of growth in a nation. From an endogenous growth perspective, knowledge is likely to flourish more when individuals are closer to each other, implying that cities can work as knowledge hubs within a country. It is used as an indicator for economic development by Perotti (1996) later followed by others (see e.g. H. Li & Zou, 1998; Panizza, 2002; Li et al. 2016). Perotti argues for ambiguous expectations of the urbanisation variable. It could be positive as it is a precondition to growth, but it could also be negative because effective tax systems are implemented easier in urban areas, harming growth.

Salvati, Sateriano, Grigoriadis & Carlucci (2017) find that there might be causality problem between urbanisation and GDP growth since economic fluctuations can influence demographics. Thus, another explanation is that people move to the city during lower growth periods, maybe because it is easier to find a job in areas with higher population density. This could be a possible flaw in our regressions resulting in endogeneity and causing a misinterpretation of the variable.

[17] The World Bank states that the variable is calculated based on individual countries specific definitions what an urban area is, implying the risk that the data can be inconsistent. Especially if there is a pattern of how the countries specify their urban population, serious biasedness impact the results. For example, it is widely known that the due to hukou system, China underestimates the number of people who lives in the city making the number unreliable (Wing Chan, 2008)

Capital formation

Capital formation[18] is used as a proxy for investments (Halter et al., 2014), and investments increase economic growth in transition between steady-state in presented economic theories. As discussed throughout the paper, investments can also affect inequality through e.g. human capital (Alesina & Rodrik, 1994; Deininger & Squire, 1996). Earlier research suggest that rich people save more than poor implying an indirect relationship between income and investment and that a higher concentration of income or wealth results in a higher ratio of investment to GDP (Lewis, 1954). According to Stiglitz (Stiglitz, 2013), a higher concentration of wealth equals a higher concentration of power, which constitutes a potential relationship between investments and inequality. In this setting, higher inequality undermines the democracy and skews the policy to benefit people with higher wealth, for example resulting in reduced taxes on capital in comparison the tax on labour income or a tendency that fiscal policy counters business cycles with tax cuts instead of public investments. For example, Piketty, Saez, & Stantcheva (2014) finds that there is a strong negative correlation between the top 1% income share and top tax rates.

Openness

Trade openness[19] has a clear positive effect on growth (H. Li & Zou, 1998) which is also found in the case of the Asian Tigers where trade policies affected growth positively (Birdsall et al., 1995). There is no consensus on its relation to inequality, but it was found to be positively related in China (T. Li et al., 2016). Openness to trade has also been included in later studies (Babu et al., 2016; Ostry et al., 2014), with ambiguous results. When Yang & Greaney (2017) includes openness in their study, including China and the U.S. among others, they also find ambiguous results of its relation to inequality and economic growth. According to convergence theory, higher openness should benefit the growth of a country since the it increases international connections and the possibilities find and to absorb knowledge relative to a closed country (Piketty, 2014; P. M. Romer, 1990; Solow, 1956).

[18] The variable is calculated as 'outlays on additions to the fixed assets of the economy plus net changes in the level of inventories' (The World Bank, 2018b)

[19] The variable is calculated as the percentage of exports to GDP

Household savings

Savings[20] clearly affect economic growth according to economic theory, as the capital stock is used for production input. Household savings can channel credit towards industries, thus having a positive effect on growth (Bénabou, 1996). Madsen, Islam et al. (2018) use savings as a dependent variable proxying for economic growth, further emphasizing its legitimacy. It is suggested that income inequalities have a significant effect on the aggregate savings rate. In specific, that the savings rate should increase with income (Stiglitz, 2012). Even though this variable according to theory equals investments, it is important to include it as the correlation is not equal to one, although it is considerably high. Given the correlation the investments and savings appear to contain different information.

Population growth

How an increasing population and GDP is connected is clear in growth theories, as increasing labour grows total output, in the Solow theory it is one of the main drives of total GDP growth. Piketty (2014, pp. 72-109) relates population growth to decreased wealth inequality, as inherited wealth becomes diluted. Population growth has been used in several papers, due to its suitability as a controlling variable, and follows the intuition to affect growth positively (Babu et al., 2016; H. Li & Zou, 1998; Ostry et al., 2014). Surprisingly, its relation to income inequality is not established. Although within the Solow theory, higher population growth has a negative effect on GDP per capita which can proxy for income. Thus, the relative importance of capital gains should benefit richer people.

Variables not included

Some variables would have been relevant to include in the regression, but were not due to data unavailability. Financial development is one control variable we would have liked to use. It is found to be a major driver of growth by Madsen & Ang (2016) and identified as an tremendously important factor to credit-access among all parts of the income brackets, driving investments in both education and R&D, transmitting to economic growth (Aghion & Bolton, 1997; Banerjee & Newman, 1993; Piketty, 1997). Government expenditures could also have been desirable to include, as it is of major importance for counter-cyclical fiscal policy (Barro, 2000). Fiscal redistribution through taxation would have been interesting to incorporate in the

[20] Household savings is calculated as $\frac{Savings\ in\ the\ personal\ sector}{Personal\ disposable\ income} * 100$

regressions too, as it is one way of redistributing income and wealth that has also proven to impact growth in previous research (see e.g. Gründler & Scheuermeyer, 2018; Ostry et al., 2014; Yang & Greaney, 2017).

5.4.5 Instrument variable - Female % of the population

The instrument variable used for the inequality variable is 'Female percentage of population'. For a valid instrument, exogeneity is crucial. Thus, it should not be affected by any other variable in the regression. We want to emphasise that our instrument may not be completely strong, because of cultural individuality in e.g. China, where the male to female ratio among new-borns increased when the ultrasound became available (Yi et al. 1993). However, this should not reflect in the GDP-levels directly, but rather through a long series of connections, making the relation weak and consequently the instrument quite strong.

Relevance for income inequality

It is a well-known fact among the public that women earn less than men. According to Arulampalam, Booth, & Bryan (2007) the pay gap between genders also widens in the top of the distribution - referred to as the widely known phrase 'glass ceiling'[21]. They speculate that gender-specific policies could affect the gaps, as it partly neglects women. Dollar & Gatti (1999) identifies inequality in education opportunities, and Rodríguez-Pose & Tselios (2009) in turn finds lower education to impose lower income. Gregorio & Lee (2002) shows that this reasoning indeed holds, finding educational distribution equality to affect income equality.

Relevance for wealth inequality

According to Freund & Oliver (2016), presenting a dataset on billionaire wealth, extreme wealth increases faster in emerging economies[22] than developing countries[23]. Datasmoothie (2018) uses the data of Freund & Oliver, and find that only 11% of billionaires are female, and that men inherits wealth to a much larger extent than women. Even though evidence is found by Cameron & Dalerum (2009) that billionaire families have a boy-girl ratio of 6:4, it is nowhere close to the inherence ratio close to 4:1. Hence, we must conclude that men inherit a

[21] The glass ceiling is defined by Oxford Dictionaries (2018) as "An unacknowledged barrier to advancement in a profession, especially affecting women and members of minorities"

[22] IMF (2017) classifies both Russia and China as emerging economies

[23] The findings partly contradict Piketty (2014), as Freund and Oliver also find wealth to be self-made with increasing speed, especially in the U.S., while wealth is inherited to a larger degree in Europe

larger portion of the family's wealth. Ruel & Hauser (2013) find that women accumulate less earnings during a lifetime than men, which reflects in less wealth over the lifetime. The relationship is also affected by women being more risk averse, gaining lower yield (Watson & Mcnaughton, 2007).

Putting this in general terms of the paper, men should have a higher representation among the top incomers of the society, while women will have a higher representation in the bottom 90%. This would mean that if more women are born, the majority of them would be categorised into the bottom 90% wealth bracket, thus increasing inequality.

Exogeneity

The exogeneity condition of the sex ratio instrument is satisfied if it is only related to growth, via the inequality variable[24]. To our knowledge, our instrument variable has not been used in previous research. Thus, we cannot confirm its exogeneity through other sources.

The drivers of human sex ratio include different factors arising from environmental and cultural conditions, as well as global migration patterns. The culture factor mainly affects selection of birth (Murphy, 2003). The environmental factor, on the other hand, relates to chemical pollution and global warming, skewing the birth distribution and mortality among men and women (Lean, 2008)[25]. These factors could be correlated with growth, as chemical spillages might be related to production. Catalano, Bruckner & Smith (2008) predict that one additional male will be born for every 1000 female if we see an average temperature increase of 1 degree Celsius. However, according to NASA (2018), it appears that the global warming has increased the average Celsius degree with approximately 0.5 Celsius since year 1990 to today, why the effect on the sample in this paper must be very low. (Orzack et al., 2015) compiles the largest dataset known to now and find that the sex ratio at conception is unbiased. However, more men than females are born in the first trimester and the birth mortality is higher for females.

[24] Exogeneity is important since the regression would otherwise produce biased coefficients of the endogenous inequality variables

[25] Vartiainen, Kartovaara & Tuomisto (1999) criticizes the relationship between chemicals and an increased male-ratio. By studying the Finnish population over a 250-year period, no evidence is found supporting a relationship between the sex ratio and increased doses of chemicals. They suggest that short sample periods in previous research heavily bias the results.

Even though environmental effects may have a small effect on the sex-ratio, it appears that cross-country culture factors are more relevant, generating a risk of endogeneity. Immigration acceptance and first child preferences can mirror a country's culture, and culture can also explain savings preferences, a key driver of growth (Guiso, Sapienza, & Zingales, 2006; Maridal, 2013). China is affected via the one child policy, as the preference caused an increased number of males on an aggregate level because of sex-selective abortion (Murphy, 2003). Sex selection in itself should not be correlated with the GDP growth, as males and females are equally as productive (Bastida, 2018). However, the culture lying behind the selection potentially could, as Tabellini (2007) finds culture to impact growth through a country's institutions, despite changing slowly. Hence, through controlling for country fixed effects, the potential endogeneity of the instrument can be removed.

There is research implying our instrument to be endogenous via female percentage on the labour market. Aguierre, Hoteit, Rupp & Sabbagh (2012) find that an increasing female ratio in the workforce could raise the GDP and that women tend to put off a larger portion of their income to education for their children. They conclude on a strong correlation between empowering women and beneficial outcomes, but without a general explanation of why this relationship can be found, except for the education spending. This thesis remains humble to the results found by Aguierre et al. (2012), but question why women and men would not be equally efficient. In line with Bastida (2018), we argue that on a general level, men and women should be equally productive and that women are not allocated to work-tasks where they lose efficiency, to any larger degree than men. Thus, we should not find any general deviations in the effectiveness between genders.

On the other hand, it could be argued that wages reflect efficiency and that women collect lower payment for the same work. This could be derived from the fact that women take on unpaid work to a greater extent than men. This could perhaps be true, which would make the instrument weaker as replacing a man with a woman could decrease the GDP directly, not only through inequality.

Instrument variables in previous research

The most modern applications of instruments are Easterly's (2007) agriculture endowments[26], and communist influence by Madsen, Islam, et al. (2018). We question the validity of both instruments in terms of relevance and exogeneity. The agriculture endowment instrument assumes that factor endowments to cause inequality, as sugar cane as a commodity is connected to slave labour. The inequality in turn directly affect low quality-institutions, underdevelopment and a small stock of human capital. All of which should have a great impact on the GDP according to theory. One implication of the instrument is that it is restricted in methodology, measuring the one-time ratio of agriculture endowment and is only applicable for cross-section data. It can also be questioned if a relationship derived from slave labour used for sugar cane production in Latin America, and wheat production among the middle class in the U.S., can be used as an instrument globally, or if the relationship is only relevant in those specific regions.

The communist influence instrument is based upon distance to a language spoken in a communist country, a communist dummy and the population. Since the first two variables are relatively constant, variations in language spoken or shifts in ideology happens rarely, the variation of the instrument would be equal to the population change. The size of the population should have a direct effect on GDP and is not be applicable when addressing the relationship between inequality and growth. Also, the language spoken is not always a good proxy for communism, West and East Germany, and North and South Korea are two examples.

5.5 Method

The purpose of this section is to provide a clear picture of the methodological approach, and the underlying choices. It begins with a thorough description of the applied method to give a clear understanding of what regressions are conducted. This gives an intuition for the reader to carry with in the subsequent subchapters. Secondly, the reasoning behind the choice of econometrical approach is presented, where different possible methods are presented and its argued why the chosen approach is optimal. After that, the chosen fixed effects model is presented, to further describe its benefits and disadvantages. Followed by that, sources of endogeneity are discussed carefully as it is important when modelling inequality and growth.

[26] Specified as "The abundance of land suitable for growing wheat relative to that suitable for growing sugarcane"

Finally, an explanation and the procedure of the instrument is included, from an econometrical point of view.

5.5.1 Applied econometrical method

The fixed effect estimator model is applied and starts with a baseline regression inspired by the H. Li & Zou (1998) framework. Two robustness analyses are performed for validation and the framework is extended through controlling for spurious regressions.

Baseline regression

The original baseline function following H. Li & Zou (1998) follows:

$$Y_{it} = \alpha_i + \beta_1 INEQ_{it-3} + \beta_2 GDP_{it-3} + \beta_3 TERT_{it-3} + \gamma_{it} + \epsilon_{it} \qquad (4)$$

Y_{it} is a proxy for a GDP growth, $INEQ_{it-3}$ is a proxy for the wealth or income inequality lagged three periods, GDP_{it-3} is logarithm of GDP per capita lagged three periods, $TERT_{it-3}$ is the logarithm of tertiary gross school enrolment lagged three periods, ϵ_t is the residual assumed to be i.i.d.[27], γ_{it} is unobserved time-variant factors correlating both with inequality and the dependent variable.

Both income and wealth inequality are increasing over time, which is not addressed by H. Li & Zou (1998). Thus, the baseline regression will be extended by controlling for the time trend with including it as an additional control variable. T, is linear in time and increases by one for every year. Altering the model to become:

$$Y_{it} = \alpha_i + \beta_1 INEQ_{it-3} + \beta_2 GDP_{it-3} + \beta_3 TERT_{it-3} + \gamma_{it} + \beta_4 T_t + \epsilon_{it} \qquad (5)$$

Although, since the dependent variable GDP growth appears to be relatively constant, the effect of the time trend does not necessarily alter the model substantially, why both models will be performed and compared.

That inequality has an immediate effect on growth appears to be quite unlikely. Kennedy et al. (2017) finds evidence that the effect from inequality on growth is delayed at least a couple of years. Further, the presence of lagged variables should reduce the simultaneity problem since future higher growth to affect inequality three years back is doubtful. Naguib (2017) postulates, referring to the research done by Mo (2000), that measuring the Gini variable in the beginning

[27] Independent and identically distributed (i.i.d.), with mean zero and constant variance

of the period or using the first lag does not necessarily remove the reversed causality problem. Thus, we cannot be sure that the reversed causality problem is removed but the third lag should mitigate the problem. Additionally, the lag does not automatically remove endogeneity derived from omitted variable bias, thus a first sensitivity analysis is performed to address the potential problem. Moreover, as already pointed out, the first lag of the inequality variable would be endogenous by construction since the growth rate is likely to depend on last year's growth rate. Lagging at least two periods avoids this constructed endogeneity and is also applied when instrumenting endogenous variables within the Arellano & Bond (Arellano & Bond, 1991) GMM estimator, as well as for the Anderson & Hsiao (1982) estimator. As noted before, unfortunately the model does not control for γ_{it}, why there is a risk that this unobserved variable can cause the estimates to be biased. Hence, sensitivity analysis one is performed aiming to control for common growth factors incorporated in the γ variable.

Sensitivity analysis one

$$Y_{it} = \alpha_i + \beta_1 INEQ_{it-3} + \beta_2 GDP_{it-3} + \beta_3 TERT_{it-3} + \beta_4 T_t + \gamma' K_{it} + \epsilon_{it} \qquad (6)$$

Where K_{it} is a $K * 5$ matrix including the control variables, logarithm of capital formation, population growth, the logarithm of openness, household savings and the logarithm of urbanisation.

The logarithmic transformation is for linearity reasons, and control variables that contains negative values are not in logarithm. Income and wealth inequality variables are not in logarithm since we want to ease the interpretation of these and it does not appear to have a linearizing effect on the variables. The control variables that are added has been addressed by earlier researchers as factors affecting growth, and the variables are included to remove the γ_{it} variable. However, it is obvious that the included control variables are endogenous, why their interpretation should be taken with caution.

In accordance with H. Li & Zou (1998) and to further address the problem of endogeneity the baseline variables are replaced by the sixth lag, but the sensitivity variables are held constant.

$$Y_{it} = \alpha_i + \beta_1 INEQ_{it-6} + \beta_2 GDP_{it-6} + \beta_3 TERT_{it-6} + \beta_4 T_t + \phi' K_{it} + \epsilon_{it} \qquad (7)$$

The test aims to address the problem of current growth being a function of lagged growth. However, similar results in these regressions compared to the regressions with the third lag

cannot conclude that endogeneity is not present. Although, it can show whether the third lag is arbitrary or whether the relationship holds for several lag dimensions.

