Master's Thesis

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Contrasting Views behind the Iron Curtain

Effect of Income Inequality on Economic Growth in Transition Economies

Abstract

In this research I try to find the effect of income inequality on economic growth in transition economies from Central Eastern Europe (CEE) and the Commonwealth of Independent States (CIS). After dealing with the problem of endogeneity of a lagged dependent variable, I find a positive effect of income inequality on economic growth in transition economies in the first twenty years after the start of their transition. I have also found that some factors have a positive contribution to this effect (like the Liberalization Index) while others have a negative contribution (like enrolment ratios of secondary and tertiary schooling).

Acknowledgements

I would like to start my acknowledgements by thanking Martin Bøg for his patience and time while supervising me, especially while struggling with the methodological part of my thesis. Secondly, I would like to thank my love, Nora, for her belief in me, my parents for their endless support (and the occasional study-promoting harassment), my closest friends for their cynical but loving encouragements, and my brother Geert and sister Bente for being who they are. Last, but certainly not least, I would like to thank Joost Bout for working together all those hours on the 3rd floor of the H-building on the EUR campus and keeping my mind fresh by offering me all kinds of challenges.

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1. Introduction

With the declining economy, the war in Afghanistan and other events that caused criticism on the Soviet government, like the nuclear disaster in Chernobyl, the growing unrest and discontent with the centralized government under the Soviet population caused Mikhail Gorbachev to implement his glasnost and perestroika reforms during the 1980s. These reforms were the beginning of the end of the Soviet Union and consequently the fall of the Iron Curtain and the liberalization of all member states of the Soviet Union and countries behind the Iron Curtain between 1989 and 1991.

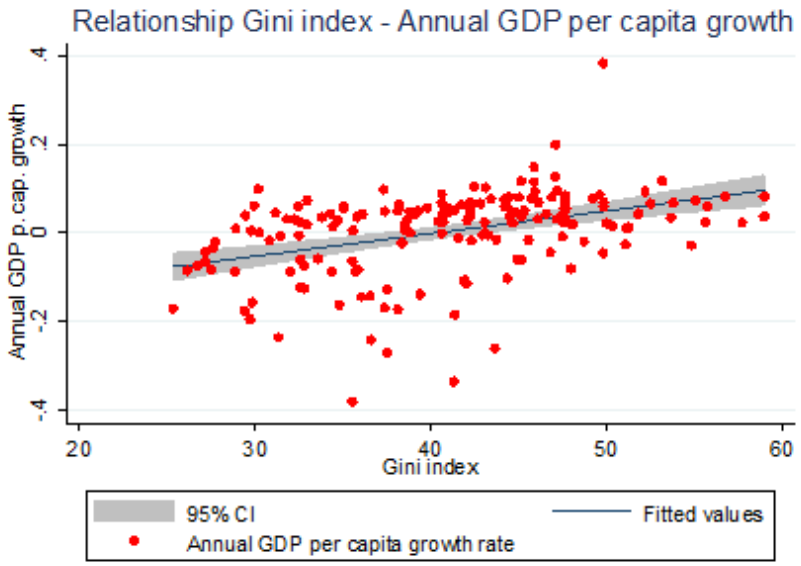
The disestablishment of the Soviet Union meant that all former member states and other countries that were imposed to a centrally planned economy behind the Iron Curtain, made a transition from a centrally planned economy to a free-market economy almost overnight. Before this transition, the former communist countries shared the same initial social characteristics like healthcare, education, political system and social security, but also the same economical characteristics like GDP growth and income inequality. After this change of political system and economic policy, both these types of characteristics changed so rapidly that it was almost unheard of in history. The income inequality rapidly increased (Milanovic, 1999), and in the first three years of transition GDP growth declined significantly into a post-communism depression (see graphs 1 and 2 in the appendix). But what effects did this sudden increase in inequality have on the economic development of the economies of the former communist countries in subsequent years?

The effect of inequality on growth has been the subject of many studies so far, but with mixed outcomes. These different outcomes can be attributed to the use of different data and variables, but also the selection of countries included in the research (Sukiassyan, 2007). Some argue that increasing income inequality has a positive effect on GDP growth (Li and Zou, 1998, Forbes, 2000), while others find a negative effect (Persson and Tabellini, 1994, Perotti, 1996, Sukiassyan, 2007). Barro (2000) found evidence that there is a different effect for the rich (positive) and poor (negative) income groups within countries. These studies and their methodology and outcomes will be elaborated on in later chapters in this thesis. But apart from Sukiassyan (2007), most researches largely neglected the Central and Eastern European (CEE) countries and the Commonwealth of Independent States (CIS), mainly because of a lack of quality data. Most of the researches used the Deininger and Squire database (1996), but this database only had data on Poland, Bulgaria and Hungary.

Sukiassyan (2007) addressed this neglect and performed a research on the effect of inequality on growth and named three main reasons why it would be interesting to perform a research of the effect of inequality on growth for these transition economies:

1. All countries started their transition at the same time, with largely the same initial characteristics (low inequality, similar levels of GDP and GDP growth rates)
2. All countries shared similar transition objectives, but the speed of implementation differed creating substantial differences in growth rates
3. International cross-section studies suffer from measurement error and an omitted variable bias. Focusing on countries which share similar measurement standards and rules deals with the problem of measurement error. Use of various databases with data from different features (macro, financial, social and political) handles the problem of the omitted variable bias problem.

If we have a look at the graph of the relationship that I am investigating, we can get an idea of what to expect from the results. Shown below is a scatter plot plotting income inequality (Gini index, see chapter 3.1 Data) against economic growth (yearly growth rate of GDP per capita). It is clear to see an upward sloping line, indicating a positive relationship between income inequality and growth. It does not yet tell us which causes what, and if the relationship will also hold empirically, so I will have to perform estimations on the data to establish a more detailed view of the effect.



Graph 1: Relationship between income inequality and economic growth

In this thesis, we will first see where this research stands in economic studies by having a look at the theory involved. Secondly, I will discuss previous researches and comment on the causes of the different outcomes, as well theoretically as methodologically. Then I will discuss the empirical results, covering the data used in this research, which estimation methods were used in previous research, which estimation methods I used in this research to analyze this data and finally I will discuss the regression results and draw final conclusions.

The results indicate a positive relationship of income inequality on economic growth, contradicting the results found earlier by Sukiassyan (2007). I have also found that some factors have a positive contribution to this effect (like the Liberalization Index) while others have a negative contribution (like enrolment ratios of secondary and tertiary schooling).

2. Theoretical Framework

In this thesis, I try to measure and explain the effect of inequality on economic growth in the first twenty years in transition economies. But before we start with the empirical part, we first have to have a full understanding of the dynamics of economic growth. Then I will introduce the variable inequality into the picture, and where this fits in the growth theories. Finally we will have a look at previously conducted researches on this topic, and discuss the differences in outcomes.

