Stockholm School of Economics
Department of Economics
Bachelor Thesis

Income Distribution and Growth

What effect does the shape of the income distribution have on economic growth in Sweden?

Abstract

Economic inequality and its effect on growth is a topic that has been researched extensively. However, the empirical findings, so far, have not come to an agreement of the overall effect. This thesis studies this relationship, using panel data on Swedish counties for the time period 1991-2006 and it investigates the reliability of earlier studies made on Swedish data. Moreover, this thesis adds to previous studies by considering how inequality, in different parts of the income distribution, affects economic growth.

Using fixed effect regressions, this thesis finds that the overall effect of inequality on growth is positive in the short run, which supports previous research made on Swedish data. Furthermore, the results indicate that this effect is driven by a positive effect of inequality on growth in the lower part of the income distribution. In contrast, inequality in the upper part of the distribution has a negative effect on growth. These findings imply that inequality in different parts of the income distribution have various effects on growth in Sweden.

Keywords: regional growth, inequality, income distribution, Gini-index

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1 Introduction

The effect economic inequality has in the society is a disputed issue, which have lead to extensive political discussions. Still, the impact of increasing income gaps is often assumed to have a negative effect on society. This topic seems to have been especially important in Sweden, where equality has been a central theme in the political debate during the 20th century. However, combining economic growth and equality has historically been seen as troublesome and it has been assumed that there exists a trade-off between equality and economic growth (Aghion et al., 1999, p. 1615). This trade-off gets support in a recent study on Swedish data, which finds that inequality has a positive effect on economic growth (Nahum, 2005). Nonetheless, empirical research on an international level does not reach a clear-cut agreement concerning this subject – some researchers find a positive effect, while others find a negative effect.

The ambiguous results are reflected in theory, where some theories explain why inequality would enhance growth and some why inequality would have a negative effect on growth. There is, however, no consensus of in what settings the models are applicable. A recent study proposes that the negative and the positive effect in the theoretical models can be linked to certain parts of the income distribution (Voitchovsky, 2005). In the study it is suggested that the theories predicting a negative effect of inequality are connected with inequality in the lower end of the income distribution, while the theories predicting a positive effect are associated with inequality at the top. It is also argued that this has not been observed in previous empirical studies, because those studies have only used one measure of inequality to capture the effect of inequality on growth. Instead, it is suggested that one should use several measures of inequality to capture the different effects in the different parts of the distribution.

The aim of this thesis is to explore how different parts of the income distribution have different effects on economic growth in Sweden. It is interesting to explore this issue because the results may indicate that policies should promote inequality in certain parts of the distribution and prevent them in other parts. Furthermore, it is interesting to see if the positive effect found in Sweden is unambiguous. Compared to the previous study, made on Swedish data, this thesis improves the research by using a better measurement of economic growth and by considering

how different parts of the income distribution affect growth. To explore the issue, data on Swedish counties is studied during the time period 1991-2006.

The thesis continues by introducing previous empirical findings and existing theories in section 2. Based on the previous empirical findings, the research questions for the thesis are presented in section 3. In section 4 and 5 the data and method used are presented and discussed. The results of the research are finally presented and analyzed in section 6 and the sensitivity of the results is tested in the section 7. Finally, section 8 and 9 concludes and discusses the results.

2 Overview of the literature

One of the earliest theories concerning the relationship between economic inequality and growth was presented by Simon Kuznets (1955). In his theory it is suggested that a nation, at first, will experience an increase in inequality as it grows economically and later, as it becomes a developed economy, inequality will start to decrease. This theory tries to explain how growth is redistributed in the economy. However, several different approaches to the relationship have developed since Kuznets's theory was presented (Johansson, 2006, p. 8). One of the main categories concerns the casual effect that inequality may have on economic growth, which is the relationship studied in this thesis. The research regarding this relationship has not reached a unanimous agreement. The results seem to depend on the specifications or the dataset used.

2.1 Empirical findings

Persson and Tabellini (1994) argue that in a more unequal economy more redistributive policies will be chosen. In addition, higher redistribution affects incentives negatively, which in turn worsens economic growth. Both Persson and Tabellini (1994) and Alesina and Rodrik (1994) test this type of model and find support that inequality has a negative effect on economic growth. However, Forbes (2000) makes another study, using a panel data on countries, and finds a positive short term effect of inequality on growth. Barro (2000) also uses panel data, but finds both a negative and a positive effect depending on the development of the country. With a low GDP per capita inequality has a negative effect on growth, while the effect is positive when GDP per capita is high.

The research mentioned above is, however, criticized for not accounting for different institutional differences between countries, which may cause bias in the estimates (Nahum, 2005, p. 6). Different studies, therefore, emerged that tried to estimate the effect of inequality within a country. Partridge (1997) uses U.S. state-level data when estimating the effect of inequality on economic growth. In contrast to Persson and Tabellini, Partridge finds that there is a positive effect of inequality on growth in the sense that the Gini-index is positively correlated to economic growth. Moreover, he finds no evidence that the income distribution has any strong effect on government policy. Hence, he concludes that the income distribution of the population affects growth through another mechanism than that of redistribution.

Panizza (2002) criticizes Partridge's results. Using a similar dataset on U.S. states, but with different specifications, he finds no evidence of a positive effect of inequality on growth. Instead, he finds weak evidence of a negative effect and concludes that "the cross-state relationship between inequality and growth is not robust to small changes in the data or econometric specification" (Panizza, 2002, p. 37).