Sensitivity analysis two

The control variables that are significant from the first sensitivity analysis, with the third lag of the baseline variables, are regressed again stepwise on the baseline regression. This is done in order to address problems connected to imperfect multicollinearity (Stock & Watson, 2010, p. 202). The multicollinearity problem arising from high correlation between regressors can cause regressors to have an imprecise estimate because the partial effect is difficult to distinguish between the two variables. Variations in the inequality coefficients when performing the second sensitivity test should therefore indicate that the first test was driven by multicollinearity.

Stationarity

For comparability with earlier research, and between income and wealth inequality, the first part of the empirical analysis uses the time trend in order to control for spurious regressions (Stock & Watson, 2010, p. 546). Yet, stationarity among the variables has not been tested for and its possible that not all variables are stationary around a linear time-trend which is assumed by the time-trend control variable. As we are highly concerned about the risk of spurious regression in former research, and from the high R-squares in our regressions, the problem is further investigated by ensuring stationarity and running the regressions again. Since the dataset is unbalanced, the usual Augmented Dickey Fuller-test (ADF) for the presence of non-stationarity is not applicable. Instead the Fisher Fist is performed (Baltagi, 2005, p. 244). It assumes that there are individual unit root processes between the countries, and the null hypothesis of the test is that all of the panels have a unit root whereas the alternative hypothesis is that at least one panel is stationary. Thus, the test is weak in its applicability, as even though we reject the null there might still be non-stationarity within countries. In accordance with Baltagi (2005, p. 261), one lag length is used. The test procedure will continue as follows for all variables:

First, the time trend will be included in the test, if we reject the null, we will redo it without time trend and if it is rejected again, the variable is assumed to be stationary. If we can't reject the null hypothesis in the second stage, we will detrend the variable and redo the test without the trend. If then the null is rejected, the variable is assumed to be stationary. On the other hand, if the test fails to reject the null hypothesis even when detrended, the variable will be differenced

before its detrended. If failing to reject the null-hypothesis again, the variable should be difference once more. However, we find that all variables that are non-stationary when detrended reject the null when differenced and the last step does not have to be performed.

Using the variables that are stationary according to the Fisher test, sensitivity test one and two will be performed again in order to secure that the former tests are not driven by trends and that the found relations are not characterised by spurious relationships. However, when detrending or differencing the variable there is a loss of information, especially in the latter case, which has been addressed before when arguing around the FD estimator. In specific measurement errors will be amplified (Portela, Alessie, & Teulings, 2010).

5.5.2 Reasoning behind the econometrical approach

According to the literature, the main problem when analysing the relationship between inequality and growth is to reduce endogeneity in the inequality variable. Similarly, the presence of serial correlation has unsurprisingly been present in earlier research when panel data analysis has been performed.

In general, the most common approach to deal with an endogenous variable is to make it exogenous via an IV-approach. However, as has been outlined, until now no strong instrument has been proposed. This study suggests a new instrument, the female share of the population, and argues for its exogeneity and relevance in terms of growth and inequality. However, subchapter 6.1 will present that the statistical results from testing the instrument variable is inadequate in its relevance, why an approach similar to H. Li & Zou (1998), with inspiration from Alesina & Rodrik's (1994) cross-sectional analysis, is performed.

OLS and GMM regressions are not performed for separate reasons. The OLS regression is most likely negatively biased due to omitted variables from unobserved country-specific factors and the same applies to the random effects estimator (Forbes, 2000). The two estimators are only consistent if the independent variables are uncorrelated with country-specific effects, which is extremely unlikely in our case. Examples of such factors are according to Forbes (2000) corruption and basic healthcare. Our dataset is characterised by long T and small N, which is non-optimal for the GMM estimator. A long T compared relatively to the size of N, overproduces instruments compared to the sample size and increases the already profound problem of instrument proliferation (Roodman, 2009). The aim of the GMM estimator is to produce consistency and reduce autocorrelation and dynamic endogeneity which can be severe

in dynamic estimators. Since our dataset has a relatively large T, the characteristic of the sample is reversed compared to earlier research. The large T should mitigate the inconsistency and the bias should be less significant compared to if the characteristics of the data was reversed (Baltagi, 2005, p. 136). Hence, a fixed effects (FE) estimator is performed. Forbes (2000) argues in favour of the fixed effects estimator since time invariant factors are most likely to generate endogeneity in the inequality variable. However, she also emphasises that the random effects (RE) estimator could be efficient as it incorporates information of individual countries. Voitchovsky (2005) finds that a large portion of inequality differences are cross-sectional why the RE estimator should be more precise compared to FE since fixed effects controls for and removes these effects. Despite this, the benefit of controlling for country-specific effects is larger than the information loss, as the former generates biasedness which we aim to reduce as for as possible since an IV-regressions is not performed.

Since the theory suggest that growth is partly driven by a convergence among countries, the estimator controls for this factor by extending the model to be a dynamic fixed effects estimator, with GDP per capita as a lagged explanatory variable. In line with H. Li & Zou (1998), the variables for inequality and school enrolment will also be lagged to reduce endogeneity. In specific, the variables will be lagged three years, as a shorter period can cause serious biases. H. Li & Zou lag their baseline regression with five years, but since our sample is smaller we use a shorter lag, still long enough to avoid endogeneity by construction, which Forbes (2000) among others address as the most severe problem for dynamic fixed effects models. Further, using lag variables can reduce the endogeneity arising from the simultaneity but does not necessarily reduce omitted variable bias. Thus, the approach used by H. Li & Zou is not directly aimed towards reducing the endogeneity arising from omitted variables. However, to use an instrument variable that is neither relevant nor exogenous does not necessarily produce a more valid estimate. Additionally, since our dataset is more consistent compared to that H. Li & Zou (1998), we will not average on a five-year level to smooth it, but instead use yearly observations. Since long-run growth is exogenous in the growth theory presented, apart from labour share in research, we avoid analysing the long-term growth as, e.g. Panizza (2002) does when averaging on 10 respectively 20 years. Yearly observations appear to be highly relevant when addressing growth dynamics in a short-run, i.e. the transitionary dynamics of the economy.

Another econometrical approach, pioneered by Anderson & Hsiao (1982), utilizes a first-differenced two stage least square (2SLS) estimator to avoid the endogeneity in the lag of the dependent variable by instrumenting it with the second lag, of all other independent variables. The second lag is by construction not correlated with the current value according to the authors. The approached is beneficial compared to GMM in that it produces less instruments and avoids overfitting. Using this approach, the endogeneity in the lagged dependent variable is removed, at least in theory. Since this study assumes endogeneity in the inequality variable, there is no way to assume that additional regressors, supplementary to the lag of the dependent variable, are exogenous why endogeneity still would persist in the inequality variable; even by construction. In practice, one can also question how relevant and exogenous the lags are.

In general, independent variables are almost always correlated with the error term, at least to some degree. Consequently, exogenous variables do not exist in a precise form which implicates that it is impossible to statistically guarantee endogeneity in the variable of interest (Ketokivi & McIntosh, 2017; Roberts & Whited, 2013). Hence, the problem of endogeneity thus not necessarily call for a solution but rather for the least bad alternative.

5.5.3 Fixed effect estimator

The FE estimator is preferred over the RE estimator as the latter implies that there is zero correlation between the inequality variable and country effects (Baltagi, 2005, p. 14), whereas the FE estimator controls for time-invariant country-specific factors. Such factors could for example be natural resources, e.g. Gylfason & Zoega (2002) find that abundance of natural resources in a country can increase economic inequality and decrease growth. However, it is very few variables that is constant over time, even natural resources are likely to shift, implying that the dummy variables will have a problem to catch country-specific factors.

The Hausman test, e.g. used by Forbes (2000), assess whether the fixed effect or the random effect is appropriate, based on the difference between the FE and RE estimator with the null hypothesis that RE is consistent (Baltagi, 2005. P.70). However, the test assumes homoscedasticity and cannot be performed using robust standard errors. In line with the suggestion from earlier research, the fixed effect estimator is assumed to be consistent relative to random effect. Further, Baltagi (2005, p.12) stress that the fixed effect estimator is preferred

when countries are in focus, since they are unlikely to be homogenous. Accordingly, the countries within the sample of this thesis are evidently very different.

The assumptions for the fixed effects estimator is that (1) the error term has a conditional mean of zero which is related to omitted variable bias and autocorrelation in the error term, (2) that large outliers are unlikely, (3) no perfect multicollinearity and (4) that the error and independent variables are i.i.d. draws from their joint distribution (Stock & Watson, 2010, p. 363). Woolridge (2002, p.281) emphasises that no serial correlation and homogeneity is key for the efficiency of the fixed effect estimator. As found in earlier empirical research, we expect our sample to suffer from deviations from both positive serial correlation in the error term and correlation between the inequality variable and the residual. A cross-sectional estimator, similar to Easterly (2007) among others, limits the problem of serial correlation, but the small sample of wealth inequality forces us to apply a panel approach. Therefore, we cannot remove observations as it would heavily reduce the already small sample. Cross-sectional data would also limit the possibility to analyse the transition dynamics over time.

Deviation from omitted variable bias is more acute, compared to deviation of serial correlation, since deviations from the first assumption results in biased estimates, whereas serial correlation in the residual causes the estimates to have lower efficiency (Stock & Watson, 2010, p. 364). With positive serial correlation, and using normal standard errors, the standard errors of the estimate will be smaller than the true standard errors, which leads to smaller confidence intervals and a tendency to reject the null hypothesis although it should not (Pindyck & Rubinfeld, 1991). Hence, in order to avoid overconfidence in the estimates, standard errors robust to autocorrelation will be used in accordance with Stock & Watson (2010, p. 364). In specific, clustered standard errors are used to make the estimates consistent with both autocorrelation and heteroskedasticity[31]. Additionally, as stated before, the long time-series in the dynamic estimator should mitigate the inconsistency and the bias should be less significant compared to if the characteristics of the data was reversed (Baltagi, 2005. P. 136).

While applying the fixed effect estimator with dummies, we realise that a first difference transformation of the time series could be beneficial since it has the same benefit of removing fixed effects but simultaneously limits the amount of control variables needed. Thus, the estimator with country dummies has the downside of increasing the risk of multicollinearity and can increase the standard errors of the estimates. However, the first-difference is avoided

since the transformation will reduce the dataset, also because of the risk that measurement errors will be amplified; reducing the signal and increasing the noise (Portela et al., 2010). Earlier researchers, such as Forbes (2000) has emphasized the risk of measurement error in inequality data. In relation to autocorrelation, Woolridge (2002, p. 284) emphasise that the fixed effect estimator is more efficient compared to the FD estimator when the error term is autocorrelated. Although, as earlier mentioned, both estimators are inconsistent if the assumption of strict exogeneity is deviated from which must be noted in the interpretation of the result. Additionally, the fixed effect estimator reduces the flexibility in terms of control variables. The convergence variable, the logarithm of GDP per capita, cannot be used as it transforms to GDP growth.

The endogeneity problem is first approached with the introduction of an instrument variable, in order to perform an IV fixed effects estimator. The suggested instrument of female percentage of the total population has to our knowledge never been used before.

5.5.4 Sources of endogeneity

The endogeneity biasedness denotes the state in which there is a correlation between the independent variable and the error term. The problem can occur in econometrical research from several independent sources including the most common ones of, (1) measurement error, (2) simultaneous causality, and (3) omitted variables (Woolridge, 2002).

(1) Measurement error arises when the data of the variable is differing from the real population. This causes an additional error to the error term if the measurement error is correlated with the dependent variable and the regressor. Forbes (2000) formulates how the bias could take shape, arguing that if more unequal countries adjust their inequality down, the coefficient would have a downward bias. Evidence of this, is however, not confirmed by literature.

(2) The simultaneity bias appears when there is simultaneous causality between the dependent variable and the regressor. Thus, if the regressor is also a function of the dependent variable. Specifically, apart from inequality causing changes in GDP, the opposite direction can also be present. If the top 10% is more likely to get a higher share from increases in GDP, then inequality is a function of GDP growth. E.g. Kuznets (1955) argues that inequality is a function of GDP rather than the other way around.

(3) The omitted variable bias emerges from limitations in the model specification, when there are relevant control variables that should be included but are left out of the model (Woolridge,

2002, p. 50). Hence, if the omitted variable is observable and measurable, an inclusion of relevant control variables can remove the correlation and solve the bias. When revising the theory, it is clear that inequality only has an indirect effect on growth, i.e. that the variable is endogenous by definition. Further they show that inequality is conditioned by country-specific history, while other researchers are carefully emphasizing the importance of country-specific effects (Forbes, 2000). Apart from limitations in terms of measuring specific relevant information, there is a trade-off between adding more control variables and omitted variable bias: e.g. misspecification of the model can increase the variance of the dependent variable and, via multicollinearity, mislead the statistical inference because of correlations between included regressors (Stock & Watson, 2010)

As said in the former subchapter and as appears in the literature review, it is nearly impossible to perform a perfect solution to the multiple problems of endogeneity. Hence, the scope of this thesis is to mitigate the endogeneity as far as possible, to provide as valid results as possible and to reduce biasedness and inconsistency in the coefficients.

5.5.5 Instrument

As the fixed effect estimator only can reduce the omitted variable bias to a certain extent, to instrument the endogeneity variable is appropriate to limit the bias. As former researchers have emphasised, see Naguib (2017) and Forbes (2000) among many others, no straightforward has yet been presented. But rather week instruments as for example the exchange rate (Bagchi & Svejnar 2013), regional dummies (Clarke, 1995; Mo, 2000) and agriculture endowment (Easterly, 2007). Even though the researchers find that these variables are relevant in accordance with the F-test, they are unlikely to meet the condition of exogeneity. The exchange rate is correlated with monetary policy which is correlated with economic fluctuations and economic growth. Regional dummies contain many variables that are likely to be correlated with culture that can be correlated with GDP via many variables. Forbes (2000) argues that corruption is one of these variables. Historical agrarian conditions are another variable that is correlated with GDP, especially in less developed countries with a high agriculture industry. It is not unlikely that historical agrarian conditions are a factor of why we see differences in GDP per capita between countries today.

Moreover, there is no econometrical evidence that an endogenous instrument would enhance the quality of the regression. Thus, a lot of emphasise will be on only applying the instrument

variable if it is relevant and exogenous in accordance with the following conditions (Stock and Watson, 2011, p.421):

$$\text{Relevant: } COV(INEQ_{it}, F_{it}) \neq 0 \tag{7}$$

$$\text{Exogenous: } COV(\gamma_{it}, F_{it}) = 0 \tag{8}$$

Where F_{it} is the instrument of female % of the population. γ_{it} is denoted in function 4, correlated with growth and inequality.

Neglecting to satisfy the relevance condition for the instrument % of females in the population can create the same problem that its implementation aims to avoid, a biased inference (Stock and Watson, 2011, p. 419-468). The same reasoning applies when using an endogenous instrument, the estimator will not converge into the population coefficient.

Accordingly, a reduced form equation is performed, where the inequality variable is expressed as a linear function of the instrument (Stock & Watson, 2011, p. 433).

$$\widehat{INEQ}_{it} = \alpha + \theta F_{it} + \omega_{it} \tag{9}$$

Since F_{it} should be uncorrelated with the error term, likewise should the $\widehat{INEQ}_{it}$. Inserting the predicted value, from the reduced form, of the inequality variable must in turn imply non-correlation with the residual; the endogenous variable is cleaned from the information that is correlated with the error. Thus γ_{it} from function (4) should efficiently be removed.

In accordance with Madsen, Islam, et al. (2018), an F-test of the instruments is performed in order to assess the relevance of the instrument. Whereas an F-statistic above 10 implies that the given instrument is relevant in its application (Stock & Watson, 2010). Contrary, following an insignificant F-statistic, the null hypothesis of the instruments relevance is rejected and so is the application of the instrument.

To test whether the exogeneity condition holds is more problematic, Easterly (2007) performed an overidentification test to assess the exclusion restriction. However, as he further argues, the test is weak, and it is also restricted in in the fact that an additional exogenous instrument is needed why it cannot be performed in the case of one instrument. The test only finds if additional instruments are exogenous, so if the first instrument is endogenous it is not detected.

Furthermore, macroeconomic data is typically characterised by positive trends. In accordance to Piketty (2014) income and wealth inequality, mutually are characterised by upward trends. The source of the upward trend is according to Piketty derived from income on capital, and the skewed distribution of those returns. When plotting the two time-series, it appears as a potential case for the inequality variables. The relevance of the instrument is tested in a detrended environment. The trend from instrument and instrumented variables is removed by extracting the time trend from both variables followed by the same procedure as earlier outlined.