2.1 Growth Models

Ever since Adam Smith wrote his thoughts on growth in his historical book 18th century book "An Inquiry into the Nature and Causes of the Wealth of Nations", economists have tried to capture the causes and dynamics of economic growth in theoretical models. Adam Smith was the first to contribute to a growth theory, which was later on called the Classical Growth Theory. This theory was that, although Smith thought agriculture to be important, economic growth was primarily dependent of the productive capacity. The Classical Growth Theory was based on the idea that if you increase the capital stock, consequently economic growth would increase. David Ricardo added to this theory by stressing the importance of trade as accelerator for the economy. In his "On the Principles of Political Economy and Taxation" (1817) he argued that comparative cost differences promote trade and which would be a strong argumentation for promoters of free trade as an essential component of economic growth.

Of course, this first growth theory was extremely limited, taking only capital accumulation and trade into account. Robert Solow (1956) and Trevor Swan (1956) were the first economists who managed to create a theoretical model (later referred to as the Solow-Swan Growth Model, the Exogenous Growth Model of the Neoclassical Growth Model), which was a collection of contributions from other authors on the topic. They molded the factors influencing economic growth mentioned in these contributions into one model. This model consists of several equations indicating the relationship between labor-time, capital goods, output, investments and economic growth in the long run. The model also stressed the importance of technological progress to increase growth, which Solow and Swan held in even higher regard than capital accumulation. The main assumption of this neoclassical

growth model is that capital is subject to diminishing returns. Given this assumption, the model makes three predictions:

- Increasing the capital-labor ratio increases economic growth, since then more capital is available per worker so the worker can be more productive.
- Less developed countries with less capital stock will tend to grow faster, since an investment in capital will produce a higher return than that same investment in a country with a lot of capital stock.
- Economies will at a certain point reach a “steady state”. This is the point when, because of the diminishing returns on capital, investments in capital will no longer make the economy grow because the accumulation of capital is only enough to compensate for the depreciation of “old” capital.

Solow and Swan argue that this steady state can be overcome by countries, by focusing on technological progress. Increasing technology will make a given amount of production factors more productive, which in its turn stimulates investments in capital and subsequently stimulates growth. But a point of criticism on this model is that this technology parameter in the model is given exogenously, so it does not tell us where this technological progress comes from or why it occurs. This is why, unsatisfied with the exogenous approach of the neoclassical growth model, economists worked towards the next step in growth theories, the Endogenous Growth Model.

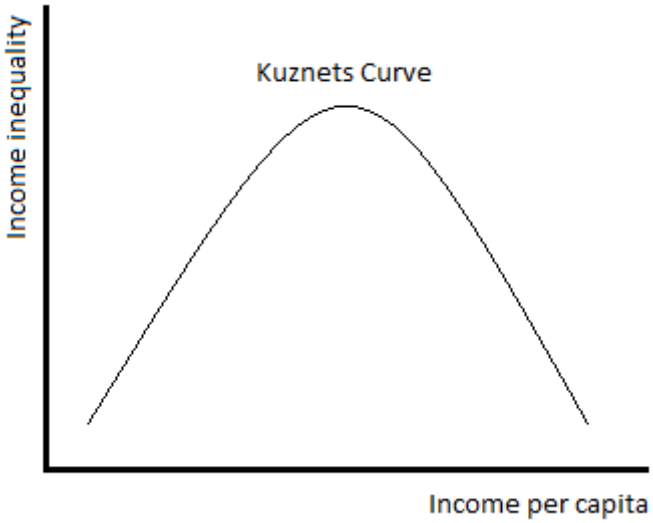
The Endogenous Growth Model was mainly developed by Paul Romer (1986-1994), Robert Lucas Jr. (1988) and Aghion and Howitt (1990-1998). The thoughts behind the model were that economic growth can be explained endogenously from an economical system, as a direct result of internal processes, and not the result of economic forces from the outside. The model assumed people to maximize their utility and introduces human capital into the equation. Investing in human capital increases technological progress. This increase in technology makes production more efficient and effective, which makes technological progress in the model endogenous. So as opposed to physical capital like in the neoclassical growth model, human capital has increasing rates of return. This way, the economy never reaches a steady state and capital can continue to accumulate, but the rate of growth is dependent of which type of capital a country invests in. The main critique on this model however, was that the Endogenous Growth Model did not match the empirical evidence very well (Jones, 1995) and that it was based mainly on empirics from developed countries in

one century (Galor and Weil, 2000). They claimed that the model was unfit to explain the different growth dynamics of less-developed countries.

Economists are still working on theoretical growth models, trying to fine-tune them and make them as robust as possible. Galor and Weil (2000) for instance, created a Unified Growth Theory, where they tried to combine various endogenous growth theories into one that is consistent over the entire process of development.

2.2 Effect of Inequality on Economic Growth: Kuznets' Hypothesis

Now that we have an understanding of what factors economists think drive economic growth, let's have a look at where inequality fits in this picture. The relationship between income inequality and economic growth has been subject to many researches so far, starting from 1955 when Kuznets constructed a hypothesis of the relationship between inequality and economic growth. He thought that the relationship between inequality and growth could graphically be represented by an inverted u-shaped curve, later referred to as the Kuznets Curve (see graph 2). His hypothesis stated that as countries develop, income inequality increases over time until a certain average income is attained. After this point, income inequality decreases again.



Graph 2: Kuznets Curve

His hypothesis was based mainly on inter-sectoral migration; that inequality should necessarily increase during the early stages of development from a more agriculture-focused economy to a more industry-focused economy, due to urbanization and industrialization and decrease later on as industries demanded additional labor, which was found in the rural labor force. Some later studies have either supported or denied this hypothesis, so it will be interesting to see if there is evidence of this Kuznets Curve in my results.

2.3 Previous Research on Effect of Inequality on Growth

This section covers previously conducted researches on the effect of inequality on economic growth, and discusses the differences in outcomes, econometrically as well as theoretically.

2.3.1 Econometric Differences

Since Kuznets' study, negative as well as positive effects of income inequality on growth have been found. According to De Dominicis et.al (2008), there are four econometric factors where the differences in results can largely be attributed to:

1. Differences in the sorts of data used to measure inequality
2. The time span of the data
3. Sample coverage (country selection)
4. Estimation methods

Some measurements of income inequality used in studies are the shares of income of particular quintiles, like the bottom or top 20 percent, and the ratio of incomes of different groups. However, the most commonly used variable to measure income inequality is the Gini index. This variable was included in the Deininger and Squire dataset (1996), which because of its comprehensiveness, was used by many researchers to investigate the effect of income inequality on growth. I will elaborate on the Gini index in chapter 3.1. Although differences in outcomes between studies can be attributed to the different variables used to measure income inequality, some studies report high correlations between all measures of income inequality (Clarke, 1995).

The time span of the data and the sample coverage are two other factors that attribute to the different outcomes in studies on the effect of income inequality on economic growth.