5.7 Reliability, replication, and validity

Research is evaluated through three important criteria: reliability, replication, and validity (Bryman & Bell, 2015, pp. 48-79). Reliability denotes the possibility to repeat the study, to verify the result, and quantitative research is often concerned about the stability of measures. The flaws in inequality data have been discussed earlier, but needs to be recognized here as well. Since it is collected through different sources in different countries, the measurement does not have full consistency which decreases the reliability of the tests somewhat. This study may also be subject to a risk of slight unreliability, as the data used in the study is sometimes updated. If the data is changed, or just added for missing years, is not anything we can control for.

Replication is closely related to reliability, as other researchers should be able to conduct the same tests, to investigate if the result found is true. The possibility to replicate is also central if the researcher has biases or subjective ideas influencing the study (Bryman & Bell, 2015, pp. 160-182). This is perhaps especially important within the inequality-growth research field, as results are ambiguous and if a researcher is out on thin ice could be hard to spot solely from findings. To enable replication, the method has been carefully described, leaving no room for arbitrary choices or opaqueness in the research approach. As previous research is ambiguous, we are also inspired to find the truth from our sample. Thus, leaving any own agendas or political opinions outside the research, which cannot be said about all readings evaluated during the course of this paper.

There are several parts of a research's validity, and measurement validity is the first. In quantitative research it means to question if a measurement represents what it is used for as a proxy. In this thesis, all variables used are proxies for a larger concept and should be questioned accordingly. The most important measures to assess is perhaps the two covering inequality, as they are used to represent income and wealth inequality as broad concepts. When using the top

10% share, it does obviously not cover all aspects of respective inequality. The other variables suffer from the same problem, as they are measurements said to denote broad concepts. What increases the validity of this study is that the variables used are consistent with previous literature, and most of all presented in a transparent way. Another aspect is internal validity, addressing any potential causality problem between independent and dependent variables (Bryman & Bell, 2015, pp. 160-182). It is addressed in the econometrical approach using lagged variables. Bryman & Bell also discuss external validity, implying the generalization of the results. Arguing our results to be conventional truth is hard, because of the limited sample both in time and countries. As the five nations included display quite different characteristics, even then thinking about them intuitively, the result may not even be generalizable for our sample. However, it does give an indication of the relationship between economic growth and the inequality measures.

6. EMPIRICAL RESULTS AND ANALYSIS

This section both presents the results found from our data when using the methodology described in the previous section, and analyses them. First, the instrument variable is tested. Secondly, results from the baseline regressions are presented as a foundation to build on further, and two sensitivity analyses are conducted to establish the robustness of the findings. Subsequently, the regressions are controlled for stationarity which is an important extension by this paper to the used approach. In the above-mentioned sections, a brief econometrical discussion is conducted in connection to the results, to divide it from the variable analysis to come. After this, the result is compared to previous studies, results are summarized, and the hypotheses are evaluated to emphasise what results are going to be analysed. In the analysis, the result is set in relation to both economic theories and empirical research to give a multifaceted and interesting discussion where all strings are tied together.

6.1 Test of instrument variable

Before proceeding with regressions using the instrument variable, it needs to be tested to ensure that it has explanatory value to our model. In specific, an F-test is performed to assess the relevance of the instrument, but also the direction of the coefficient.

Table 4 - Instrument first step regression

This table present the first step regression for the instrument variable. In the regressions labelled as (2) all variables are detrended with a linear time-trend whereas regressions labelled as (1) contain the original variables from Appendix E. The relevance of the instrument is rejected if the F-statistic is below 10.

Dependent Variable: Income inequality	(1)	(2)
Female % of the total population	-0,13	-0,04
	-4,97	-2,51
N	167	167
F-statistic	24,71	6,28

Dependent Variable: Wealth inequality	(1)	(2)
Female % of the total population	-0,13	-0,04
	-4,97	-2,51
N	167	167
F-statistic	4,06	0,2

In the original instrument equation, we find that the F-statistic is well above the threshold of 10 for the income inequality variable. However, the opposite is true for wealth inequality, where the F-statistic is equal to 6.46. Hence, the instrument appears to be weak for the latter variable. A weak instrument means it has low explanatory value to the independent variable, thus not

removing endogeneity properly which is the purpose of using an instrument variable (Crown, Henk, & Vanness, 2011).

One explanation to the contrasting F-statistic results could be that wealth inequality is more persistent through time and generation. This could imply wealth inequality to be rigid, not as sensitive to changes in the percentage of females in the population, and goes hand in hand with the potential flaws identified when the instrument variable was introduced. Income inequality may however be sensitive to the percentage of females in the population due to gender wage differences. It was also argued earlier that wealth inequality is affected through income accumulation in connection to the instrument variable. This idea is possible when interpreting the F-statistics, and emphasises the higher relevance of the instrument variable for income inequality. The coefficients for both variables also appears to be negative, opposite to what was predicted in the instrument discussion. This can point toward endogeneity in the instrument variable, resulting from correlation with another omitted variable causing biased estimates. It could also indicate that the relation is the opposite of what was expected. As no explanation can be found and as the instrument is not relevant across both variables, it becomes inapplicable for the research of this study. Thus, comparability between the two inequality measures is key.

To further address the relevance of the instrument for income inequality, the linear time trend is removed, and the validity is again estimated with an F-test to remove the risk of running spurious regressions. The outcome from the altered regression indicates that the former test of the instruments was driven by shared trends exaggerating the relevance of the variable as a valid instrument. Hence, realising the poor performance of the instrument, it is rejected for the estimations of the relationship between inequality and economic growth.

6.2 Baseline results

The baseline regressions show basic results of how income and wealth inequality affect economic growth and are influenced by the H. Li & Zou (1998) approach which in turn is an alteration of Alesina & Rodrik's (1994) cross-sectional analysis of the relationship. In contrast to these earlier studies, our study addresses the potential problem of spurious regressions adding a linear time-trend to control for spurious relationships. Adjusted R-square is high does not change to a high degree between the regressions including the wealth inequality variable and

the income inequality variable. All dummy variables are highly significant which probably is the reason for the high adjusted R-square.

Table 5. Baseline regressions

The table presents the baseline regressions. L3 describes the third lag, and the country names denote dummy variables. Trend is a linear trend variable, controlling for any trends in the independent variables is included in regressions 2, 4, 5 and 6. Six regressions are listed to show different variations of the model specification, testing different combinations of regressors. The financial crisis is a dummy the financial crisis of 2007/2008. Tertiary education and GDP per capita is in logarithm. All F-tests are significant at the 5% level.

Dependent Variable: GDP growth	(1)	(2)	(3)	(4)	(5)	(6)
L3 Income inequality	0,0898	0,0839			0,0904	0,111
	(0,96)	(0,87)			(0,96)	(1,21)
L3 Wealth inequality			-0.124**	-0.123**	-0.124**	-0.126**
			(-2.70)	(-2.67)	(-2.69)	(-2.80)
L3 Tertiary education	0.0216*	0.0218*	0.0373***	0.0371***	0.0332**	0.0353***
	(2,21)	(2,22)	(3,88)	(3,84)	(3,17)	(3,44)
L3. GDP per capita	-0.0251***	-0.0267**	-0.0284***	-0.0303***	-0.0302***	-0.0324***
	(-4.18)	(-3.28)	(-4.74)	(-3.75)	(-3.74)	(-4.10)
United States	0.256***	0.271**	0.414***	0.428***	0.393***	0.406***
	(3,67)	(3,15)	(5,26)	(4,84)	(4,11)	(4,35)
France	0.257***	0.271**	0.399***	0.413***	0.382***	0.397***
	(3,68)	(3,19)	(5,13)	(4,73)	(4,12)	(4,38)
United Kingdom	0.254***	0.269**	0.401***	0.415***	0.381***	0.394***
	(3,56)	(3,10)	(5,13)	(4,74)	(4,03)	(4,28)
China	0.293***	0.303***	0.449***	0.455***	0.416***	0.426***
	(4,06)	(3,84)	(5,99)	(5,87)	(4,74)	(4,98)
Russia	0.215**	0.226**	0.372***	0.381***	0.340***	0.348***
	(3,30)	(3,01)	(5,42)	(5,19)	(4,01)	(4,21)
Trend		0,00015		0,000165	0,0000689	0,000243
		(0,30)		(0,35)	(0,14)	(0,51)
Financial crisis						-0.0210**
						(-2.90)
N	147	147	147	147	147	147
adj. R-sq	0,811	0,809	0,819	0,818	0,818	0,827
F-stat all variables	79,68	70,38	84,11	74,3	66,93	64,9
F-stat country dummies	12,06	11,02	11,14	16,04	8,86	10,59
P-value	0,000	0,000	0,000	0,000	0,000	0,000

t statistics in parentheses
* p<0.10, **p<0.05, *** p<0.01

The baseline results indicate that there is a contradictory relationship between growth and the two different inequality proxies. The wealth inequality variable is significantly negative whilst income inequality is positive but insignificant. Hence, the baseline regressions cannot conclude that income inequality significantly affects economic growth. As income and wealth inequality has a relatively high correlation (see Appendix C), they are regressed together in regression 5 and 6 to assess whether either of them is included in the other one. There is no switch in signs when including both inequality variables, and wealth inequality continuous to be significant. The finding further indicates that there is a difference between how inequality and wealth inequality affects growth. The difference in both magnitude and sign suggests wealth inequality to be a relatively more important factor to growth than income inequality. The size of the wealth inequality coefficient also appears to be more robust, since it varies very little in magnitude across the regressions. For the income inequality coefficient there is a larger variation which might imply that the variable suffers from biases. Thus, conclusions should not be drawn too fast because the results have not been proven to be robust. The risk of omitted variables appears to be possible in the baseline regressions, since relevant factors likely are absent from the model specification. As noted before, growth is affected by many factors and lagging the inequality variables does not necessarily avoid the biases from endogeneity.

The trend variable seems to not add any additional information to the model specification as it appears non-significant. However, the positive sign indicates that growth increases over time, although with a very small impact, which probably is due to the growth rate appearing to be relatively constant across the countries in the sample. Both tertiary education and GDP per capital stays significant when the time trend is added, and signs are consistent with theory. The F-test for the country variables rejects the zero hypothesis across all regressions at the one percent level. The prediction of the high relevance for country-specific factors is confirmed in accordance with Forbes (2000) and our own predictions.

6.3 Sensitivity analysis

As explained in the methodology, the potential endogeneity in the inequality variable can produce biased coefficients. The lag of three years can mitigate the problem, but a sensitivity test is conducted to check the robustness of the inequality coefficients and address omitted variable bias. The first sensitivity test includes additional control variables, which are inspired

by H. Li & Zou (1998) but slightly altered. For example, GDP per capita is used instead of total GDP as it should be a better proxy for country development, and tertiary gross enrolment is used instead of primary enrolment since developed countries are overweighed in our sample. The black-market premium and financial development are not included. As H. Li & Zou (1998) point out, it is obvious that the sensitivity variables are endogenous via various unobserved growth drivers. Hence, the interpretation of the coefficients of additional control variables should be interpreted carefully why focus will remain on the baseline variables.

6.3.1 Income inequality sensitivity analysis

The results in the baseline regressions indicate that income inequality is not significant. However, when including additional, commonly used, control variables in the sensitivity analysis, income inequality becomes significantly positive in majority of the regressions. Hence, baseline regressions are likely to be characterised by omitted variable bias, now addressed in the sensitivity analysis. When including wealth inequality in the last regressions, income stays significant and positive, while wealth inequality is persistently significantly negative as in the baseline regression.

Table 6. Income inequality sensitivity analysis 1

The table presents a sensitivity analysis where control variables are added to the baseline regression to control for omitted variable bias. The L3 denotation stands for that the variable is lagged three periods. In regressions 4-8 a linear trend is added to control for spuriousness among the dependent variables. Income inequality is included as the sole measure for inequality in regressions 1-6 and wealth inequality is included as an explanatory variable in regression 7 and 8. Tertiary education, GDP per capita, Capital formation, urbanisation and openness is in logarithm. All F-tests are significant at the 5% level.

Dependent Variable: GDP growth	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
L3 Income inequality	0.247***	0,12	0.150*	0.291***	0.203**	0.178**	0.229***	0.261***
	(2,82)	(1,35)	(1,72)	(3,20)	(2,34)	(1,99)	(2,79)	(3,35)
L3 Wealth inequality							-0.205***	-0.212***
							(-4.07)	(-4.45)
L3 Tertiary education		0.0244**	0.0452***		0.0527***	0.0421***	0.0493***	0.0517***
		(2,47)	(3,83)		(4,55)	(3,57)	(4,56)	(5,06)
L3. GDP per capita	-0,0046		-0.0179***	0,00831		-0,00597		
	(-0.91)		(-3.01)	(0,89)		(-0.67)		
Urbanisation	-0.165***	-0.267***	-0.247***	-0.210***	-0.330***	-0.238***	-0.301***	-0.315***
	(-3.60)	(-5.38)	(-5.08)	(-3.95)	(-6.69)	(-4.91)	(-6.38)	(-7.05)
Capital formation	0.0862***	0.108***	0.0955***	0.0887***	0.101***	0.0903***	0.133***	0.142***
	(4,09)	(5,33)	(4,72)	(4,22)	(5,21)	(4,48)	(6,62)	(7,46)
Openness	0.0390***	0.0384***	0.0330**	0.0565***	0.0595***	0.0654***	0.0612***	0.0651***
	(2,66)	(2,67)	(2,35)	(3,13)	(4,10)	(3,75)	(4,46)	(5,01)
Household savings	-0,0143	-0,0349	-0,0417	-0,0179	-0,0517			
	(-0.28)	(-0.69)	(-0.85)	(-0.35)	(-1.08)			
Population growth	-2.569*	-4.459***	-3.629***	-2.702**	-3.996***		-4.405***	-4.418***
	(-1.96)	(-3.46)	(-2.83)	(-2.07)	(-3.27)		(-3.79)	(-4.02)
United States	0.182***	0.222***	0.365***	0,0961	0.262***	0.301***	0.442***	0.455***
	(3,18)	(3,93)	(5,03)	(1,25)	(4,82)	(3,71)	(6,40)	(6,97)
France	0.138***	0.174***	0.334***	0,0413	0.216***	0.257***	0.362***	0.373***
	(2,67)	(3,58)	(4,70)	(0,53)	(4,58)	(3,15)	(6,24)	(6,81)
United Kingdom	0.140***	0.189***	0.348***	0,0438	0.232***	0.276***	0.378***	0.390***
	(2,70)	(3,59)	(4,73)	(0,56)	(4,56)	(3,31)	(6,21)	(6,77)
China	0,0446	0,0629	0.223***	-0,0382	0.124**	0.180**	0.247***	0.246***
	(0,68)	(1,07)	(2,86)	(-0.46)	(2,15)	(2,34)	(4,11)	(4,34)
Russia	0,0874	0.123**	0.248***	0,00798	0.151***	0.221***	0.317***	0.324***
	(1,54)	(2,19)	(3,63)	(0,11)	(2,84)	(3,06)	(4,81)	(5,20)
Trend				-0,00105	-0.00164***	-0.00141**	-0.00144***	-0.00135***
				(-1.64)	(-4.13)	(-2.24)	(-3.81)	(-3.78)
Financial crisis								-0.0251***
								(-4.16)
N	147	147	147	147	147	147	147	147
adj. R-sq	0,828	0,834	0,843	0,83	0,852	0,841	0,867	0,881
F-stat all variables	59,82	62,57	61,92	56,12	65,92	65,6	74,62	78,95
F-stat country dummies	4,09	5,47	7,6	6,39	8,67	5,41	7,33	13,19
P-value	0,004	0,004	0,000	0,000	0,000	0,001	0,000	0,000

t statistics in parentheses

* p<0.10, ** p<0.05, *** p<0.01

The signs of tertiary education, capital formation and openness are in line with what is predicted. However, puzzling is that urbanisation and population growth are negative, which could be due to endogeneity as mentioned before. GDP per capita is insignificant in most of the regressions, but we see a tendency of it to be negative which is according to theory. Even when including the additional control variables, the country dummies are significant according the F-test, which rejects the null in al regressions.

The first sensitivity analysis is complemented by another robustness test. The regressions are developed just like sensitivity analysis one, but the baseline variables are lagged six years instead of three (see Appendix A). Compared to the high significance levels in the first sensitivity analysis, the income inequality variable appears to be non-robust when lagged six years as it loses significance. Although, the positive sign continues to be consistent. When adding the sixth lag of wealth inequality, similar to the first sensitivity analysis, it still appears as negative and significant emphasising its negative effect on growth. However, the additional lag causes the sample to be reduced significantly, which should be taken into consideration as the weight of Russia is seriously reduced in favour of the United Kingdom, United States, China, and France.

Since many control variables can cause problems because of multicollinearity, a stepwise sensitivity analysis, in line with H. Li & Zou (1998), is carried out, regressing only one additional control variable on the baseline regression in each regression. Stepwise regressions are performed with all control variables that are significant, so to further check for the robustness of the model specification.

Table 7 - Income sensitivity analysis 2

To address the potential problem of multicollinearity significant control variables from the first analysis are regressed one by one on the baseline variables. L3 denotes that the variable is lagged for three periods. Both the F-tests are significant across all regressions. Income is constant across all regressions and wealth inequality is added for regression number 5. Tertiary education, GDP per capita, Capital formation, urbanisation and openness is in logarithm. All F-tests are significant at the 5% level.

Dependent Variable: GDP growth	(1)	(2)	(3)	(4)	(5)
L3 Income inequality	0,0981 (1,03)	0,103 (1,08)	0,0832 (0,86)	0,0843 (0,88)	0,0904 (0,96)
L3 GDP per capita	-0.0255*** (-3.13)	-0.0268*** (-3.34)	-0.0254*** (-2.91)	-0.0262*** (-3.17)	-0.0302*** (-3.74)
L3 Tertiary education	0.0356*** (2,80)	0,016 (1,60)	0.0194* (1,73)	0.0200* (1,87)	0.0332*** (3,17)
Urbanisation	-0.0547* (-1.70)				
Capital Formation		0.0421** (2,24)			
Openness			0,0057 (0,44)		
Population Growth				-0,412 (-0.44)	
L3 Wealth inequality					-0.124*** (-2.69)
United States	0.253*** (2,94)	0.317*** (3,63)	0.272*** (3,15)	0.268*** (3,09)	0.393*** (4,11)
France	0.261*** (3,08)	0.314*** (3,65)	0.266*** (3,08)	0.265*** (3,08)	0.382*** (4,12)
United Kingdom	0.264*** (3,06)	0.316*** (3,59)	0.263*** (2,99)	0.262*** (2,97)	0.381*** (4,03)
China	0.282*** (3,56)	0.309*** (3,98)	0.299*** (3,76)	0.297*** (3,70)	0.416*** (4,74)
Russia	0.212*** (2,81)	0.269*** (3,51)	0.223*** (2,95)	0.219*** (2,83)	0.340*** (4,01)
Trend	-0,000207 (-0.38)	0,00049 (0,95)	0,0000863 (0,17)	0,000184 (0,36)	0,0000689 (0,14)
N	147	147	147	147	147
adj. R-sq	0,812	0,815	0,808	0,808	0,818
F-stat all variables	64,49	65,7	62,99	62,99	66,93
F-stat country dummies	5,6	2,55	7,34	6,63	11,02
P-value	0,000	0,042	0,000	0,000	0,000

t statistics in parentheses
* p<0.10, **p<0.05, *** p<0.01

The results from the second sensitivity analysis are unanimous with the six-lag model, income inequality is positive but insignificant. The indication itself is of little value when the variable is insignificant, thus it is surrounded by ambiguity in accordance with earlier research. Thus, evidence of income inequality appears to weak according to the econometrical analysis, but when the variable is significant it is always positive.

6.3.3 Wealth inequality sensitivity analysis

The sensitivity test, where control variables are added in order to reduce omitted variable bias is performed to check the robustness of the significant and negative wealth inequality coefficient that is found in the baseline regression. As stated before, the added control variables are likely to suffer from endogeneity, why the results should be interpreted with caution.

Table 8. Wealth inequality sensitivity analysis 1

The table presents the first sensitivity analysis for the wealth inequality variable. The analysis aims to address problems related to omitted variables, thus misspecification of the model. Income inequality is added for the last two regressions, number 7 and 8. The control variable including a linear time-trend is included for all regressions except for the three first. Both F-tests are significant below 5% in all regressions performed. Tertiary education, GDP per capita, Capital formation, urbanisation and openness is in logarithm. All F-tests are significant at the 5% level.

Dependent Variable: GDP growth	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
L3 Wealth inequality	-0.200***	-0.217***	-0.230***	-0.206***	-0.196***	-0.210***	-0.205***	-0.212***
	(-3.58)	(-4.10)	(-4.49)	(-3.51)	(-3.79)	(-3.81)	(-4.07)	(-4.45)
L3 Income inequality							0.229***	0.261***
							(2,79)	(3,35)
L3 Tertiary education		0.0332***	0.0565***		0.0574***	0.0490***	0.0493***	0.0517***
		(3,94)	(5,27)		(5,23)	(4,46)	(4,56)	(5,06)
L3 GDP per capita	0,000571		-0.0186***	-0,00238		-0.0169*		
	(0,12)		(-3.34)	(-0.25)		(-1.88)		
Urbanisation	-0.0876*	-0.226***	-0.202***	-0,0781	-0.273***	-0.151***	-0.301***	-0.315***
	(-1.96)	(-4.79)	(-4.36)	(-1.49)	(-5.71)	(-3.04)	(-6.38)	(-7.05)
Capital formation	0.104***	0.138***	0.126***	0.105***	0.127***	0.115***	0.133***	0.142***
	(4,75)	(6,64)	(6,15)	(4,75)	(6,20)	(5,51)	(6,62)	(7,46)
Openness	0.0457***	0.0424***	0.0371***	0.0419**	0.0583***	0.0536***	0.0612***	0.0651***
	(3,17)	(3,10)	(2,80)	(2,33)	(4,15)	(3,19)	(4,46)	(5,01)
Household savings	-0,0174	-0,0378	-0,0465	-0,0161	-0,0547			
	(-0.35)	(-0.79)	(-1.01)	(-0.32)	(-1.18)			
Population growth	-2,081	-4.631***	-3.736***	-2,081	-4.131***		-4.405***	-4.418***
	(-1.64)	(-3.80)	(-3.10)	(-1.63)	(-3.49)		(-3.79)	(-4.02)
United states	0.420***	0.486***	0.659***	0.443***	0.518***	0.632***	0.442***	0.455***
	(5,43)	(7,10)	(7,85)	(4,38)	(7,76)	(6,36)	(6,40)	(6,97)
France	0.330***	0.400***	0.588***	0.355***	0.435***	0.560***	0.362***	0.373***
	(4,84)	(6,92)	(7,42)	(3,61)	(7,65)	(5,77)	(6,24)	(6,81)
United Kingdom	0.338***	0.419***	0.607***	0.362***	0.456***	0.582***	0.378***	0.390***
	(4,96)	(7,03)	(7,54)	(3,71)	(7,78)	(5,98)	(6,21)	(6,77)
China	0.294***	0.309***	0.502***	0.314***	0.370***	0.497***	0.247***	0.246***
	(3,95)	(5,61)	(6,39)	(3,36)	(6,57)	(5,73)	(4,11)	(4,34)
Russia	0.350***	0.386***	0.544***	0.370***	0.417***	0.550***	0.317***	0.324***
	(4,84)	(6,30)	(7,19)	(4,01)	(6,96)	(6,29)	(4,81)	(5,20)
Trend				0,000223	-0.00124***	-0,000459	-0.00144***	-0.00135***
				(0,35)	(-3.28)	(-0.75)	(-3.81)	(-3.78)
Financial crisis								-0.0251***
								(-4.16)
N	147	147	147	147	147	147	147	147
adj. R-sq	0,833	0,85	0,861	0,832	0,861	0,852	0,867	0,881
F-stat all variables	62,24	70,67	70,99	57,09	70,8	71,46	74,62	78,95
F-stat country dummies	10,49	11,65	11,24	10,17	10,01	9,24	12,93	15,36
P-value	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000

t statistics in parentheses
* p<0.10, **p<0.05, *** p<0.01

Wealth inequality is significant and negative in all the regressions of the first sensitivity analysis. The magnitude of the coefficient increases a lot when control variables are included, which is worrying from an endogenous perspective. From the change in magnitude we derive

that the wealth inequality is positively biased before including control variables. As in the first sensitivity analysis for income inequality, urbanisation, openness, population growth, and capital formation persist to be significant and household savings insignificant, with the same signs as well.

Similar to what was done for income inequality, two other sensitivity analyses for robustness are performed. One with the baseline variables lagged six years instead of three years, and one with stepwise regressions where all significant control variables are regressed one by one on the baseline. When regressing the baseline variables lagged six periods the main result does not change, and wealth inequality is still significant and negative across all regressions (see Appendix B). Thus, suggesting that the interpretation of the variable is robust, and that wealth inequality affects economic growth regardless of the lag length. The magnitude of the coefficient is slightly lower for the sixth-year lag, more recent inequality information appears to have higher importance for the current growth.

Table 9 - Wealth sensitivity analysis 2

Table nine includes the second sensitivity analysis for wealth inequality. The analysis aims to discover whether sensitivity analysis one was influenced by multicollinearity. Thus, the significant control variables from the first sensitivity analysis is regressed one by one the baseline. Tertiary education, GDP per capita, Capital formation, urbanisation and openness is in logarithm. All F-tests are significant at the 5% level.

Dependent Variable: GDP growth	(1)	(2)	(3)	(4)	(5)
L3 Wealth inequality	-0.116**	-0.256***	-0.137***	-0.153***	-0.124***
	(-2.11)	(-4.97)	(-2.88)	(-3.08)	(-2.69)
L3 Income inequality					0,0904
					(0,96)
L3 Tertiary education	0.0388***	0.0383***	0.0320***	0.0331***	0.0332***
	(3,22)	(4,25)	(3,02)	(3,33)	(3,17)
L3 GDP per capita	-0.0299***	-0.0342***	-0.0271***	-0.0291***	-0.0302***
	(-3.61)	(-4.52)	(-3.19)	(-3.61)	(-3.74)
Urbanisation	-0,00872				
	(-0.23)				
Capital formation		0.0971***			
		(4,69)			
Openness			0,0151		
			(1,17)		
Population growth				-1,552	
				(-1.58)	
United states	0.419***	0.685***	0.443***	0.447***	0.393***
	(4,34)	(6,93)	(4,97)	(5,04)	(4,11)
France	0.406***	0.649***	0.411***	0.419***	0.382***
	(4,37)	(6,78)	(4,71)	(4,82)	(4,12)
United Kingdom	0.408***	0.662***	0.411***	0.417***	0.381***
	(4,44)	(6,81)	(4,69)	(4,78)	(4,03)
China	0.447***	0.613***	0.457***	0.461***	0.416***
	(5,16)	(7,69)	(5,90)	(5,97)	(4,74)
Russia	0.373***	0.624***	0.385***	0.381***	0.340***
	(4,61)	(7,27)	(5,25)	(5,23)	(4,01)
Trend	0,000114	0.000914*	-0,0000141	0,000276	0,0000689
	(0,22)	(1,93)	(-0.03)	(0,58)	(0,14)
N	147	147	147	147	147
adj. R-sq	0,817	0,842	0,818	0,82	0,818
F-stat all variables	66,42	79,24	67,19	67,85	66,93
F-stat country dummies	6,68	7,21	10,98	9,06	10,64
P-value	0,000	0,000	0,000	0,000	0,000

t statistics in parentheses
* p<0.10, **p<0.05, *** p<0.01

The signficant variables from the first sensitivity analysis are regressed one by one and the results appear to be similar and wealth inequality appears to be negative and signficant. Thus, multicollinearity appears to be a weak problem in the first sensitivity analysis for the wealth inequality variable as it continues to be significant and negative across the table. The magnitude of the wealth inequaity coefficicent has large shifts, in regressions number (2) the absolute size is about twice as large compared to the other regressions. Thus, absence of capital formation may have a positive bias on the wealth inequality variable. Apart from capital forrmation, the control variables that are regressed one by one on the baseline regressions are failing to be signficant..

6.4 Stationary sensitivity analysis

Fisher's unit root test, in Appendix D, finds out that several variables are most likely stationary around a deterministic trend. In specific, it shows that income inequality, population growth, urbanisation, GDP per capita, and tertiary education are nonstationary, even when detrended. This can indicate trend variable does not efficiently control for the time trend in these variables. Most important is that income inequality appears not to be stationary around a time trend but must be differenced to be stationary. Thus, the test will aid to conclude whether the lack of evidence for the insignificance of income inequality is driven by trend in the inequality variable. Further, the same applies to control variables since common trends increase the risk for multicollinearity.

As the logarithm of GDP per capita becomes transformed to the growth rate of GDP per capita when the first-difference is taken, we will assume that the variable is non-stationary for the benefit to control for the countries' convergence. It is important to note that this could produce invalid estimates for the variable. The GDP growth per capita is not a relevant regressor on GDP growth why it otherwise would be removed. The population growth variable is nonstationary when detrended and the variable needs to be differenced, however since the interpretation of differenced growth is difficult to interpret it is also left out.

6.4.1 Income inequality sensitivity analysis 1, with stationarity

To secure that the income inequality variable is stationary, the first-difference is performed in accordance to what is found in the Fisher-test. The first-difference does not only cause information loss but also alters the interpretation of the variable. In the table, the income

inequality variable is now the delta in the top 10% income share, i.e. the change from one year to the next. Thus, it could be interpreted as the short-term effect compared to the regressions in levels.

Table 10. Income inequality sensitivity analysis 1, with stationary variables

The table presents the same sensitivity analysis as in Table 6. The difference is that all variables have been made stationary in accordance to the Fisher-test. FD denotes that the variable is first-differenced, and DT is short for detrended. Capital formation and GDP per capita are still in logarithms. Important to note is that income inequality is in first-difference and that wealth inequality is detrended. Since all variables are stationary, the trend variable is dropped. All F-tests are significant at the 5% level.

Dependent Variable: GDP growth	(1)	(2)	(3)	(4)	(5)	(6)
L3 Income inequality FD	0,0951	0,219	0,0977	0,0889	0,157	0,0664
	(0,47)	(1,05)	(0,48)	(0,44)	(0,77)	(0,37)
L3 Wealth inequality DT					-0.152***	-0.224***
					(-2.74)	(-4.74)
L3 Tertiary education FD		0,00482	-0,0166	-0,0151	0,0181	0.0512*
		(0,12)	(-0.42)	(-0.38)	(0,46)	(1,66)
L3 GDP per capita	-0.0120***		-0.0122***	-0.0126***		-0.0123***
	(-3.36)		(-3.38)	(-3.56)		(-4.11)
Urbanisation FD	0,593	1,881	0,583	0,697	1,267	
	(0,48)	(1,53)	(0,47)	(0,57)	(1,04)	
Capital formation	0.0431*	0.0681***	0.0418*	0.0373*	0.0970***	0.101***
	(1,95)	(3,12)	(1,87)	(1,80)	(4,00)	(5,01)
Openness DT	0.0347***	0,0141	0.0358***	0.0347***	0.0186*	0.0392***
	(3,02)	(1,37)	(3,03)	(2,99)	(1,86)	(3,94)
Household savings	-0,0274	-0,0635	-0,029			
	(-0.52)	(-1.17)	(-0.55)			
United states	0.296***	0.162***	0.300***	0.292***	0.230***	0.423***
	(5,09)	(3,64)	(5,08)	(5,11)	(4,54)	(7,10)
France	0.253***	0.145***	0.256***	0.247***	0.183***	0.341***
	(5,00)	(3,54)	(5,00)	(5,11)	(4,54)	(7,04)
United Kingdom	0.259***	0.159***	0.262***	0.254***	0.200***	0.348***
	(5,24)	(3,84)	(5,23)	(5,33)	(4,78)	(7,14)
China	0.262***	0.141**	0.266***	0.251***	0.159***	0.312***
	(4,17)	(2,60)	(4,16)	(4,37)	(3,56)	(8,84)
Russia	0.255***	0.175***	0.257***	0.249***	0.228***	0.366***
	(5,69)	(4,40)	(5,68)	(5,83)	(5,24)	(7,86)
Financial crisis						-0.0213***
						(-3.35)
N	137	137	137	137	137	137
adj. R-sq	0,844	0,829	0,843	0,844	0,838	0,869
F-stat all variables	65,06	58,47	59,24	64,98	62,02	76,61
F-stat country dummies	3,83	3,63	3,84	4,6	7,22	11,32
P-value	0,0058	0,0079	0,0057	0,0017	0	0

t statistics in parentheses
* p<0.10, **p<0.05, *** p<0.01

Following former level regressions, the income inequality variable continues to be insignificant with a positive sign of the coefficient. Why it appears as the former results in the sensitivity analysis should not have been heavily influenced by trends. Instead the evidence points towards that neither the levelled variable nor the first-difference variable of income inequality influence the growth rate significantly. Urbanisation switches sign from negative to positive and becomes insignificant when the first-difference is taken. It is also interesting no note that education loses its significance and the sign shifts heavily across the regressions, indicating spurious regressions.

6.4.2 Wealth inequality sensitivity analysis 1, with stationarity

The wealth inequality variable is stationary when a linear time trend is removed. The control variables are altered in same way as in the analysis of income inequality in Table 10.

Table 11. Wealth inequality sensitivity analysis 1, with stationary variables

This table performs the first sensitivity analysis on the wealth inequality variable but with the alteration that all variables are made stationary in accordance with the Fisher-test. Accordingly, wealth inequality is detrended with a linear time-trend. FD denotes that the variable is first-differenced, and DT is short for detrended. Capital formation and GDP per capita are still in logarithms. Important to note is that income inequality is in first-difference and that wealth inequality is detrended. Both F-tests reject the null at the 5% level.