For instance, Kuznets' (1955) empirical findings were from longitudinal data from the first half of the nineteenth century from only three developed countries (the U.S.A., Germany and England), while when developing countries were included in the sample, evidence for a Kuznets Curve disappeared (Deininger and Squire, 1997).

But even when all three of the conditions mentioned above are the same in different researches, the outcomes can still vary due to the use of different estimation methods. We will have a more detailed look at the methodological differences in chapter 3.2.

2.3.2 Theoretical Differences

But the differences in the outcomes of different studies are not only due to the fact that authors use different estimation methods, but also because of differences on their views on how to measure inequality, which is often supported by a theoretical background. For instance, Alesina and Rodrik (1994) and Deininger and Squire (1998) show that the negative impact of land inequality on growth is more robust than that of income inequality. Castelló-Climent (2004) finds that a positive effect of income inequality remains robust when controlling for a self-constructed Gini index for human capital to measure educational inequality, while the effect of human capital inequality on economic growth remains negative. Some studies used wealth inequality as a determinant for inequality. According to Aghion et al. (1999), the results were often that wealth inequality has a positive effect on growth because:

1. The rich are more likely to save more than the poor (marginal propensity to save). If the savings rate and investment rate, and the investment rate and growth rate are both positively correlated, inequality is an incentive for an economy to grow faster.
2. Concentrated wealth is essential for creating new economic activities, with investment indivisibilities and large sunk costs present.
3. The third and last reason Aghion et al. name is the trade-off between equity and efficiency. The more equal the wealth is distributed among the workers and output depends on their work effort, the less incentive they have to make additional efforts in their work and thus reduce the efficiency of the production system.

Perotti (1996) measures inequality through the distribution of income and investigated four different channels from theoretical contributions that explain why income inequality should have a negative impact on economic growth:

1. The endogenous fiscal policy approach: government interventions cause distortions. If inequality increases, governments will redistribute income. This will cause a decline of capital investments and thus cause economic growth to decline (Persson and Tabellini, 1994 and Alesina and Rodrik, 1994).
2. The socio-political instability approach: an unequal distribution of resources induces people to resort to unwanted social behavior (such as crime, protests and revolutions). This behavior discourages investments and capital accumulation because potential investors distrust the economic system. This decline in investments slows economic growth in the long run (Alesina and Perotti, 1996).
3. The borrowing and investment in education approach: this approach focuses on the effect of inequality on the ability of agents to accumulate physical and human capital. Aghion et al. (1999) and Galor and Zeira (1993) found that if there are credit market imperfections and an unequal distribution of resources, it is harder for the people with a lower initial endowment of resources to invest in human capital. Consequently, this has a negative impact on economic growth.
4. The joint education/fertility approach: as we have seen at point 3, investment on education has a positive effect on economic growth, while societies with high fertility rates often show low economic growth rates. Galor and Zang (1997) show that, given a distribution of income, a high fertility rate means families have less to invest in education. They also show that the higher the inequality in a society, the higher the fertility rate, the lower the investments in education and consequently the lower the economic growth.

More recently, Galor and Moav (2004) constructed a theory in which they imply that the distribution of income and growth depend on the stage of development of a country and are not stable over time. They argue that in early stages of economic development or industrialization of a country, there is a positive impact of inequality on growth, because in this phase the accumulation of physical capital is the accelerator of growth and this accumulation increases when differences in assets and income are larger. After these early stages, it is no longer the accumulation of physical capital that accelerates growth, but the accumulation of human capital. As we have seen earlier (point 3 of Perotti's reasons why

inequality has a negative impact of growth), a more egalitarian distribution of income and assets stimulates investment in education, given the presence of credit market imperfections. In this phase, government policies will have to be directed towards reducing inequality. This is an explanation towards support for Kuznets' hypothesis.

As we can see from earlier studies, not only do they find contrasting empirical findings, but the researchers also do not yet agree on the theory behind the different outcomes.

2.4 Previous Research on Effect of Inequality on Growth in Transition Economies

Some studies on the effect of inequality on growth have been conducted specifically for transition economies. The first few years after the transition, real GDP declined in almost all of the transition economies, but the rate in which these economies recovered differed greatly (Sukiassyan, 2007). According to Sukiassyan, this was due to differences in:

- Initial conditions
- External factors
- Speed of liberalization
- Market reform strategies

The influence of these factors on the success of the transitions has been confirmed by other studies. For instance, Fischer and Sahay (2000) and Havrylyshyn et al. (1999) attribute the difference in success between transition economies to the effectiveness of stabilization and structural reforms. They also found that the speed in which these reforms were executed, the faster the transition economies recovered and subsequent growth increased. This was confirmed by Coricelli (1998), who found that if the speed of policy reforms were reduced, inequality would decrease. But because the speed of policy reforms decreased, the reforms stagnated causing less subsequent growth. Coricelli also found evidence for a Kuznets curve, showing empirical evidence where inequality rose in the first few years after transition. Berg et al. (1999) concluded that these structural reforms were more important in explaining the cross-country differences in success of transition than the initial conditions of a transition economy and macroeconomic variables. Some other studies state that the speed of transition, through the effectiveness of the speed of liberalization and market reform strategies, are being constrained by fiscal policies (Dewatripont and Roland, 1995 and

Chadha and Coricelli, 1997). On the one hand, countries that imposed a big-bang strategy temporarily increased inequality, but this increase in inequality was soon succeeded by increasing economic growth. But on the other hand, using a more gradual approach to economic transition is easier to implement and has a larger chance of attracting investments in the early phases of transition. Another important aspect of the success of a transition is the speed and efficiency of bank privatization. Bonin et al. (2004) show that the banks that were privatized early are more efficient than banks that have been privatized later on in the transition.

De Melo et al. (1997) showed that not just initial conditions or economic policy cause the differences in performance in transition economies, but that these are jointly responsible for these differences. They also found that the effect of the initial conditions reduced over time during the transition. Their main finding, however, was that not so much the speed of reforms that determined the rate of success of a transition, but achieving macroeconomic stability and allocating factors of production to their optimal and most efficient use.

But opposed to the previously discussed literature, Godoy and Stiglitz (2004) found a negative effect of the speed of liberalization and privatization on economic growth. They addressed three issues that they believed the earlier studies lacked:

- They did not adequately treat the endogeneity problems
- The earlier studies confused of speed and level of privatization
- They did not sufficiently cope with problems of multicollinearity

Their other results also did not match the earlier studies. For instance, they found the initial conditions to have an insignificant effect on cross-sectional growth. According to them, this insignificance can be explained by their use of more recent data and thus longer time series.

As far as this research is concerned, it will be interesting to see what effect inequality has on economic growth in the data and setup used and what effect liberalization and macroeconomic factors will have on the effect of inequality on subsequent growth. Previous research has shown spurious results so far, so using the correct methodology and other sources of data and more recent data should help to identify the correct relationships.