Dependent Variable: GDP growth	(1)	(2)	(3)	(4)	(5)	(6)
L3 Wealth inequality DT	-0.259***	-0.151***	-0.246***	-0.244***	-0.152***	-0.224***
	(-4.63)	(-2.72)	(-4.59)	(-4.63)	(-2.74)	(-4.74)
L3 Income inequality FD					0,157	0,0664
					(0,77)	(0,37)
L3 Tertiary education FD		0,0162	-0,012	-0,0127	0,0181	0.0512*
		(0,41)	(-0.33)	(-0.35)	(0,46)	(1,66)
L3 GDP per capita	-0.0159***		-0.0181***	-0.0179***		-0.0123***
	(-4.52)		(-5.16)	(-5.26)		(-4.11)
Urbanisation FD	-1,316	1,082	-1,472	-1,501	1,267	
	(-1.03)	(0,87)	(-1.20)	(-1.23)	(1,04)	
Capital formation	0.102***	0.0990***	0.0872***	0.0886***	0.0970***	0.101***
	(4,43)	(4,03)	(3,89)	(4,08)	(4,00)	(5,01)
Openness DT	0.0507***	0.0220**	0.0581***	0.0584***	0.0186*	0.0392***
	(4,28)	(2,11)	(4,95)	(5,01)	(1,86)	(3,94)
Household savings	0,00361	-0,0454	0,0131			
	(0,07)	(-0.85)	(0,26)			
United states	0.494***	0.245***	0.510***	0.511***	0.230***	0.423***
	(6,74)	(4,53)	(7,18)	(7,25)	(4,54)	(7,10)
France	0.397***	0.198***	0.406***	0.409***	0.183***	0.341***
	(6,73)	(4,38)	(7,06)	(7,22)	(4,54)	(7,04)
United Kingdom	0.401***	0.213***	0.411***	0.413***	0.200***	0.348***
	(6,90)	(4,66)	(7,27)	(7,42)	(4,78)	(7,14)
China	0.392***	0.186***	0.408***	0.414***	0.159***	0.312***
	(5,72)	(3,32)	(6,13)	(6,54)	(3,56)	(8,84)
Russia	0.403***	0.239***	0.412***	0.414***	0.228***	0.366***
	(7,17)	(5,16)	(7,66)	(7,79)	(5,24)	(7,86)
Financial crisis						-0.0213***
						(-3.35)
N	137	137	137	137	137	137
adj. R-sq	0,84	0,838	0,867	0,868	0,838	0,869
F-stat all variables	67,37	62,11	71,41	78,51	62,02	76,61
F-stat country dummies	8,34	5,76	9,99	10,84	7,22	11,32
P-value	0	0,0003	0	0	0	0

t statistics in parentheses
* p<0.10, **p<0.05, *** p<0.01

In line with earlier regressions, wealth inequality is negative and significant even when detrended. However, in this table the changes in magnitude of the wealth inequality coefficient appears to be relatively larger than earlier regressions when the time-trend variable was used to control for the trend. Especially when removing the GDP per capita variable, the size of the coefficient falls considerably. This can be due to that the GDP per capita variable is not altered to be nonstationary or because it has information otherwise omitted and that convergence is a relevant factor which is indicated by its significance.

In order to have consistency in the comparison between income inequality and wealth inequality, the first-difference is performed of the wealth inequality variable as well. This is done even though we found the wealth inequality variable to be stationary when detrended. As with income inequality, the interpretation of the variable is changed equivalently to the delta of the ratio. The same regressions are performed in terms of control variables.

Table 12. Differenced wealth inequality, with stationary variables

In relation to Table 10, this table applies the first difference on the wealth inequality variable for comparability reasons. FD denotes that the variable is first-differenced, and DT is short for detrended. Capital formation and GDP per capita are still in logarithms. Important to note is that income inequality is in first-difference and that wealth inequality is detrended. Both F-tests reject the null at the 5% level across all regressions.

Dependent Variable: GDP growth	(1)	(2)	(3)	(4)	(5)	(6)	(7)
L3 Wealth inequality FD	0,139 (0,95)	0,138 (0,98)	0,137 (0,98)	0,139 (0,95)	0,138 (0,99)	0,146 (0,99)	0,0972 (0,68)
L3 Income inequality FD						0,216 (1,03)	0,284 (1,41)
L3 Tertiary education FD	0,00722 (0,18)	-0,0162 (-0.41)		0,00722 (0,18)	-0,0148 (-0.38)	0,00955 (0,24)	-0,00964 (-0.24)
L3 GDP per capita		-0.0125*** (-3.53)	-0.0123*** (-3.52)		-0.0129*** (-3.69)		
Urbanisation FD	2.161* (1,74)	0,778 (0,62)	0,787 (0,63)	2.161* (1,74)	0,884 (0,72)	2.426** (2,00)	2.364** (2,03)
Capital formation	0.0661*** (3,07)	0.0421* (1,95)	0.0434** (2,03)	0.0661*** (3,07)	0.0382* (1,90)	0.0634*** (3,03)	0.0683*** (3,38)
Openness DT	0,0119 (1,11)	0.0338*** (2,83)	0.0328*** (2,81)	0,0119 (1,11)	0.0328*** (2,79)	0,00721 (0,71)	0,0147 (1,46)
Household savings	-0,0605 (-1.11)	-0,0267 (-0.51)	-0,0252 (-0.48)	-0,0605 (-1.11)			
United states	0.154*** (3,47)	0.298*** (5,07)	0.295*** (5,08)	0.154*** (3,47)	0.291*** (5,11)	0.133*** (3,50)	0.161*** (4,28)
France	0.138*** (3,42)	0.256*** (5,01)	0.253*** (5,02)	0.138*** (3,42)	0.248*** (5,14)	0.118*** (3,55)	0.139*** (4,26)
United Kingdom	0.153*** (3,75)	0.263*** (5,27)	0.260*** (5,28)	0.153*** (3,75)	0.255*** (5,38)	0.134*** (3,86)	0.153*** (4,51)
China	0.126** (2,31)	0.258*** (4,01)	0.254*** (4,02)	0.126** (2,31)	0.244*** (4,23)	0.0894** (2,20)	0.112*** (2,82)
Russia	0.168*** (4,30)	0.257*** (5,71)	0.255*** (5,71)	0.168*** (4,30)	0.249*** (5,87)	0.153*** (4,46)	0.175*** (5,21)
Financial crisis							-0.0236*** (-3.26)
N	137	137	137	137	137	137	137
adj. R-sq	0,829	0,844	0,845	0,829	0,845	0,829	0,842
F-stat all variables	58,36	59,67	65,53	58,36	65,48	58,26	58,59
F-stat country dummies	3,55	3,51	3,5	3,5	4,22	5,1	6,61
P-value	0,0089	0,0095	0,0098	0,0098	0,0032	0,0008	0,0001

t statistics in parentheses
* p<0.10, **p<0.05, *** p<0.01

Table results presented shows that the wealth inequality variable is positive and not significant. The findings when the first-difference is performed on the wealth inequality variable are

remarkable and emphasizes the ambiguity of earlier research. Earlier findings, concluding that wealth inequality was consistently significant, and negative are contrasted, and the variable emerges to be conditioned upon the model specification. When comparing to earlier studies, Naguib (2017) too finds the exact same relation. She first finds a significantly negative relationship using the FE-estimator, and a positive insignificant relationship when applying the difference GMM estimator. Despite the different method used, this indicates that the first-difference estimator has a significant impact of the sign of the wealth inequality coefficient.

Except for the final stationarity regression on wealth, where the variable is differenced, the two inequality measures show opposite signs. The contrary sign between income inequality and wealth inequality favours the argument made by Corneo (2015), as he argues that wealth inequality constitutes long-run inequalities, compared to income inequality which proxies for short-run inequalities. Thus, since wealth inequality is more constant, the effect on incentives from higher wealth inequality should be different, reducing incentives for the poorer which consequently results in a negative growth rate. The shifting sign when wealth inequality is differenced could also be in line with this reasoning, as the long-run information can be lost when differencing the variable.

6.5 Inequality's effect on growth compared to other studies

The tendency of a positive relationship between income inequality and growth is in line with previous research using the fixed effect approach (see Forbes, 2000 and H. Li & Zou, 1998). The result is also in line with other research using various methods (Li et al., 2016; Ostry et al., 2014; Halter et al., 2014; Voitchovsky, 2005). The ambiguity in findings when incorporating studies using other methods is however unmistakeable, as a small majority indeed finds a negative relationship, opposite to our result. As the fixed effects method seems to consistently show a positive relationship between income inequality and growth, in contrast to other methods with equivocal output, it cannot be ruled out that it biases the result. Since the income inequality variable is insignificant, its effect on growth must be considered ambiguous in accordance with the literature consensus.

The negative inclination of the wealth inequality coefficient is in line with Bagchi & Svejnar (2015), who also finds a significant negative relationship. Their econometrical approach is a fixed effects model too, which could possibly be a determinant of the similarity as the datasets differ. The result is also consistent with Naguib (2017) when using a fixed effects estimator.

The size of the wealth coefficients has large variations, ranging from between -.123 and -.259 although the since are contrasting its considerably close to Naguib's (2017) estimation which had a size range between .11 and .23.

6.6 Control variable discussion

As the control variables does not hold any central part in this paper but is important in terms of the model specification, they are discussed here. Further, interesting patterns can be seen. The control variables are possible channels through which inequality affects growth, why they are included to begin with. Thus, it is in order to discuss the control variable findings too, mainly in connection to previous empirical research but also to growth theories. All control variables will be mentioned briefly here for consistency, and the most important will be further discussed later in the analysis discussion.

Household savings and capital formation

Household savings is insignificant across the regressions, somewhat surprising considering neoclassical growth theories. It is also inconsistent with Madsen, Islam, et al. (2018), who acknowledges private savings to the extent of using it as a growth channel to regress inequality on. Capital formation however, representing capital accumulation in a nation which should be connected to household savings, is significantly positive in accordance with neoclassical growth theories. Thus, the information on growth from the household savings variable should be incorporated in the capital formation variable, this is also confirmed in the high correlation between the two variables (see Appendix C).

Education

We find tertiary education to have a significantly positive influence on economic growth throughout the baseline and sensitivity analysis where the time-trend is added, in line with neoclassical growth theory where education increases human capital and consequently the labour input in the production model. This relationship was also found in the Asian Tigers, where education played an important role to the rapid growth (Birdsall et al., 1993, 1995). In contrast to the Tiger economies, where primary and secondary schooling was the focus, our study covers tertiary education. Tertiary education is likely a larger influencer of growth in our sample countries because of the higher degree of development. In the regressions where all variables are made stationary, the education variable is differenced, and this causes the variable to become insignificant.

Urbanisation

Another unexpected result is that the urbanisation ratio is significantly negative to growth. This is contradictory to Kuznets (1955) theoretical claims that urbanisation increases growth. However, in developed countries, the urbanisation is saturated whilst the growth rate falls, which could explain the relationship as our sample has an overrepresentation of developed countries. Another possible explanation is that people move to the city during lower growth periods, perhaps because it is easier to find a job in areas with higher population density. However, to our knowledge, this relationship cannot be confirmed by earlier studies. As our sample is overrepresented by countries with an already high ratio of urban population in the beginning of the time-period, except for China, the result could indicate that urbanisation only has a positive effect on growth in early stages of an economy.

Openness

Openness is significantly positive in relation to growth, in line with empirical findings from the Asian Tigers, where open trade policies were an essential factor (Birdsall et al., 1995). In the regressions when the variables are made stationary we see that openness is insignificant in two of the regressions. Thus, the results indicate that the countries benefit from higher exports as a percentage of the total GDP.

Population growth

It is interesting to note that the population growth is significant across the regressions with negative signs. The negative coefficient contrasts with both neoclassical theories and endogenous growth theories. The Solow model argues that the growth in population should decrease GDP per capita but not the total GDP. In the data sample, the growth rate of the population is positive except for a short period in Russia and for four years in the United Kingdom (see Appendix E). Peterson & Wesley (2017) argue that high population growth can slow the economic development in poor countries, and add Piketty's reasoning that lower population growth can increase national inequality. Especially wealth inequality would increase as larger families would dilute the inheritance (Piketty, 2014, p. 83, sourced by Peterson & Wesley, 2017). In fact, as argued before, wealth inequality appears to be more persistent through generations and Piketty shows that inheritance is an important factor to wealth inequality. Thus, if wealth inequality has a negative impact on the economic growth, so should population growth.

GDP per capita

The GDP per capita variable, included to control for convergence, is significantly negative which is in line with former research (see e.g. H. Li & Zou, 1998). Thus, a higher level of economic development leads to a lower growth rate across our sample-countries and time-period, and the "catch-up" dimension of growth can be confirmed. According to the endogenous growth theory, the relationship should be nonlinear across a wide range of different economies, i.e. countries in the middle-income bracket should have the highest growth rate whereas low and high-income countries should have lower growth. Our result thus not catch this nonlinear effect but what is visible is only that the higher GDP per capita the lower growth rate the countries has. It can indicate that all countries have reached the top of their growth curve and that growth rates are falling. This fits very well with the predictions, especially for the developed countries of United Kingdom, France, and United States. For China and Russia, the opposite relationship should be found, but the countries are not analysed individually due to limitations in our model. Thus, nonlinear relationships are not included in the model but may appear. However, when Naguib (2017) summarizes the literature on the subject the results are ambiguous.

Country dummy variables

The dummy variables for each country has only been commented on very shortly in the results and will not be evaluated to any extent here either. What is understood from the results is that country-specific effects play an important role to economic growth, as the dummies are significant throughout most regressions. As a discussion on the channels of country-specific effects would be speculative and out of scope, we refrain from trying to draw any conclusions. The fact that adjusted R-square appears to be very constant across all regressions are derived from Voichovsky's (2005) statement that country-specific factors are highly important when analysing inequality, in our regressions country-specific factors seems to explain a very large part of the total variation in the growth variable. This should be unsurprising seeing their heterogeneity.

Financial crisis

The dummy for the time period of the financial crisis is negative and significant, just as expected when including it. The importance of the crisis is evident, and controlling for it crucial, but no inferences can be drawn further than that.

6.7 Summary and hypotheses validation

Even though the results for the effect of income inequality on economic growth are ambiguous in general because of insignificance, we find that the relationship tends to be positive across the baseline, sensitivity analysis, and stationarity regressions. This implies that higher income inequality fastens the growth rate. However, since the coefficient is not significant across the regressions, it should be interpreted with caution. The hypotheses on income inequality follow:

H 1.0 Income inequality affect GDP growth

H 2.0 Income inequality has a positive relationship to GDP growth

Because of the insignificance found in the results, both H 1.0 and H 2.0, is rejected. However, when income inequality is significant in the regressions, the coefficient is positive. This implies that if there is a relationship between income inequality and growth, it is positive.

Wealth inequality however, shows significance to a larger degree through the baseline, sensitivity analysis, and stationarity regressions. It consistently shows a negative sign, except for when differenced, where it loses its significance. The hypotheses on wealth inequality are presented below:

H 3.0 Wealth inequality affect GDP growth

H 4.0 Wealth inequality has a positive relationship to GDP growth

As the variable fails to be significant across all regressions when differenced, we are forced to reject both hypotheses H 3.0 and H 4.0. However, when only assessing the regressions in levels, wealth inequality is significantly negative. The hypothesis is only rejected because of the variable's insignificance once differenced, implying that the result does not hold across all settings. However, if there is an effect of wealth inequality on growth it is negative, as the variable is always negative when significant.

The results show that the two inequality measures affect economic growth differently, if there is a relation even though it cannot be proved through our results. These findings are fascinating in the light of some earlier research proxying wealth inequality with income, but also because of the assumed relationship that income and wealth affects each other. However, we want to

emphasise that the pre-tax/net differences between our two inequality measurements may have significant impact, unfortunately impossible for us to control for.

In both cases of inequality; biasedness from omitted variables can cause the econometrical analysis to be invalid even though emphasis has been to check for the robustness of the model with various sensitivity analyses. Thus, the method of lagging the variables does not necessarily rule out the threat of endogeneity but can mitigate it.

The findings indicate that the results are dependent on the model specifications. Earlier research of which the model is based upon, neglect to assess whether there are trends driving the correlation between inequality and growth, which can be problematic if the trend is not a relevant factor in the relationship between the variables. However, when the variables are in levels, including the trend variable does not influence the main conclusion to any noticeable degree.

6.8 Analysis and discussion

For us to contribute with a comprehensive discussion, the analysis takes off from the results that wealth inequality is significantly negative in most cases, and that income inequality is insignificant. However, when income inequality is significant it is always positive which can indicate that it has a positive effect on economic growth. Kuznets is only elaborated on briefly because of its inclusion in other discussions based on its importance for the growth-inequality relationship.