3. Empirical Results

In this part I will discuss the empirical results from this research. First I will elaborate on the data used in the regressions. Then I will discuss the methodology other authors used and which methodology we applied to the data. Finally, we will see what the results from the regressions look like.

3.1 Data

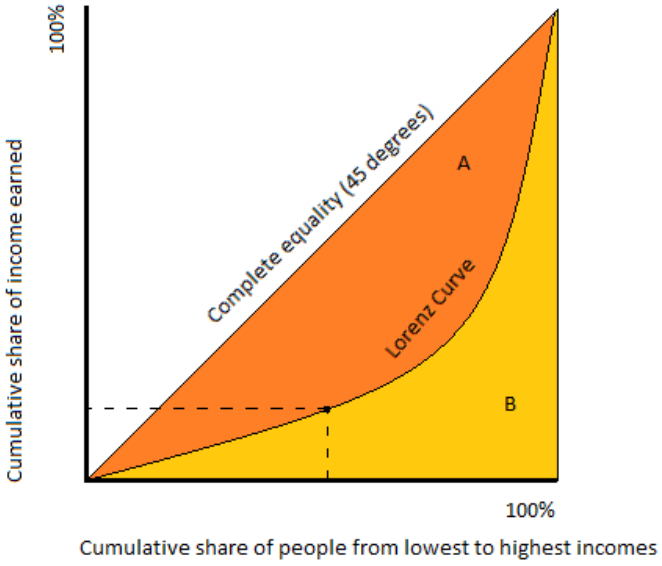
This section is about the data used in this research. It also gives an overview of which variables have been used in this research and which databases they were taken from.

The dataset covers the period from 1988 until 2009 for Central Eastern Europe (CEE) and the Commonwealth of Independent States (CIS), in total consisting of 28 countries. The tables containing the descriptive statistics can be found in the appendix, the list of countries can be found in graph 1 of the appendix. The year 2010 has been excluded from the regressions because the recent economic crisis would have influenced the data too much and the effect was not relevant for this particular research.

To measure economic growth, I constructed a variable by taking the data for the Gross Domestic Product per capita (constant US Dollars) and taking the logarithm of the average annual GDP per capita growth in the past three years, $\frac{\ln\left(\frac{Y_{t+3}}{Y_t}\right)}{3}$. From here on, I will simply refer to this dependent variable as the annual GDP per capita growth rate. The GDP per capita data has been taken from the Penn World Tables 7.0 from the Center for International Comparisons at the University of Pennsylvania (CICUP) and the TransMONEE 2011 Database from UNICEF.

The variable used to measure income inequality is the Gini index. The Gini index is a value between 0 and 1, 0 meaning the income distribution is completely equal and 1 meaning only one person in the country earns all the money and the rest of the population earns nothing. This value is calculated by looking at the graphical analysis of income distribution in a certain country, as showed in graph 3 on the next page. The 45-degree line is the situation where everybody in the country earns the same amount of money, so there the Gini index would be 0 and the far southeast corner of area B is the situation where one person earns all the

money and the rest of the population of the country earn nothing, so the Gini index there would be 1. Both situations are not very likely in real life. The Lorenz Curve depicted in the graph, is the situation between Gini values of 0 and 1. For instance, the point drawn on the Lorenz Curve below indicates that a cumulative proportion of roughly fifty percent of the population earns a cumulative proportion of the income in that country of roughly 10 percent. The Gini index is the ratio between area A (the area between the 45-degree line and the Lorenz Curve) and the total area under the 45-degree line, so A+B.



Graph 3: The Lorenz Curve

The Gini indices data have been taken from the World Bank World Development Indicators Database (WDI), the World Income Inequality Database from the United Nations University (WIID) and the Standardized World Income Inequality Database (SWIID) from F. Solt (2009). The SWIID is a standardized version of the WIID. Solt argues that the broadness of the dataset of the WIID hinders the comparability across nations. He constructed a missing-data algorithm to standardize the database to optimize comparability across nations. Within the SWIID, there are two types of Gini indices available, the net and the gross Gini index. The gross Gini index should be the better fit for this research, since this measures inequality before the local government imposed its income redistributive measures.

Because different countries began the transition at different times, it is important to find variables that indicate the measure in which a countries economy is liberalized. For this purpose, De Melo et al. (1996) used data from the European Bank for Reconstruction and Development (EBRD) to construct a so called Liberalization Index (LI). This Liberalization Index consists of three different liberalization indicators: the Internal Liberalization Index (LII) which measures to which extent the internal market is liberalized, the External Liberalization Index (LIE) which shows the status of liberalization of access to external markets, and the Private Sector Conditions Index (LIP) which indicates how the liberalization for privately owned firms evolves. Each of these indices consists of a weighted average of a few variables related to their respective sectors. The variables used to construct each index from the EBRD, range between 1 and 4.33, where 1 represents little or no change from a rigid centrally planned economy and 4.33 represents the standards of an industrialized market economy. Consequently, all the liberalization indices also range between 1 and 4.33. The openness of the transition economies is not only measured by looking at the External Liberalization Index, but also by looking at the openness of the economy by measuring the trade volume as a percentage of the GDP (WDI).

Other control variables used in the regressions are identical to the control variables that are most commonly used in previously conducted researches on this subject. Firstly the population increase rate, the crude birth rate (live births per 1000 population), and the total fertility rate (live births per woman aged 15-49), which have all been retrieved from the TransMONEE 2011 Database. These variables should give an insight in the social impact that the changes in GDP growth and income inequality could have (Galor and Zang, 1997). Two control variables that are used to measure human capital accumulation, are the secondary and tertiary school enrolment ratios (UNESCO Institute for Statistics). According to Moock et al. (1998), the transition from a planned to a market economy has a strong impact on the returns to education. Data on the unemployment rates was taken from three different databases, the IMF World Economic Outlook Databases (WEO), WDI and TransMONEE 2011. According to Kuznets (1955) and Sukiassyan (2007), the economic development from a more agricultural economy to a more industrialized economy has an impact on income inequality. Adding the share of agriculture as a percentage of the GDP per country (EBRD) should prove a good indicator of the progress of economic development of an economy. A variable for inflation was constructed by calculating the annual percentage changes of the Consumer Price Indices taken from the WDI database.

3.2 Methodology

In this part, I will discuss the methodology most commonly used in researches of the effect of inequality on economic growth and which methodology I applied to the data.