6.8.1 Inequality from a neoclassical perspective

Basic neoclassical theory assumes a representative individual, why there is no direct relationship between growth and inequality, since it would imply differences among people. As growth in neoclassical theory is exogenous in the long-run we focus the study on the short-run dynamics of the economies. Moreover, in the short-run, capital stock is essential and there are several explanations to how inequality can affect capital accumulation, assuming heterogenous income levels among individuals. Hence, if and how inequality affects the capital stock, will determine how it affects growth in transition periods. According to theory, there is no clear relationship in how the economic inequality should affect economic growth, and from what we

discover, we must conclude that it appears to be very complicated and rely on external theories outside the basic models.

Our results reveal a non-robust and insignificant relationship between income inequality and growth, highly dependent on the model specification. From a neoclassical perspective, this implies that income inequality does not have a significant effect on the capital stock, including the factors that drives its accumulation. According to Solow, the main factor that drives growth is savings, channelled through investments. The former appears as insignificant in our findings, while investments is a significant factor. Thus, our results are in line with Solow's predictions. As soon as the savings ratio differs from the steady-state ratio of savings, it should influence economic growth. Thus, the model presents results that are in line with the neoclassical framework, as factors increasing the capital stock also increase economic growth. The insignificant result of the income inequality coefficient should imply that the income distribution does not affect the level of capital stock within the sample economies.

The fact that income inequality does not affect growth does not necessarily reject the theory that savings increase with income (Lewis, 1954), but it does question that it should imply higher inequalities to have positive implications on the capital stock and the level of the GDP. The result showing that wealth inequality is negative further contrast the theory. Combining Lewis' theory and our result, an explanation could be the importance of consumption, driving national demand being an important of the GDP level. Hence, falling consumption rates due to a higher concentration of capital within the top 10% does not only cause the aggregate savings ratio to increase, but also the consumption ratio to fall. This could have a large impact on the GDP, at least in short-run, potentially explaining the negative coefficient of wealth inequality. As wealth is more persistent through time, it should also have a stronger relation to the life-time consumption and choices connected to consumption smoothing as the Ramsey model builds upon. Continuing the Ramsey model, the negative effect from higher wealth inequality could be due to higher taxation if the median voter is negatively affected by inequality (Esarey et al., 2012). Reducing both incentives and demand for the top income bracket.

Since the wealth inequality coefficient is negative, inserting it in a neoclassical perspective implies that it has a direct or indirect effect on the capital stock, even when capital formation and savings are controlled for. Neither does the third growth factor in our regression, population growth, affect the sign of the wealth inequality variable. The exact impact of wealth inequality

on the capital stock is however unclear, as wealth inequality has not been regressed on specific growth channels. The negative relationship could be explained by convergence, implying that more developed countries, which should have a lower growth rate, have higher wealth inequality. This is also in line with recent s-shape extension of the Kuznets curve (see e.g. Galbraith et al., 2000; List & Gallet, 1999; Tribble, 1999), showing that economic inequality starts to rise again when GDP per capita grows beyond a certain level. However, the break point where inequalities start to rise again is not precisely defined. Looking at Figure 2 and 3, we see a rising inequality trend across our sample. Intuitively it seems strange that two developing countries in China and Russia would have reach the same points on the Kuznets curve as France, U.K., and U.S. However, in the case of Russia, we might see the initial uprising inequality trend explained by Kuznets. On the other hand, data might be flawed because of the communist regime and lack of data.

6.8.2 Inequality and growth in endogenous growth theories

From an endogenous growth theory perspective, the results of long-run growth are driven by technological improvements increasing the productivity of the labour force. Even though we do not aim to explain the long-run growth in this study, the endogenous growth theory can add explanatory power in the findings. For example, there are indications that tertiary gross enrolment positively, connected to knowledge in endogenous theories, affects the economic growth in our regressions. This suggests that a higher enrolment rate does fasten the growth rate, perhaps via increased total productivity of the labour force in the case of developed countries, via technology transferring and the ability to absorb information in the case of China and Russia who are developing countries (International Monetary Fund, 2017).

The negative sign of wealth inequality in our results can be due to its negative effect on the knowledge stock, if assumed that increased wealth inequality implies that individuals in the lower wealth bracket cannot afford to invest in human capital. Wolfson (2000) also argues that increasing economic inequality can hurt the knowledge stock because of lower average health. However, the proxy for wealth inequality does not directly contain this kind of information as only the share of the richest top 10% is included. Further, the relationship should not be restricted to the wealth inequality variable, but the same relationship should be seen in the income inequality variable for the theory to hold.

In endogenous theories, R&D investments drive growth. If economic inequality produces incentives for individuals to make investments improving R&D, this contrasts with the finding that wealth inequality is significantly negative. Social mobility might be an important factor relating inequality to incentives. If social mobility is low, individuals may see no chance of accumulating higher income than their parents. It leads to lower incentives to invest in R&D, as the chances of reaping any income benefits are low even though inequalities are high. If an individual cannot reach higher income brackets because of her background and not because of her education, it is unlikely that high inequalities in the form of intergenerational mobility would stimulate the economy. This thesis find that wealth inequality is negative and significant even when controlling for tertiary education. The measure of economic inequality does not necessarily provide a holistic picture of how equal a country is in terms of endogenous growth theory. Thus, other growth factors should have important influences on the relationship between inequality and growth and social mobility is probably an important one. Although, as has been elaborated on, tertiary gross enrolment is not a perfect proxy for human capital why effects from inequality still can affect growth via lower investments in human capital.

Our result of wealth inequality decreasing growth would indicate that individuals are de-incentivised to invest in R&D, perhaps because of immobility. Contrasting, the result indicates that income inequality has positive effect on GDP growth, which would then mean that the possibility of reaching higher income brackets indeed incentivises individuals. These results are in line with the idea of wealth inequality to be more persistent because of inheritance, and income inequality is more of a short-run measure. Thus, it might be harder to reach the top 10% wealth bracket compared to the top 10% income bracket, why the two have different implications for incentives. Further, as income inequality is only a snapshot in time, a high ratio does not necessarily imply that life-time inequality is high. As wealth is more persistent, a high ratio of wealth inequality might reduce peoples' willingness to invest in human capital. Thus, a higher income inequality causes higher incentives, higher R&D investments and knowledge externalities whereas a higher wealth inequality has a contrasting impact since it reduces the incentives because of it seems more difficult to attain.

6.8.3 Findings in the light of Piketty

Our results on wealth inequality are well in line with Piketty's (2014, pp.1-35) claim of inequality affecting growth negatively. Knowledge and skill transmission's positive effect on growth is harder to justify through our result, but we do at least find tertiary education to

significantly affect growth in our sensitivity analysis. Supporting evidence from the Asian Tiger countries, claiming knowledge to be transferred through R&D spill over (Lucas, 1993) may however be a reasonable explanation, as tertiary education may in many cases be needed to absorb and use the spill over information. This would then also be in line with endogenous growth theory's claim of education developing human capital and consequently growth. The measurement of higher education may also be more relevant in developed countries, as poorer nations in the third world must focus on basic primary and secondary education to start with.

When assessing Piketty's second law of capitalism, that the capital to income ratio equals the savings rate divided on the growth rate, we can connect it to our results. Here, we assume that savings ratio in Piketty's formula is equal to investments in our regressions. Investments drive growth as we know, and from our result we find that it driver growth with a ratio substantially less than one. Thus, when economies are growing in transition periods according to neoclassical models, our findings imply that the capital to income ratio will slowly increase automatically since the nominator in Piketty's formula will grow faster than the denominator. Further connecting this to neoclassical theory, when reaching steady state where investments does not drive growth, investments will flatten out, thus not changing the capital to income ratio anymore. Thus, Pikettys second law of capitalism should only be valid in transition economies.

With regards to Piketty's primary force of divergence, when return of capital is higher than the economic growth, we cannot say anything about the relationship itself. However, we do find that wealth inequality very likely affects economic growth to a larger extent than income inequality, supporting the notion that wealth inequality indeed plays a more important role as an inequality measure, if the somewhat criticized return-growth ratio is assumed to be true. This is in turn connected to the potential real estate bubble (Holzhey & Skoczek, 2017), which states unproportioned growth in asset value compared to income, perhaps supporting the relative importance of wealth inequality. However, if rising wealth inequality is driven by assets bubbles, it follows that the importance of the rising trend is restricted in time, since a bubble cannot continue to grow in eternity. Thus, the information contained in the variable might as well be a function of decreasing interest rates and other factors driving asset prices, signalling that inequality will down adjusted when the bubble bursts. Intuitively, everything else equal, housing prices should not have a faster growth rate than income, why the increased wealth inequality could be an anomaly to the natural state assuming its only dependent on this. With

this is mind, it could be interesting to include a variable controlling for economic cycles and asset bubbles in future research.

The negative sign of the insignificant household savings variable in our results could perhaps be an indication that savings are invested in current assets instead of productive capital causing asset price bubbles (Holzhey & Skoczek, 2017). Instead of savings driving growth this could harm the economy, as it would drive price bubbles seen in the financial crisis of 2007/2008 and elaborated on in the section of Piketty's forces of divergence. The positive sign of the investment variable could potentially confirm this relationship. Again, when the positive effect from investment is exhausted, household savings has an adverse effect on growth, and would increase wealth inequality as asset prices grow. In this scenario increasing wealth inequality predicts economic downswings, which gives an indication for the importance of policymakers to address rising wealth inequalities. This relationship cannot be derived from our data, but should be found in pre-tax wealth inequality data.

Piketty discuss taxation to be an economic determinant, much in line with other researchers. His fundamental attitude is that redistribution is good, as it should reduce inequality. Reduced inequality should in turn increase growth. However, when comparing with other results, the fiscal policies may actually harm growth (Gründler & Scheuermeyer, 2018; Yang & Greaney, 2017). It is hard to derive anything about this directly from our data, but through simplified reasoning we can elaborate that the positive effect from decreased wealth inequality could possibly override negative effects from lower incentives through progressive tax schemes. Thus, a successful targeted tax scheme, reducing wealth inequality, and not income inequality, can in accordance with the result of this study increase growth. But since redistribution is not included in the method, and neither the size of the effects from governmental interventions, a clear effect is ambiguous. Thus, we would have liked to employ the variable in our regressions to see what we could possibly have found and continue the elaboration on the interdependence between redistribution, inequality, and growth.

The opposite signs between wealth inequality and capital formation found across most regression tables but for the differenced wealth variable, indicates that policymakers have efficient measures to increase growth, at least in the short-run, via redistribution policies enabling investments. Thus, reducing wealth inequality by increasing the taxes on wealth and simultaneously invest the surplus in physical capital should have a dual positive effect on the

growth rate. With the income inequality variable being insignificant, it could imply redistribution actions taken by policy makers to be more effective when imposed on wealth. It is tempting to draw this conclusion but bear in mind that inconsistencies in the data where income inequality is pre-tax, and wealth is net, again make it impossible to draw firm conclusions.

Another explanation to why we see such a vast difference between how income inequality and wealth inequality affect growth may be that the overlap between the wealthiest top 10% and the top 10% with the highest income is not absolute. Retired individuals are an example of people that have no, or low, income but high wealth. Hence, factors that affects the individuals within the top 10% wealth segment does not necessarily have the same effect on the income inequality measure. For example, in accordance to Piketty (2014, pp. 72-109), a larger population should dilute inheritance, and wealth, since its shared by more people but the effect on income is according to the Solow theory negative as GDP per capita should decrease with a higher population. Moreover, as argued by both Naguib (2017) and Corneo (2015), income inequality is only a snapshot in time whereas wealth inequality is more persistent and travels through generations, so the latter should provide a better picture of inequality within a country.

6.8.2 Findings in the light of Kuznets

Kuznets (1955), and several researchers after him, argues that the relationship between income inequality and growth may differ depending on the development of the country (see e.g. Ahluwalia, 1976b; Deininger & Squire, 1998). This nonlinear relationship has not been addressed within this study but could explain the lack of evidence regarding the relationship between inequality and growth. The heterogeneity in development among the sample countries in this study might cancel out each other and leave an insignificant aggregate effect. Pagano (2004) and Barro (2008) for example, finds that income inequality has a negative effect for poor countries and a positive effect for rich countries, suggesting that is derived from lower credit market efficiencies in poor markets and that investment human capital should therefore be restrained.

6.8.6 Inequality connected to the Asian growth miracle

Our result, where wealth inequality very likely affects economic growth negatively, is partly in line with the findings from the Asian Tiger economies that contradicted the opposite belief of the relationship at the time. Land ownership was highly distributed in the Asian Tigers (Rodrik,

1994), which certainly is connected to wealth in the light of Piketty's (2014) discussion of asset prices driving wealth inequalities. It was found that, inequality decreased during the time of high growth in the region, certainly similar to our result, but the causality direction is not concluded (Siddiqi & Hertzman, 2001). However, it seems likely that the land distribution was equal also before the growth started, at least implying that it was not a one-way relationship where growth affected inequality. With this in mind, the scepticism to our result is partly reduced as the relationship has been found before. What we find interesting is that some of the key drivers of growth for the Asian Tigers were education and exports. We control for both, still finding wealth inequality to be significant in contrast to income inequality. However, one must remember that the Asian Tigers might be a unique example of the interdependence between growth and inequality.

Savings and growth

The Asian tigers showed the interesting relationship of growth significantly affecting savings, called 'reverse causation', but not the other way around (Birdsall et al., 1995). From our findings, it must be questioned if there is a relationship, due to the insignificance of found in the household savings variable. Perhaps, a more interesting question to ask is if the household savings variable might be more noteworthy in the context of very poor countries, compared to developed ones. The savings that are later used for investments, consequently increasing GDP in neoclassical growth theories, might not come from households today, but rather from corporations and foundations, which are not included in the household savings variable, and neither affects inequality directly. Corporations might be thought of as an invalid example since their revenue is someone's spending, thus originates in the savings of a private person. On the other hand, the largest contracts today are without a doubt between businesses, and corporations' 'saving' of last year's net income transferred to retained earnings is likely not included in any savings measurement. The large corporations are in turn owned by a small percentage of individuals benefiting from this, possibly affecting wealth and income inequality. This would go hand in hand with the Asian Tigers relationship, as the absence of larger manufacturers increased the savings of what could still be loosely defined as a private person, and decreased income inequality too.

6.8.7 Channels outside our model through which inequality affects growth

As have been understood throughout this thesis, inequality possibly affects growth in an immense number of ways, with ambiguous signs depending on what countries, time-period,

and econometrical model is used. In the U.S., interstate-growth can be derived from the history of slavery and its implications on today's economic inequality (N. A. Ross et al., 2000). The richness of oil and minerals in a country affects growth positively, but decreases inequality in some cases (D.-H. Kim & Lin, 2017). Other researchers find natural resource abundance in a nation to increase inequalities and possibly decrease growth too, if stealing labour from more efficient industries (Gylfason & Zoega, 2002; Papyrakis & Parcero, 2016). We do however argue that natural resources should be quite constant in our short time sample, why it should not affect our results to any greater extent. On the other hand, e.g. fluctuating oil prices affect the growth of oil abundant countries (The World Bank, 2017), likely transferring some implications to economic inequality too. Some of our country dummies likely catches the effect of oil and minerals. Infrastructure is vital to economic growth and could possibly decrease economic inequality according to Calderon & Serven (2014), but in urban China infrastructural changes affect inequality in ambiguous ways depending on what type of infrastructure is invested in (Miguel & Mendoza, 2005). In our results presented, the country-dummies are significant to the one percent level throughout almost all regressions, implying that there are many country-specific variables affecting growth, and much likely both of our inequality measures. As we use the fixed effect model, we cannot run regressions without dummy variables to find if, and how much, they also change the inequality coefficients. Our literature findings do however make it clear that relationships should be found. Even though we cannot derive any evidence of which country is affected by what variables, it is clear that country-specific factors to a large extent affects growth and that including this information could add additional information to the complex nexus of growth and inequality.

7. CONCLUSION AND RECOMMENDATIONS

Since 1980, inequality levels have been rising sharply. In a recent study by Piketty (2014), it is shown that wealth has been accumulated rapidly, resulting in large concentrations at the top of the society. Wealth concentration is shown to be vastly higher than the income concentration, across all countries and time-periods that has been researched. In the academia, the evolution of wealth inequality and its effect on the economy has rarely been examined due to limitations in data. Instead, the main proxy for economic inequality has been income inequality. With new data from the World Inequality Database the possibility to assess their differences arise.

This study examines if income and wealth inequality are significant factors in driving economic growth. As earlier researchers have never focused on both inequality measures at the same time, this study aims towards finding dissimilarities between the two; analysing both within the same framework to reduce methodological issues.