3.2.1 Methodology of previous Researches

The most commonly used estimation method is assuming a simple linear relationship, and regressing the logarithmic difference of gross domestic product per capita in a certain time period, on a number on explanatory variables, including one for income inequality. The OLS (Ordinary Least Squares) equation is shown below, where the dependent variable is the annual growth of real GDP per capita y_t of all countries at time t, g a measure of income inequality, X a collection of explanatory variables including a constant and ε the classic error term.

$$y_t = \alpha_0 y_{t-1} + \alpha_1 g_t + \beta X_t + \varepsilon_t \quad (1)$$

This estimation method is used in various cross-country regressions (ex. Alesina and Rodrik, 1994, Persson and Tabellini, 1994, Clarke, 1995 and Deininger and Squire, 1998) very often with the same outcome, which is a negative effect of inequality on growth. The main critique to this kind of estimation method is the problem of a bias due to omitted variables. Many unobservable factors such as climate, technology, institutions and other country-specific variables could also potentially have an effect on the economic growth, but are not taken into account in the model and are absorbed by the error term.

To counter this problem of the bias of omitted variables, one can control for those factors using a fixed or random effects model. Using such a model results in a modified panel data version of the equation above, where ξ_t is a time-specific fixed effect, v_i captures the characteristics of a country assumed to be constant over time and $\varepsilon_{i,t}$ captures the rest of the error which varies over time and countries.

$$y_{i,t} = \alpha_0 y_{i,t-1} + \alpha_1 g_{i,t} + \beta X_{i,t} + \xi_t + v_i + \varepsilon_{i,t} \quad (2)$$

Choosing between different techniques to estimate this equation depends on assumptions about the correlation of the error term with the explanatory variables. Estimating this panel data equation can be done using the fixed and random effects model. Both the random and fixed effect model contain a lagged regressor in equation (2), which undermines the

assumption that the explanatory variables have to be strictly exogenous. Most of the studies estimating such panel data use the fixed effects model instead of the random effects model, because the random effects model requires v_i to be distributed independently of the explanatory variables. This is not the case in the equation (2), because $\ln y_{i,t}$ is dependent of v_i. On the other hand, the fixed effects model does allow this correlation between the unobserved individual effects and the conditioning variables. However, the fixed effects model also has its problems. Temple (1999) mentions some of these problems using the fixed effects model. He argues that too often studies use the fixed effects model to analyze the effect of variables that are fairly constant over time, or that effect growth only in the long run. Using the fixed effects model can also lead to misleading results when the variation is cross-sectional, which is the case with a variable like income inequality.

Because of all the econometric problems mentioned above, many studies used the GMM (Generalized Method of Moments) estimator developed by Arellano and Bond (1991). This estimator first-differences all the variables to eliminate the country-specific effects and then uses all the lagged values of the explanatory variables as instruments to counter the problem of the endogenous explanatory variables. However, this estimation method is also not without its flaws. The lagged explanatory variable does not often perform very well when the other variables are very persistent, because then the lagged levels are not very strong instruments for first differences. To counter this problem, Arellano and Bover (1995) and Blundell and Bond (1998) proposed a system GMM estimator, which combines an estimation in levels with an estimation in first-differences in a system of equations. In this system GMM, lagged levels are used as instruments for first-differences, and vice versa.

Besides these linear relationships, some authors claim that the functional form of the effect of inequality on growth might be a non-linear one (Banerjee and Duflo, 2003). They found that a change in income inequality in any direction has a negative effect on economic growth.

3.2.2 Methodology of this Research

This section describes how the data was manipulated and which estimation methods were used to analyze the collected data.

Firstly, all variables, except for the dependent variable "annual GDP per capita growth rate", were lagged three years to counter any problems with reverse causality. Reverse causality would mean that in the regression, not only the effect of inequality on growth would be measured, but also the effect of growth on inequality. In other words, cause and effect in reverse. The argument is that although current values of inequality might be endogenous to economic growth, it is unlikely that past values of inequality are predetermined. A problem with adding the lags is that there is no way of gauging empirically how serious the endogeneity problem is, and whether the solution of adding three-year lags is adequate to deal with it. Secondly, I chose three-year intervals for the dependent growth variable in order to increase the number of observations. Other authors like Barro (2000) and Sukiassyan (2007) typically use five-year intervals.

After the data was ready to use, the first estimation method applied was an OLS (Ordinary Least Squares). All performed regressions (including OLS with country dummies and GMM estimations) were also checked for robustness, including heteroskedasticity of variance. The regression equation is as follows:

$$y_{i,t} = \alpha_0 y_{i,t-1} + \alpha_1 GINI_{i,t} + \beta X_{i,t} + \mu_i + \varepsilon_{i,t} \quad (1)$$

Where the dependent variable is the annual GDP per capita growth rate $y_{i,t}$ of country i at time t. The first independent variable is the one-period lagged annual GDP per capita growth rate. This variable is added because you want to check for conversion by looking if the growth rate of this period is influenced by growth in previous period. $GINI$ is the measure of income inequality, the GINI index, for country i at time t, X is a collection of explanatory variables including a constant, μ are the unobserved country fixed effects and finally ε is the classic error term.

However, there are a number of problems with these OLS regressions. There is the omitted variable problem as I discussed in chapter 2 and the presence of country fixed effects. These two issues lead to the problem of endogeneity. Having omitted variables and country fixed effects, the error term absorbs most of the effects that have not been taken into account in the equation by variables that have not been used in the equation or by country-specific effects that influence the dependent variable (like geographical location, climate, etc.). For the omitted variable, this means that it is both correlated with an independent variable in the model and with the error term. So if we assumed the true model we should be

estimating to be $y_{i,t} = \alpha + \beta X_i + \gamma Z_i + v_{i,t}$, but omit variable Z_i, Z_i becomes absorbed by the error term. This way, we actually estimate $y_{i,t} = \alpha + \beta X_i + \varepsilon_{i,t}$, where:

$$\varepsilon_{i,t} = \gamma Z_i + v_{i,t} \quad (2)$$

If the correlation between X and Z is not 0 and Z separately affects y (meaning $\gamma \neq 0$), then X is correlated with the error term. The country fixed effects influence the error term in the same way, only then the error term includes the country fixed effects:

$$\varepsilon_{i,t} = \mu_i + v_{i,t} \quad (3)$$

We want to get rid of this endogeneity problem, and a proven method in OLS is using country dummies. Using country dummies counters the problem of country fixed effects because adding a dummy for each country absorbs the effects particular to each country. This would eliminate μ_i from equation (3). This method performs estimations on the deviations from individual country means. This works perfectly in an OLS without a lagged endogenous control variable or even in an OLS with a lagged endogenous variable with many time periods (Nickell, 1981). However, the regressions in this study do contain a lagged endogenous variable and there are not enough time periods available in the data to compensate for the presence of this lagged endogenous variable. This way, even when controlling with country dummies, the problem of endogeneity still persists.

The next step to counter this problem would be to look at first differences. However, looking at first differences with lagged variables does not eliminate the correlation of the endogenous control variable with the error term. One way to tackle this problem is using instrumental variables (IV). One of the estimation methods using IV is the two-stage least squares estimation (2SLS). In the first stage, each endogenous explanatory variable in the equation of interest is regressed on all of the exogenous variables in the model, including both exogenous instrumental variables in the equation of interest and the excluded instruments. The predicted values from these regressions are obtained. In the second stage, the regression of interest is estimated as usual, except that in this stage each endogenous explanatory variable is replaced with the predicted values from its first stage model from the first stage. This estimation method unfortunately yielded very poor results, probably due to specification problems. Also, the 2SLS estimation method can only use one IV at a time, so the suspicion of correlation between the lagged endogenous control variable and the error

term persists. Moreover, it transforms the error term so that it may no longer be spherical which influences the standard assumptions that need to be satisfied for OLS estimations.