The findings present that neither income inequality nor wealth inequality is robust throughout the sensitivity analyses and that the magnitude of the coefficients vary, which indicates that there are important omitted variables in the model specification. Wealth inequality is negative and significant when the variable is in levels, whereas the levelled income inequality variable is positive with a non-robust significance level. Thus, the study finds important differences between wealth and income inequality. Accordingly, when wealth inequality is significant it is always negative whereas the opposite applies for income inequality, it is always positive when significant. Additionally, this thesis finds that the first-difference transformation has a large impact on the performance of the wealth inequality variable but not on the income inequality variable. It causes the coefficient of wealth inequality to switch to a positive sign, compared to when it is in levels. The results emphasise the importance of choosing the right method when analysing the complex relationship between wealth inequality and growth.

An important finding is that neither inequality measurement is stationary, which probably has driven earlier researchers to have overconfidence in the significance level of the income inequality variable. However, we also find that when the inequality variables are differenced both are stationary, why later research applying differenced methods should not suffer from this.

In a thorough literature review this study uncover that no straightforward instruments exist for income or wealth inequality, but that all instruments may lack either relevance or exogeneity. The female % of the total population is suggested as a new instrument but it lacks relevance across wealth inequality and income inequality. There are indications that it can be valid for income inequality, why future research only interested in income inequality may use it with benefit. However, a longer time-period and a wider sample of countries is needed in order to generalize the applicability of the instrument.

To review, the study finds indications that wealth and income inequality differs in how they affect economic growth, which is important since earlier researchers has focused on income inequality as a measure of economic inequality. The study also reveals several econometrical difficulties important to consider and emphasises that different methods can change the result when measuring the relationship between inequality and growth.

Recommendations for future research

The World Inequality Dataset is set to expand, aiming to increase coverage in Asia, Africa, and Latin America (World Inequality Database, 2018g). This will allow for expanded regressions, including a wider range of countries, where generalizable conclusions can be drawn. It will also enable research focused on countries or regions with specific characteristics. Many interesting findings can likely be drawn comparing compare developing countries, or comparing regions etc. This will deepen the analysis and address the potential nonlinear relationship between inequality and growth.

Further, as this study was limited in its econometrical approach due to limitations in data, future studies should aim to uncover which is the most valid method to handle endogeneity in a sample where T is long, and N is short. In addition, to efficiently tackle the endogeneity problem, future scholars must aim their research to find and specify the factors that are correlated both with inequality and economic growth as this. This would allow future studies to apply econometrical methods that can address how country-specific factors affects the relationship between inequality and growth, which is not possible in a fixed effects estimator.

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9. APPENDICES

Appendix A. Income inequality sensitivity analysis with 6-year lag

In the second step of the sensitivity analysis significant variables are regressed on the baseline regression in order to address the problem of multicollinearity. An overfitted model can produce severe restrictions for the validity of the model, both via correlation between the inequality variable and control variables but also correlation between control variables. All F-tests are significant at the 5% level.

Dependent Variable: GDP growth	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
L6 Income inequality	0,0555	-0,0416	-0,00934	0,119	0,0615	0,0849	0,114	0,118
	(0,66)	(-0.49)	(-0.11)	(1,35)	(0,74)	(0,97)	(1,41)	(1,51)
L6 Wealth inequality							-0.177***	-0.158**
							(-3.56)	(-3.27)
L6 Tertiary education		0.0210*	0.0334**		0.0559***	0.0270*	0.0461***	0.0484***
		(1,99)	(2,71)		(4,34)	(2,39)	(3,87)	(4,20)
L6GDP per capita	-0,00276		-0,0115	0,0132		0,00282		
	(-0.52)		(-1.90)	(1,50)		(0,35)		
Urbanisation	-0.123**	-0.207***	-0.206***	-0.168***	-0.305***	-0.201***	-0.280***	-0.291***
	(-2.90)	(-3.99)	(-4.01)	(-3.63)	(-5.66)	(-4.47)	(-5.32)	(-5.74)
Capital formation	0.0986***	0.110***	0.0994***	0.102***	0.0991***	0.0942***	0.126***	0.125***
	(4,41)	(5,14)	(4,56)	(4,62)	(4,91)	(4,38)	(5,91)	(6,10)
Openness	0.0474**	0.0431**	0.0458**	0.0665***	0.0722***	0.0789***	0.0732***	0.0763***
	(3,32)	(3,08)	(3,28)	(4,05)	(4,87)	(4,80)	(5,09)	(5,49)
Household savings	-0,0408	-0,0628	-0,0753	-0,0457	-0.105*			
	(-0.84)	(-1.28)	(-1.54)	(-0.96)	(-2.24)			
Population growth	-1,605	-3.696**	-3.239*	-1,9	-4.195**		-3.946**	-3.980**
	(-1.26)	(-2.69)	(-2.34)	(-1.50)	(-3.24)		(-3.17)	(-3.31)
United States	0.280***	0.307***	0.402***	0.174*	0.367***	0.299***	0.495***	0.485***
	(4,85)	(5,86)	(5,57)	(2,36)	(7,17)	(4,01)	(7,50)	(7,62)
France	0.223***	0.250***	0.351***	0,107	0.306***	0.235**	0.402***	0.393***
	(4,20)	(5,46)	(5,01)	(1,45)	(6,82)	(3,21)	(7,25)	(7,35)
United Kingdom	0.238***	0.273***	0.373***	0,121	0.332***	0.258***	0.428***	0.420***
	(4,48)	(5,53)	(5,19)	(1,65)	(6,86)	(3,46)	(7,36)	(7,47)
China	0.165**	0.186***	0.282***	0,077	0.267***	0.195**	0.313***	0.302***
	(2,69)	(3,41)	(3,82)	(1,07)	(4,88)	(3,00)	(5,80)	(5,80)
Russia	0.205***	0.225***	0.300***	0,112	0.257***	0.231***	0.371***	0.359***
	(3,78)	(4,48)	(4,73)	(1,66)	(5,40)	(3,69)	(6,11)	(6,12)
Trend				-0.00137*	-0.00186***	-0.00172**	-0.00169***	-0.00162***
				(-2.25)	(-4.22)	(-2.74)	(-4.03)	(-4.01)
Financial crisis								-0.0175**
								(-3.17)
N	134	134	134	134	134	134	134	134
adj. R-sq	0,862	0,866	0,869	0,867	0,883	0,871	0,889	0,897
F-stat all variables	70,99	73,44	69,51	68,11	78,5	76,07	83,87	84,44
F-stat country dummies	5,03	6,38	7,12	5,95	10,61	7,31	13,38	14,49
P-value	0,001	0,000	0,000	0,000	0,000	0,000	0,000	0,000

t statistics in parentheses
* p<0.10, **p<0.05, *** p<0.01

Appendix B. Wealth inequality sensitivity analysis with 6-year lag

The table presents the same regressions as in Table 8 but with the modification that the baseline variables are lagged six periods. L6 denotes variables that are lagged for six periods and the time-trend is included in regressions 4 to 6. In the last regression a dummy variable for the financial crisis of 2007/2008 is included. All F-tests are significant at the 5% level.

Dependent Variable: GDP growth	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
L6 Wealth inequality	-0.178***	-0.168***	-0.205***	-0.161***	-0.161***	-0.183***	-0.177***	-0.158***
	(-3.30)	(-3.22)	(-3.94)	(-2.79)	(-3.28)	(-3.30)	(-3.56)	(-3.27)
L6 Income inequality							0,114	0,118
							(1,41)	(1,51)
L6 Tertiary education		0.0184**	0.0396***		0.0561***	0.0308***	0.0461***	0.0484***
		(2,05)	(3,52)		(4,59)	(2,87)	(3,87)	(4,20)
L6 GDP per capita	-0,00425		-0.0171***	0,00279		-0,00797		
	(-0.91)		(-2.97)	(0,30)		(-0.94)		
Urbanisation	-0.0740*	-0.188***	-0.178***	-0.0910**	-0.274***	-0.142***	-0.280***	-0.291***
	(-1.83)	(-3.75)	(-3.66)	(-2.03)	(-5.36)	(-3.27)	(-5.32)	(-5.74)
Capital formation	0.117***	0.138***	0.125***	0.114***	0.121***	0.113***	0.126***	0.125***
	(5,33)	(6,50)	(5,95)	(5,19)	(5,94)	(5,28)	(5,91)	(6,10)
Openness	0.0495***	0.0463***	0.0498***	0.0560***	0.0711***	0.0699***	0.0732***	0.0763***
	(3,63)	(3,46)	(3,82)	(3,61)	(5,14)	(4,54)	(5,09)	(5,49)
Household savings	-0,0333	-0,0482	-0,0694	-0,0372	-0.0973**			
	(-0.72)	(-1.04)	(-1.52)	(-0.80)	(-2.16)			
Population growth	-1,251	-3.785***	-3.179**	-1,383	-4.331***		-3.946***	-3.980***
	(-1.02)	(-2.86)	(-2.45)	(-1.12)	(-3.48)		(-3.17)	(-3.31)
United states	0.475***	0.457***	0.649***	0.416***	0.534***	0.566***	0.495***	0.485***
	(5,89)	(6,83)	(7,08)	(3,96)	(8,18)	(5,53)	(7,50)	(7,62)
France	0.392***	0.375***	0.569***	0.330***	0.448***	0.480***	0.402***	0.393***
	(5,43)	(6,61)	(6,65)	(3,28)	(8,03)	(4,95)	(7,25)	(7,35)
United Kingdom	0.406***	0.398***	0.591***	0.345***	0.475***	0.503***	0.428***	0.420***
	(5,64)	(6,76)	(6,82)	(3,45)	(8,18)	(5,17)	(7,36)	(7,47)
China	0.338***	0.287***	0.481***	0.295***	0.405***	0.425***	0.313***	0.302***
	(4,61)	(5,78)	(5,93)	(3,33)	(7,47)	(5,27)	(5,80)	(5,80)
Russia	0.400***	0.361***	0.525***	0.351***	0.422***	0.483***	0.371***	0.359***
	(5,36)	(6,10)	(6,59)	(3,76)	(7,37)	(5,61)	(6,11)	(6,12)
Trend				-0,000527	-0.00172***	-0,000978	-0.00169***	-0.00162***
				(-0.88)	(-4.24)	(-1.60)	(-4.03)	(-4.01)
Financial crisis								-0.0175***
								(-3.17)
N	134	134	134	134	134	134	134	134
adj. R-sq	0,873	0,877	0,884	0,873	0,892	0,88	0,889	0,897
F-stat all variables	77,93	80,35	79,59	71,86	85,9	83,02	83,87	84,44
F-stat country dummies	7,88	8,24	9,67	5,89	10,16	7,88	11,03	13,19
P-value	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00

t statistics in parentheses

* p<0.10, **p<0.05, *** p<0.01

Appendix C. Correlation matrix

The table presents a correlation diagram between the variables included in the regressions of the result. No transformations have been done to the variables, but all appear in their original form.

	Income inequality	Wealth inequality	GDP growth	GDP per capita	Urbanisation	Population growth	Tertiary education	Openness	Capital formation	Household savings
Income inequality	1									
Wealth inequality	0,6416	1								
GDP growth	-0,0312	-0,2832	1							
GDP per capita	0,2487	0,3831	-0,482	1						
Urbanisation	0,2234	0,5319	-0,7204	0,5967	1					
Population growth	-0,2514	-0,1939	0,2529	0,1791	-0,4547	1				
Tertiary education	0,6739	0,7557	-0,4731	0,7422	0,6687	-0,108	1			
Openness	0,1648	-0,0539	-0,023	-0,1877	0,1888	-0,7866	-0,0617	1		
Capital formation	-0,1383	-0,2854	0,7274	-0,5587	-0,8367	0,3272	-0,6222	-0,0657	1	
Household savings	-0,121	-0,3301	0,5147	-0,4653	-0,6332	0,1152	-0,543	0,1996	0,8108	1

Appendix D. Fischer's unit root test

The table presents the results from the Fisher unit root test. As described in method, the test is performed using the first lag. When a variable is ensured to be stationary, no further test is performed on the variable. However, since an additional regression is performed on the differenced wealth inequality variable for comparability reasons, the test show that wealth inequality is stationary when differenced and detrended.

	Trend included		No trend included		Detrended variables No trend included		Differenced Variables	
	Statistic	P-value	Statistic	P-value	Statistic	P-value	Statistic	P-value
GDP Growth	40,23	0,00	48,30	0,00				
Log Capital investment	26,55	0,00	16,73	0,08				
Income Inequality	9,97	0,44	2,52	0,99	13,68	0,19	58,78	0,00
ln Household Savings	20,57	0,02	33,87	0,00				
ln Urbanisation	7,16	0,71	3,38	0,97	6,19	0,80	27,77	0,00
ln Tertiary education	8,01	0,63	2,80	0,99	8,44	0,59	21,42	0,02
ln GDP per capita	13,68	0,19	10,37	0,41	13,66	0,19	41,26	0,00
Wealth inequality	15,56	0,11	16,58	0,08	22,99	0,01	32,98	0,00
Population growth	14,53	0,15	10,40	0,41	9,67	0,47	57,84	0,00
ln Openness	16,24	0,09	15,70	0,11	17,54	0,06		

Appendix E. Dataset

The table represents the entire dataset employed in this study. All variables are rounded to the third decimal to fit the page.

Country	Time	Population growth	Household savings	Wealth inequality	Urbanisa-tion	Tertiary gross enrolment	Openness	Income inequality	GDP per capita	Female % of total population	Capital formation	GDP growth
US	1980	0,010	10,550	0,651	73,740	0,535	0,098	0,342	12597,668	0,510	0,233	-0,002
US	1981	0,010	11,190	0,648	73,890	0,555	0,095	0,347	13993,167	0,510	0,242	0,026
US	1982	0,010	11,460	0,635	74,040	0,568	0,085	0,349	14438,976	0,510	0,221	-0,019
US	1983	0,009	9,440	0,627	74,190	0,573	0,076	0,354	15561,426	0,510	0,222	0,046
US	1984	0,009	10,750	0,621	74,340	0,581	0,075	0,367	17134,286	0,510	0,251	0,073
US	1985	0,009	8,560	0,618	74,490	0,580	0,070	0,367	18269,422	0,510	0,241	0,042
US	1986	0,009	8,200	0,614	74,640	0,592	0,070	0,365	19115,053	0,510	0,237	0,035
US	1987	0,009	7,270	0,622	74,790	0,618	0,075	0,376	20100,859	0,510	0,235	0,035
US	1988	0,009	7,820	0,633	74,940	0,645	0,085	0,389	21483,233	0,510	0,228	0,042
US	1989	0,009	7,810	0,633	75,090	0,672	0,089	0,387	22922,437	0,510	0,224	0,037
US	1990	0,011	7,780	0,636	75,300	0,708	0,092	0,387	23954,479	0,510	0,215	0,019
US	1991	0,013	8,160	0,635	75,700	0,726	0,096	0,386	24405,165	0,510	0,201	-0,001
US	1992	0,014	8,880	0,651	76,100	0,771	0,097	0,398	25492,952	0,510	0,200	0,036
US	1993	0,013	7,360	0,655	76,490	0,787	0,095	0,396	26464,853	0,509	0,203	0,027
US	1994	0,012	6,320	0,655	76,880	0,783	0,099	0,399	27776,636	0,509	0,212	0,040
US	1995	0,012	6,380	0,659	77,260	0,783	0,106	0,407	28782,175	0,509	0,212	0,027
US	1996	0,012	5,920	0,664	77,640	0,778	0,107	0,415	30068,231	0,508	0,216	0,038
US	1998	0,012	6,180	0,680	78,380	0,706	0,105	0,426	32949,198	0,508	0,228	0,044
US	1999	0,011	4,420	0,686	78,740	0,722	0,103	0,434	34620,929	0,508	0,233	0,047
US	2000	0,011	4,160	0,688	79,060	0,681	0,107	0,439	36449,855	0,507	0,236	0,041
US	2001	0,010	4,320	0,678	79,230	0,690	0,097	0,428	37273,618	0,507	0,221	0,010
US	2002	0,009	5,010	0,678	79,410	0,793	0,091	0,427	38166,038	0,507	0,216	0,018

US	2003	0,009	4,830	0,679	79,580	0,813	0,090	0,429	39677,198	0,507	0,217	0,028
US	2004	0,009	4,550	0,686	79,760	0,815	0,096	0,439	41921,810	0,507	0,225	0,038
US	2005	0,009	2,590	0,685	79,930	0,821	0,100	0,451	44307,921	0,507	0,232	0,033
US	2006	0,010	3,310	0,689	80,100	0,821	0,107	0,460	46437,067	0,506	0,233	0,027
US	2007	0,010	2,950	0,698	80,270	0,830	0,115	0,458	48061,538	0,506	0,224	0,018
US	2008	0,009	4,880	0,728	80,440	0,850	0,125	0,453	48401,427	0,506	0,208	-0,003
US	2009	0,009	6,100	0,736	80,610	0,886	0,110	0,443	47001,555	0,506	0,175	-0,028
US	2010	0,008	5,600	0,742	80,770	0,942	0,124	0,458	48373,879	0,506	0,184	0,025
US	2011	0,007	6,020	0,741	80,940	0,963	0,136	0,459	49790,665	0,506	0,185	0,016
US	2012	0,007	7,620	0,745	81,110	0,948	0,136	0,471	51450,122	0,506	0,194	0,022
US	2013	0,007	5,000	0,732	81,280	0,888	0,136	0,463	52787,027	0,506	0,198	0,017
US	2014	0,007	5,670	0,730	81,450	0,867	0,137	0,470	54598,551	0,505	0,201	0,026
FR	1971	0,009	20,329	0,573	71,460	0,185	0,163	0,337	3173,840	0,508	0,273	0,053
FR	1972	0,009	20,842	0,571	71,860	0,196	0,165	0,335	3857,373	0,508	0,275	0,045
FR	1973	0,009	20,908	0,569	72,260	0,214	0,174	0,342	4965,855	0,507	0,281	0,063
FR	1974	0,008	0,214	0,557	72,650	0,222	0,205	0,338	5317,620	0,507	0,290	0,043
FR	1975	0,007	22,261	0,549	72,930	0,235	0,187	0,333	6672,511	0,507	0,248	-0,010
FR	1976	0,005	19,944	0,541	73,000	0,247	0,192	0,328	6846,352	0,507	0,264	0,043
FR	1977	0,004	2,007	0,532	73,070	0,248	0,201	0,312	7513,345	0,507	0,255	0,035
FR	1978	0,003	21,646	0,525	73,140	0,258	0,201	0,305	9248,442	0,507	0,242	0,040
FR	1979	0,003	19,665	0,519	73,210	0,242	0,206	0,314	11170,460	0,507	0,248	0,036
FR	1980	0,004	19,176	0,516	73,280	0,251	0,208	0,306	12712,601	0,507	0,257	0,016
FR	1981	0,004	18,961	0,509	73,350	0,254	0,218	0,302	11110,560	0,507	0,234	0,011
FR	1982	0,005	18,021	0,502	73,430	0,269	0,213	0,293	10505,735	0,508	0,237	0,025
FR	1983	0,005	1,730	0,500	73,500	0,274	0,223	0,294	10005,152	0,508	0,217	0,013
FR	1985	0,006	14,658	0,501	73,650	0,290	0,231	0,303	9775,339	0,508	0,211	0,016
FR	1986	0,006	13,690	0,506	73,730	0,296	0,202	0,312	13557,147	0,508	0,217	0,024
FR	1987	0,006	1,202	0,505	73,800	0,300	0,194	0,321	16324,394	0,509	0,222	0,026
FR	1988	0,006	1,227	0,505	73,880	0,309	0,202	0,326	17696,511	0,509	0,232	0,047
FR	1989	0,006	12,462	0,508	73,950	0,344	0,215	0,328	17704,959	0,509	0,242	0,044

FR	1990	0,006	13,511	0,503	74,060	0,370	0,208	0,322	21795,238	0,509	0,243	0,029
FR	1991	0,001	14,262	0,507	74,230	0,395	0,212	0,321	21782,417	0,509	0,235	0,010
FR	1992	0,005	15,240	0,510	74,400	0,428	0,212	0,314	23937,057	0,509	0,218	0,016
FR	1993	0,004	0,157	0,512	74,570	0,457	0,206	0,317	22503,260	0,510	0,194	-0,006
FR	1994	0,004	15,094	0,512	74,740	0,495	0,215	0,318	23625,530	0,510	0,202	0,023
FR	1995	0,004	1,564	0,511	74,910	0,503	0,224	0,317	27037,973	0,510	0,204	0,021
FR	1996	0,004	14,869	0,540	75,080	0,523	0,228	0,322	27015,258	0,510	0,195	0,014
FR	1997	0,004	15,901	0,552	75,250	0,532	0,252	0,325	24359,423	0,510	0,193	0,023
FR	1998	0,004	15,309	0,563	75,420	0,537	0,258	0,328	25101,370	0,510	0,206	0,036
FR	1999	0,005	14,959	0,569	75,610	0,541	0,257	0,327	24799,295	0,510	0,213	0,034
FR	2000	0,007	14,693	0,571	75,870	0,544	0,282	0,331	22465,641	0,510	0,224	0,039
FR	2001	0,007	15,288	0,561	76,130	0,544	0,278	0,334	22527,318	0,510	0,221	0,020
FR	2002	0,007	16,244	0,546	76,380	0,534	0,270	0,329	24275,243	0,510	0,212	0,011
FR	2003	0,007	15,612	0,538	76,630	0,548	0,256	0,332	29691,181	0,510	0,211	0,008
FR	2004	0,007	15,835	0,530	76,880	0,552	0,259	0,335	33874,744	0,509	0,218	0,028
FR	2005	0,008	14,518	0,524	77,130	0,554	0,264	0,334	34879,729	0,509	0,224	0,016
FR	2006	0,007	14,539	0,528	77,380	0,555	0,272	0,332	36544,506	0,509	0,232	0,024
FR	2007	0,006	15,088	0,536	77,620	0,548	0,271	0,339	41600,585	0,509	0,241	0,024
FR	2008	0,006	14,981	0,532	77,860	0,545	0,274	0,337	45413,066	0,509	0,241	0,002
FR	2009	0,005	16,219	0,541	78,110	0,549	0,241	0,322	41631,131	0,509	0,213	-0,029
FR	2010	0,005	15,794	0,559	78,350	0,571	0,260	0,326	40703,346	0,509	0,219	0,020
FR	2011	0,005	15,642	0,551	78,580	0,580	0,278	0,332	43810,202	0,509	0,232	0,021
FR	2012	0,005	15,112	0,545	78,820	0,600	0,285	0,322	40838,025	0,509	0,226	0,002
FR	2013	0,005	14,323	0,549	79,060	0,622	0,286	0,326	42554,120	0,509	0,223	0,006
FR	2014	0,005	14,674	0,553	79,290	0,644	0,289	0,326	42955,242	0,509	0,227	0,009
UK	1971	0,003	5,530	0,634	77,030	0,146	0,214	0,293	2649,802	0,515	0,236	0,035
UK	1972	0,002	7,780	0,660	77,200	0,154	0,202	0,289	3030,433	0,514	0,230	0,043
UK	1973	0,001	8,600	0,634	77,360	0,161	0,220	0,283	3426,276	0,514	0,270	0,065
UK	1974	0,000	8,900	0,610	77,520	0,168	0,263	0,281	3665,863	0,514	0,275	-0,025
UK	1975	0,000	9,730	0,587	77,680	0,186	0,249	0,278	4299,746	0,514	0,237	-0,015

UK	1976	0,000	9,480	0,610	77,840	0,192	0,274	0,279	4138,168	0,514	0,258	0,029
UK	1977	0,000	8,480	0,577	78,010	0,193	0,291	0,280	4681,440	0,513	0,252	0,024
UK	1978	0,001	10,380	0,588	78,160	0,191	0,274	0,278	5976,938	0,513	0,246	0,042
UK	1979	0,001	11,880	0,540	78,320	0,192	0,268	0,284	7804,762	0,513	0,247	0,037
UK	1981	0,000	13,400	0,532	78,590	0,189	0,254	0,310	9599,306	0,514	0,192	-0,008
UK	1982	0,000	12,480	0,512	78,540	0,190	0,251	0,312	9146,077	0,514	0,200	0,020
UK	1983	0,002	11,230	0,507	78,490	0,211	0,252	0,318	8691,519	0,514	0,209	0,042
UK	1984	0,002	12,650	0,467	78,440	0,211	0,270	0,325	8179,194	0,514	0,220	0,023
UK	1985	0,002	12,400	0,487	78,390	0,210	0,273	0,327	8652,217	0,514	0,218	0,042
UK	1986	0,002	11,500	0,488	78,340	0,215	0,243	0,329	10611,112	0,514	0,216	0,031
UK	1987	0,002	9,500	0,504	78,290	0,225	0,239	0,333	13118,587	0,514	0,225	0,053
UK	1988	0,003	7,850	0,482	78,240	0,233	0,215	0,342	15987,168	0,514	0,252	0,057
UK	1989	0,003	9,080	0,485	78,190	0,244	0,219	0,342	16239,282	0,514	0,258	0,026
UK	1990	0,003	11,180	0,460	78,140	0,265	0,226	0,369	19095,467	0,514	0,230	0,007
UK	1991	0,003	13,280	0,456	78,110	0,292	0,219	0,377	19900,727	0,514	0,196	-0,011
UK	1992	0,002	14,780	0,480	78,170	0,332	0,222	0,376	20487,171	0,514	0,188	0,004
UK	1993	0,003	14,450	0,498	78,230	0,380	0,241	0,383	18389,020	0,514	0,184	0,025
UK	1994	0,003	12,580	0,495	78,290	0,428	0,253	0,383	19709,238	0,514	0,194	0,039
UK	1995	0,003	13,600	0,469	78,350	0,483	0,252	0,385	23013,459	0,514	0,186	0,025
UK	1996	0,003	12,630	0,484	78,410	0,501	0,257	0,393	24219,623	0,514	0,188	0,025
UK	1997	0,003	11,250	0,516	78,470	0,533	0,253	0,389	26621,480	0,514	0,180	0,040
UK	1998	0,003	9,630	0,519	78,530	0,556	0,237	0,395	28014,895	0,513	0,186	0,031
UK	1999	0,004	7,500	0,501	78,590	0,602	0,236	0,413	28383,669	0,513	0,181	0,032
UK	2000	0,004	9,300	0,506	78,650	0,585	0,248	0,410	27982,356	0,513	0,185	0,037
UK	2001	0,004	9,530	0,502	78,750	0,593	0,247	0,414	27427,588	0,512	0,179	0,025
UK	2002	0,005	9,150	0,508	79,050	0,626	0,238	0,410	29785,986	0,512	0,178	0,025
UK	2003	0,006	8,100	0,503	79,340	0,621	0,235	0,414	34173,980	0,511	0,174	0,033
UK	2005	0,007	7,580	0,512	79,920	0,590	0,247	0,416	41732,641	0,510	0,172	0,031
UK	2006	0,008	7,600	0,520	80,200	0,591	0,267	0,420	44252,316	0,510	0,176	0,025
UK	2009	0,008	10,850	0,540	81,030	0,582	0,261	0,415	38262,182	0,509	0,144	-0,042

UK	2012	0,007	9,250	0,519	81,830	0,592	0,297	0,391	41790,779	0,508	0,158	0,015
CH	1980	0,013	9,540	0,408	19,360	0,012	0,057	0,272	194,805	0,487	0,354	0,078
CH	1981	0,013	14,560	0,408	20,120	0,018	0,074	0,277	197,071	0,487	0,337	0,052
CH	1984	0,013	15,890	0,408	22,200	0,021	0,076	0,287	250,714	0,487	0,352	0,151
CH	1985	0,014	18,710	0,408	22,870	0,025	0,080	0,295	294,459	0,487	0,399	0,134
CH	1986	0,015	13,170	0,408	23,560	0,030	0,084	0,299	281,928	0,487	0,386	0,089
CH	1987	0,016	22,430	0,408	24,260	0,032	0,100	0,297	251,812	0,487	0,382	0,117
CH	1988	0,016	22,280	0,408	24,970	0,031	0,106	0,301	283,538	0,487	0,399	0,112
CH	1989	0,015	14,440	0,408	25,700	0,030	0,086	0,307	310,882	0,487	0,379	0,042
CH	1990	0,015	26,450	0,408	26,440	0,030	0,120	0,304	317,885	0,487	0,347	0,039
CH	1991	0,014	28,110	0,408	27,310	0,029	0,130	0,311	333,142	0,487	0,359	0,093
CH	1992	0,012	28,430	0,408	28,200	0,028	0,137	0,323	366,461	0,487	0,398	0,142
CH	1993	0,011	27,610	0,408	29,100	0,029	0,121	0,335	377,390	0,487	0,442	0,139
CH	1994	0,011	29,040	0,408	30,020	0,037	0,187	0,340	473,492	0,487	0,409	0,131
CH	1995	0,011	25,890	0,408	30,960	0,045	0,181	0,336	609,657	0,487	0,397	0,109
CH	1996	0,010	23,830	0,430	31,920	0,050	0,180	0,335	709,414	0,487	0,384	0,099
CH	1997	0,010	26,520	0,446	32,880	0,055	0,195	0,336	781,744	0,487	0,363	0,092
CH	1998	0,010	26,260	0,459	33,870	0,060	0,185	0,339	828,580	0,487	0,357	0,078
CH	1999	0,009	23,730	0,469	34,870	0,065	0,181	0,345	873,287	0,486	0,350	0,077
CH	2000	0,008	20,790	0,478	35,880	0,077	0,209	0,356	959,372	0,486	0,344	0,085
CH	2001	0,007	22,240	0,484	37,090	0,100	0,204	0,363	1053,108	0,486	0,364	0,083
CH	2002	0,007	24,900	0,490	38,430	0,128	0,226	0,394	1148,508	0,486	0,371	0,091
CH	2003	0,006	27,730	0,490	39,780	0,156	0,268	0,402	1288,643	0,486	0,406	0,100
CH	2004	0,006	28,800	0,506	41,140	0,179	0,309	0,409	1508,668	0,486	0,429	0,101
CH	2005	0,006	30,200	0,523	42,520	0,193	0,338	0,419	1753,418	0,486	0,414	0,114
CH	2006	0,006	33,010	0,539	43,870	0,205	0,359	0,421	2099,229	0,486	0,409	0,127
CH	2007	0,005	34,570	0,558	45,200	0,208	0,354	0,424	2695,366	0,486	0,415	0,142
CH	2008	0,005	36,410	0,569	46,540	0,209	0,326	0,424	3471,248	0,485	0,433	0,097
CH	2009	0,005	36,930	0,582	47,880	0,225	0,246	0,423	3838,434	0,485	0,464	0,094
CH	2010	0,005	36,810	0,628	49,230	0,240	0,271	0,426	4560,513	0,485	0,476	0,106

CH	2011	0,005	35,760	0,667	50,570	0,249	0,266	0,429	5633,796	0,485	0,477	0,095
CH	2012	0,005	37,780	0,665	51,890	0,272	0,254	0,415	6337,883	0,485	0,472	0,079
CH	2013	0,005	39,840	0,666	53,170	0,302	0,244	0,421	7077,771	0,485	0,474	0,078
CH	2014	0,005	39,720	0,667	54,410	0,394	0,236	0,413	7683,503	0,485	0,470	0,073
CH	2015	0,005	39,300	0,674	55,610	0,434	0,216	0,414	8069,213	0,485	0,454	0,069
RU	1995	0,000	16,200	0,526	73,370	0,431	0,284	0,424	2665,740	0,531	0,254	-0,041
RU	1996	-0,001	20,400	0,544	73,370	0,447	0,242	0,483	2643,898	0,531	0,237	-0,036
RU	1997	-0,002	15,300	0,596	73,360	0,462	0,229	0,452	2737,557	0,531	0,220	0,014
RU	1998	-0,002	6,100	0,624	73,360	0,484	0,277	0,432	1834,847	0,531	0,150	-0,053
RU	1999	-0,003	-2,300	0,657	73,350	0,519	0,400	0,460	1330,751	0,532	0,148	0,064
RU	2000	-0,004	5,400	0,646	73,350	0,558	0,413	0,482	1771,587	0,532	0,187	0,100
RU	2001	-0,004	7,500	0,667	73,350	0,616	0,346	0,495	2100,362	0,532	0,219	0,051
RU	2002	-0,005	10,880	0,643	73,340	0,669	0,326	0,479	2375,059	0,533	0,201	0,047
RU	2003	-0,005	12,560	0,667	73,370	0,707	0,328	0,482	2975,133	0,534	0,209	0,073
RU	2004	-0,004	11,040	0,670	73,420	0,706	0,319	0,482	4102,372	0,534	0,209	0,072
RU	2005	-0,004	10,490	0,657	73,460	0,726	0,326	0,474	5323,474	0,535	0,201	0,064
RU	2006	-0,003	10,230	0,638	73,510	0,728	0,314	0,492	6920,194	0,535	0,212	0,082
RU	2007	-0,002	9,440	0,639	73,550	0,741	0,280	0,490	9101,253	0,536	0,242	0,085
RU	2008	0,000	5,460	0,664	73,600	0,750	0,291	0,521	11635,260	0,536	0,255	0,052
RU	2009	0,000	13,050	0,629	73,640	0,754	0,258	0,497	8562,810	0,536	0,189	-0,078
RU	2011	0,001	9,970	0,683	73,730	0,765	0,280	0,481	14351,212	0,536	0,244	0,053
RU	2012	0,002	9,230	0,679	73,790	0,761	0,270	0,455	15434,575	0,536	0,245	0,037
RU	2013	0,002	9,250	0,679	73,850	0,780	0,258	0,473	16007,090	0,536	0,231	0,018
RU	2014	0,002	6,150	0,685	73,920	0,787	0,271	0,457	14348,960	0,536	0,222	0,007
RU	2015	0,002	13,730	0,713	74,010	0,804	0,289	0,455	9478,791	0,535	0,224	-0,028