To summarize using the paper by Mileva (2007), we have identified the following problems estimating the effect of inequality on economic growth:

1. The lagged annual GDP per capita growth rate control variable is assumed to be endogenous. This regressor may be correlated with the error term.

2. Time-invariant country characteristics (fixed effects), such as geography and demographics, may be correlated with the explanatory variables. The fixed effects are contained in the error term in equation (1), which consists of the unobserved country-specific effects μ_i, and the observation-specific errors $v_{i,t}$, like we have seen in equation (3).

3. The presence of the lagged dependent variable $y_{i,t-1}$ gives rise to the suspicion of autocorrelation.

4. The panel dataset has a short time dimension (T =20) and a larger country dimension (N =29).

According to Mileva (2007), all of these issues are reasons for using the Generalized Method of Moments (GMM), introduced in this setting by Arellano and Bond (1991). This estimation method needs a certain number of moment conditions are specified for the model. These moment conditions are functions of the model parameters and the data, such that their expectation is zero at the true values of the parameters. The GMM estimation method then minimizes a certain norm of the sample averages of the moment conditions. Like the 2SLS estimation method, GMM uses instruments to counter the problem of endogeneity. Here I instrument the lagged annual GDP per capita growth rate to tackle this issue and use all lags of the control variables as instruments, since they are not likely to be predetermined. The GMM estimation has as advantage over 2SLS that it not only looks at one moment differences, but differences across all moments. Instruments used have to be strictly exogenous and preferably highly correlated with the instrumented variable. This is tested with the Sargan-Hansen tests of over-identifying restrictions, which are based on the observation that the residuals should be uncorrelated with the set of exogenous variables if the instruments are truly exogenous. The number of instruments in theoretically infinite. However, if too many instruments are used (rule of thumb: keep the number of instruments equal or less then the number of groups (Mileva, 2007)), the endogenous variables can be

over-fitted by the instruments, failing to expunge their endogenous components and biasing estimations of coefficients, often leading to a type I error of falsely rejecting the null hypothesis (Roodman, 2008).

3.3 Results

In tables 1 to 3 shown below, and table 5 in the appendix, the results from the various regressions, as discussed in the methodology part, are shown. Apart from table 5 - the 2SLS estimations - all regressions perform relatively well, especially considering the limited amount of data. The OLS and OLS with country dummies show reasonable R-squares ranging from 0.3765 to 0.6055. From here on, I will not include the 2SLS estimation in the results section, since there is clearly a misspecification problem with those regressions.

OLS, dependent variable is annual GDP per capita growth rate

Regression	1	2	3	4	5
Lagged annual GDP per capita growth rate	0.4652744***	0.5094276***	0.3057681***	0.3734539***	0.3685589***
Gini index	0.0024015***	0.0018304***	0.0016044**	0.011412***	0.0088986***
Secondary Education		-0.0011837			
Tertiary Education		-0.000423	-0.0008797***		-0.0007369**
Liberalization index			0.0371805***	0.1593134***	0.1350755***
Gini*Liberalization index				-0.0033255***	-0.0025422***
No. observations	152	139	137	146	137
F-statistic of joint significance	24,75	11,39	16,42	21.81	17.71
R-squared	0,4127	0.4299	0,5264	0.5269	0.5569
***significant at the 1% level, **significant at the 5% level, *significant at the 10% level					

Table 1: OLS results

The first table showing the results from the OLS regressions shows a positive, significant effect of income inequality on economic growth. The lagged growth rate is between 0 and 1, indicating that the growth rate is converging over time. The variables measuring education have a negative effect on economic growth, although not significant in the second regression. The Liberalization Index has a positive, significant effect on economic growth, while the interaction effect between the Gini index and the Liberalization Index has a negative, significant effect on economic growth. In table 2, country dummies are included in the OLS regression. This way we can see if the results remain consistent among different estimation methods.

OLS with country dummies, dependent variable is annual GDP per capita growth rate

Regression	1	2	3	4	5
Lagged annual GDP per capita growth rate	0.3906268***	0.4410243***	0.0483928	0.1897102***	0.116094
Gini index	0.0056088***	0.0046277***	0.0007732	0.0087309***	0.0050309
Secondary Education		-0.0033263***			
Tertiary Education		-0.0007998	-0.0021041***		-0.002116
Liberalization index			0.0874162***	0.171302***	0.1525153**
Gini*Liberalization index				-0.0027771**	-0.0017126***
No. observations	152	139	137	146	137
F-statistic of joint significance	23,89	11,21	29,42	21.28	23.61
Adjusted R-squared	0,3765	0,4312	0,5995	0,5045	0,6055
***significant at the 1% level, **significant at the 5% level, *significant at the 10% level					

Table 2: OLS with country dummies results

Adding country dummies does not affect the signs of the different estimators, indicating the effects remain the same. The third and final table shows the results of the Arellano and Bond's first difference General Method of Moments (GMM) estimation, including time dummies.

Arellano and Bond's first difference General Method of Moments (GMM), dependent var. is annual GDP p. capita growth rate

Regression	1	2	3	4	5
Lagged annual GDP per capita growth rate	0.3512697***	0.180696	0.5273673**	0.3701616**	0.5196728
Gini index	0.0023052	-0.0088744	0.0041692	0.0555489**	0.047056**
Secondary Education		-0.0172066***			
Tertiary Education		0.0023804	-0.0022106		-0.0019938*
Liberalization index			-0.0757782	1.069294**	0.7312872*
Gini*Liberalization index				-0.020242**	-0.0154883*
No. observations	126	113	112	121	112
Arellano & Bond test for AR(1) Prob.	0,022	0,530	0,010	0,714	0,237
Arellano & Bond test for AR(2) Prob.	0,393	0,090	0,260	0,220	0,934
Sargan test of overidentifying restrictions Chi2	59.36***	8,63	42.85***	13.13	19.08**
Hansen test of overidentifying restrictions Chi2	17,95	9,42	16,50	10,61	15,03
***significant at the 1% level, **significant at the 5% level, *significant at the 10% level					
All regressions include time-specific dummies					

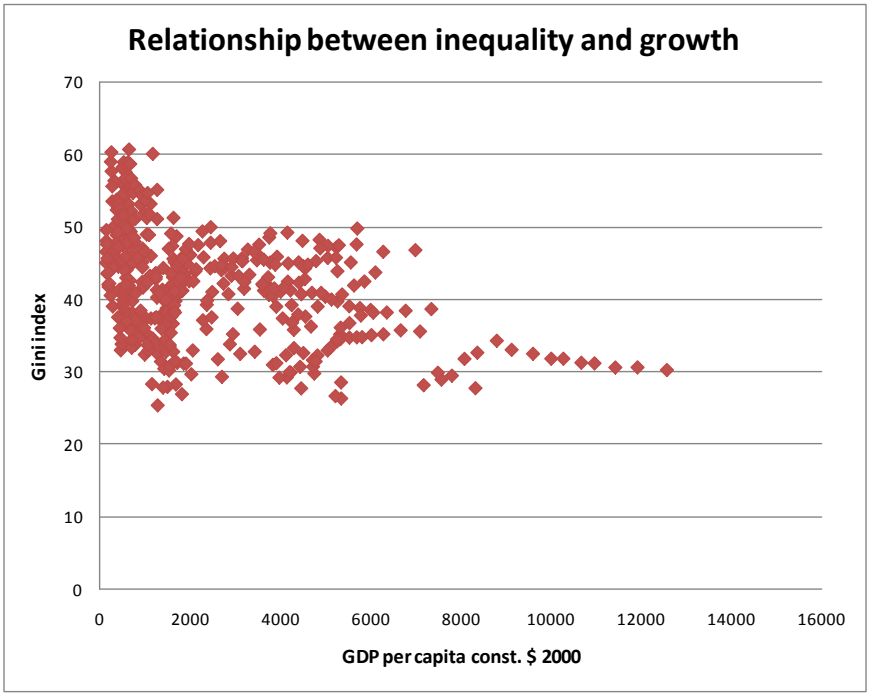
Table 3: GMM with time dummies results

These results support the results found in the other two estimation types, when significant. Now we will have a closer look at these outcomes and try to explain them using what we have learnt from the theory discussed in chapter 2.

The main effect I am interested in is the effect of income inequality on economic growth. Apart from one insignificant negative sign in the GMM estimations, all signs are positive even when controlling with various variables, confirming the relationship seen in graph 1 in the introduction. The magnitude of the effect differs slightly depending on the estimation method used and which control variables were included in the regression. Surprisingly, these results contradict the findings of Sukiassyan (2007). Although this is a surprising result, I can point out some reasons for the difference in outcomes. The differences could be due to the number of observations included in the regression due to country selection and that I use

more recent data then Sukiassyan (maximum 69 observations in Sukiassyans regressions, maximum 152 in my regressions), the number of lags used for the control variables (Sukiassyan used one-period lagged control variables, I used three lags) and the data used (Sukiassyan did not use the SWIID). This indicates that the data used matches the outcomes of studies that found a positive effect of inequality on growth, as discussed in the theory part of this thesis.

It is hard to tell if these results support or contradict Kuznets' hypothesis mentioned earlier in chapter 2, since we don't exactly know in what stage of economic development the transition economies are in. The graph shown below adds to this inconclusive outcome, showing signs of a regular u-shaped curve instead of an inverted u-shaped curve. Kuznets' hypothesis states that in the beginning of economic development, inequality will increase up to a certain point of average income, after which it will decrease again. A positive impact of income inequality on economic growth in the first stages of economic development could be an indication that a Kuznets Curve is forming. However, if the transition economies are is a more advanced stage of economic development, a positive impact then contradicts this hypothesis. The effect should be closely monitored in the coming periods, to see if the point of is being reached where the effect reverses, meaning economic growth should then have a detrimental effect on income inequality (Galor and Moav, 2004), or vice versa.



Graph 4: Relationship between inequality and growth

When checking for convergence effects using the lagged annual GDP per capita growth rate on the right hand side of the equation, $0 < \alpha < 1$ indicating that indeed there are signs of convergence and of a more stable economic growth over time. This means that the positive and negative growth peaks are declining over time.

The Liberalization Index performs well, having a positive effect on economic growth when significant. Of course this was to be expected, with increasing privatization, banking reforms, improved Trade and Forex system, etc. having a positive effect on economic growth. These findings imply that the more liberalized a country gets after the economic transition, the larger the increase in subsequent economic growth.

The indicators for human capital accumulation, the secondary and tertiary school enrolment ratios, show a negative effect on economic growth, indicating that higher enrolment ratios have a detrimental effect on economic growth in the transition period. Although this contradicts the endogenous growth theory discussed in the theory part, there is some logic behind these findings. The time span of this study is only twenty years. The effects of this human capital accumulation should be studied over a longer period of time to get an image of the net effect, since people that are still in school are not yet productive and the governmental educational expenditures don't show their return in the short run and are not used to stimulate growth in the short run (Aghion and Commander, 1999).

The interaction effect between income inequality and the Liberalization Index yielded a negative, significant effect. This implies that, even though independently both variables have a positive effect on economic growth, jointly they have a negative effect on growth. This means that if the government further liberalizes the economy when there is high inequality, this has a combined negative effect on economic growth. Cornia and Court (2001) argue that the liberalization of domestic banking and of international financial flows mainly benefit the high-wage financial sector, and that privatization causes uncertainty amongst lower-wage workers. This could cause an outflow of low-wage workers to other economies where they would face less uncertainty and higher wages which has a detrimental effect on economic growth.

Even though the effects are quite robust among all estimation methods, there seem to be a few problems with the results from the GMM estimations. Firstly, the AR(1) and AR(2) hypotheses are rejected in a few regressions, giving rise to the suspicion of presence of auto correlation. Secondly, the Sargan test of overidentifying restrictions is also rejected in a few

regressions, meaning the instruments used are not completely exogenous. However, the Hansen test of overidentifying restrictions is not rejected in any regression. This could be because the Sargan test is not distributed as chi-square under heteroskedasticity and the Hansen test is. This could cause Sargan to incorrectly reject the null-hypothesis.

4. Concluding remarks

All in all, I find a positive effect of income inequality on economic growth in transition economies in the first twenty years after the start of their economic transition from a centrally planned economy to a free market economy. I have also found that some factors have a positive contribution to this effect (like the Liberalization Index) while some have a negative contribution (like enrolment ratios of secondary and tertiary schooling). Through the theory, I have also found a number of reasons why there could be a positive effect of income inequality on growth, like the higher propensity to save by the rich than the poor, the theory that concentrated wealth is essential for creating new economic activities and that there could be a trade-off between equity and efficiency. These findings also support the theory by Galor and Moav (2004) mentioned in chapter 2.3.2, that the effect of income inequality on economic growth depends on the stage of development of the economy, and that in the first stages of economic development inequality can be an accelerator of economic growth.

As I have said before in the results part, these findings are reasonably robust among all used estimation methods and the problem of endogeneity is dealt with sufficiently. But the lack of truly exogenous instruments doesn't make the results one hundred percent reliable. Also, the number of observations is not as high as other non-transition researches in this field have. Most researches on the effect of income inequality on economic growth in transition economies deal with these topics and try to cope with them as well as possible. But as long as these problems persist, the results will be spurious, giving positive, negative and inconclusive empirical evidence on the effect. To truly measure the relationship between income inequality and growth in transition economies, we need to keep performing these types of studies, increasing the number of observations and improving the quality of the data as time passes by and the transition economies continue their development.

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Appendix

Table 4: Summary Statistics Variables

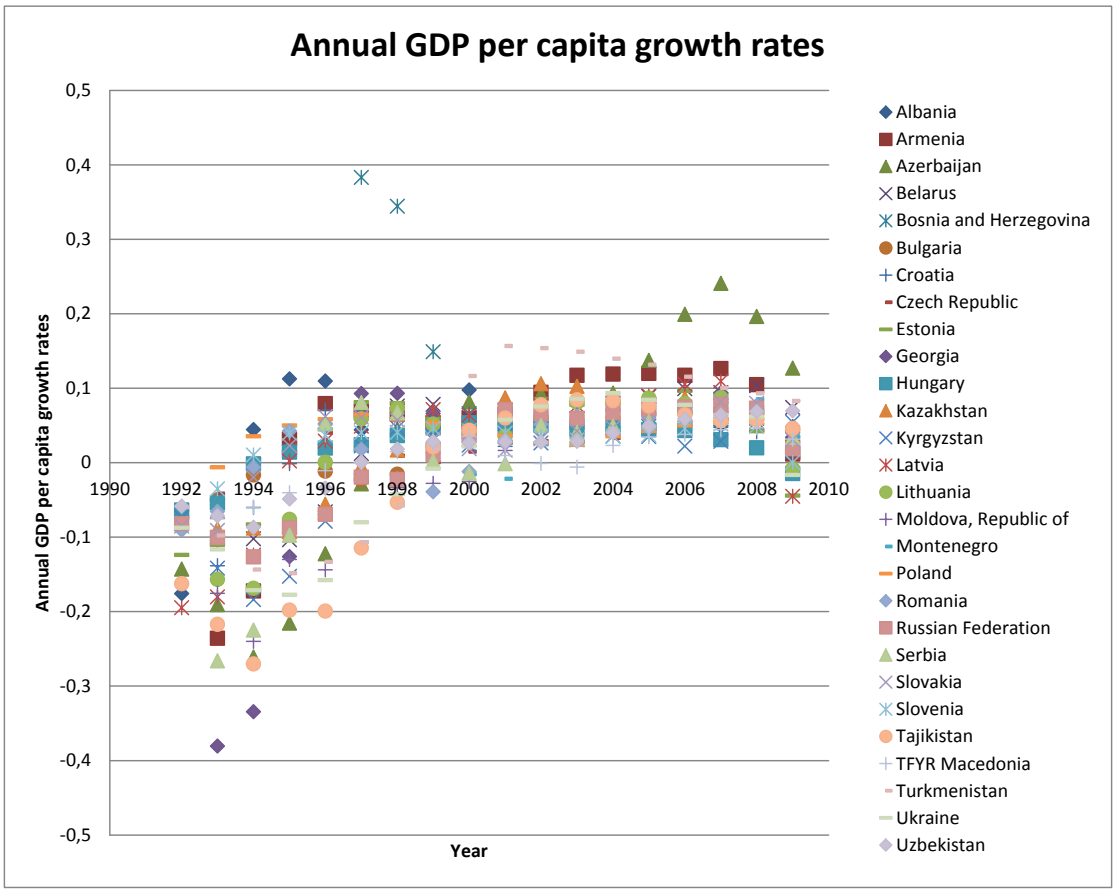
Name	Variable	Obs.no.	Mean	Std.Dev.	Min	Max
countrydummy	Country Dummy	203	15	8,387284	1	29
year	Year	203	2000	6,014833	1991	2009
ygrowthwpt	Annual GDP per capita growth PWT	154	0,0345724	0,0629626	-0,2693423	0,310798
ygrowthtm	Annual GDP per capita growth TM	191	0,0019854	0,0972244	-0,385013	0,3829581
giniwb	Gini index WB	155	30,82275	6,589881	19,4	53,7
giniwiid	Gini index WIID	172	32,47907	7,406195	19,4	54,3
giniswiid	Gini index SWIID	182	41,09629	7,60715	25,36826	58,98751
popincrrate	Population increase rate	187	0,0008942	0,017701	-0,154476	0,042686
crudebirthrate	Crude birth rate	187	14,70214	6,830938	7,7	39,1
totalfertilityrate	Total fertility rate	186	1,896559	0,7831848	1,09	5,08
logfertility	Log total fertility rate	186	0,5732258	0,3488891	0,09	1,63
avgagemothersfirstbirth	Avg. age mothers first birth	164	23,71098	1,295249	21,1	28
li	Liberalization index	189	2,562508	1,049744	1	4,143
lip	Private sector conditions index	189	2,389635	1,027992	1	4,11
lie	External liberalization index	189	2,845608	1,377509	1	4,33
lii	Internal Liberalization index	189	2,509683	0,8705942	1	4
unemploymentrateimf	Unemployment rate IMF	135	10,7478	7,569143	0,025	36,687
unemploymentratewb	Unemployment rate WB	96	12,28869	7,932963	0,6	36,68732
unemploymentratetm	Unemployment rate TM	150	7,563333	7,276637	0,1	41,7
shareofagriculturegdp	Share of agriculture as % of GDP	153	15,2483	11,0908	2,080166	46
openness	Openness of economy	170	95,63716	35,37004	26,2567	199,675
interact	Interaction effect Gini and Openness	169	112,9104	52,90682	25,36826	200,7279
inflation	Inflation rate	127	152,7098	531,2763	-1,129479	4447,9
secondaryedu	Secondary education enrolment ratio	165	90,15385	7,619907	70,08045	108,2539
tertiaryedu	Tertiary education enrolment ratio	168	33,66011	16,91618	6,92201	82,99341

Table 5: 2SLS output

2SLS with first differences, dependent variable is first difference annual GDP per capita growth rate
Instrumented variable: diff. lagged annual GDP per capita growth rate
Suppressed constant term and therefore no R-squared of F-statistic of joint significance

Regression	1	2	3	4	5
ΔLagged annual GDP per capita growth rate	-1.634418***	-1.701487***	-1.599101***	-1.833749***	-2.13008***
ΔGini index	0.0086267***	0.0056603***	-0.0044929	-.0156507	-0.0224586*
ΔSecondary Education		-0.0037041			
ΔTertiary Education		0.0031983	0.0010438		0.0014695
ΔLiberalization index			0.1870926***	-0.0534974	-0.0556186
Δ(Gini*Liberalization index)				0.0055627	0.0067216*
No. observations	126	113	112	121	112
***significant at the 1% level, **significant at the 5% level, *significant at the 10% level					

Graph 1: Annual GDP per capita growth rates



Graph 2: Income inequality over time (Gini indices)