Nahum (2005) also uses within country data, but on Swedish counties, to test how inequality affects economic growth. She tests the effect in 1, 3, 5 and 10-year growth periods, for the time period 1960-2000, using both fixed effects regressions and 2SLS regressions. She finds a robust, positive and significant effect of inequality on economic growth in the short run of 1 to 5-year growth periods. The effect is, however, less significant and stable in the long run, using 10-year growth periods. In contrast to earlier studies, she does not use real GDP per capita as her growth measure but instead uses growth in incomes.

In regard to previous research, Voitchovsky (2005) criticizes the research of focusing too much on general measures of inequality, such as the Gini-index. Instead, she suggests that different parts of the distribution are important to understand the effect of inequality on economic growth. She tests her hypothesis, by studying 5-year growth periods for 21 OECD countries. She finds that inequality in the lower part of the income distribution affects growth negatively, while inequality in the upper part of the income distribution affects growth positively.

2.2 Theoretical explanations to the empirical findings

In regards to the empirical findings, several theories have developed to explain the different results. Looking at the theory presented in the literature, some theories suggest a positive effect of inequality on economic growth, while others mean that the effect is negative.

One theory that suggests a positive effect argues that inequality increases savings. In this theory, it is assumed that the marginal propensity to save increases with income and that savings are equal or similar to investment. Under these assumptions, an unequal economy, which consists of more rich people, will have higher savings and, thus, higher investments. Because investments increase growth, a more unequal economy will grow faster (Barro, 2000, p. 8).

Another hypothesis is that inequality enhances growth through greater investment possibilities. In this theory it is assumed that investments are characterized by large setup costs and that there exists credit-market imperfections, i.e. there are limits to borrow money. In that setup an initial personal wealth is needed to be able to invest in a project. An unequal economy would have more people with a personal wealth, who are able to invest and initiate new industrial activity, which would enhance economic growth (Aghion et al., 1999, p. 1615).

Finally, in a third theory it is suggested that inequality creates incentives that would have a positive effect on economic growth. The main argument is that equal wages would discourage people to exert maximal effort. Instead, in a society with an unequal wage structure, workers would have an incentive to exert effort to receive a higher wage (Aghion et al., 1999, p. 1615; Voitchovsky, 2005, p. 276).

There are also theories that predict a negative effect of inequality on growth. The first theory argues that inequality reduces investments opportunities. This theory assumes that capital markets are imperfect and that "wealth or human capital endowments are heterogeneous across individuals" (Aghion et al., 1999, p. 1621). Under such circumstances it is not possible for everyone to fully exploit the investment opportunities they face. Furthermore, it is assumed that there is diminishing return to investment i.e. an additional investment by a rich person gives a lower return compared to an additional investment by a poorer person. Hence, it would be better with an equal distribution in the economy, because it would maximize return to investments (Aghion et al., 1999, pp. 1621-1622).

A second reason why inequality would affect growth negatively is that inequality worsens borrowers' incentives. This theory is based on the same assumption as the previous theory and that capital markets have limited liability. In other words, an entrepreneur who borrows money is not personally responsible to repay all money in the case of a bankruptcy. Furthermore, an entrepreneur who borrows a large percentage of money also needs to share a large percentage of the profit. This implies that entrepreneurs who borrow money will have fewer incentives to exert effort compared to those who invest personal wealth. Hence, in an unequal economy more people would need to borrow money to invest, which could reduce the overall effort-level in the economy (Aghion et al., 1999, pp. 1624-1625).

Finally, some researchers point to the possibility of sociopolitical unrest in an unequal society. Income- and wealth-inequality can give incentives for the poor to participate in disruptive activities such as crime (Nilsson, 2004). These activities can even threaten the political system, which may create a greater uncertainty in the political institutions. Participation in such activities represents a direct waste of resources that hampers economic growth (Barro, 1990, p. 7).

2.3 Implications of the theoretical explanations

If all the above theories are correct, then inequality has both positive and negative effects on economic growth. If not specifically controlled for, the observed effect found will, therefore, be the net effect of all these theories. However, different theories may be more or less applicable and have various impacts in different settings. Since the empirical research uses different datasets and studies different countries or regions, the relative importance of the above theories could, thus, differ between the studies. Whether the net effect is positive or negative, then, depends on the impact each theory has in the particular setting studied. This could explain why previous research has come to different conclusions.

Voitchovsky (2005) argues that it is the shape of the distribution that affects how much impact each theory has. She argues that the effects of the different theories can be more or less influential in different parts of the income distribution. Moreover, she means that the theories that predict a positive effect are combined with inequality in the upper part of the distribution, while the theories that predict a negative effect on growth are traced to inequality in the lower end of the distribution. That is, inequality among the population with the highest income is good

for economic growth, while inequality among the population with the lowest income is bad for economic growth. Voitchovsky argues that, by just using one inequality measure, both the negative effects and the positive effects are measured at the same time. Thus, only the net effect inequality has on growth is estimated. Therefore, in order to capture the different effects, one should use several measures of inequality simultaneously. These measures should reflect the inequality in different parts of the income distribution.

3 Research questions

As was stated in the introduction the aim of this thesis is to explore how different parts of the income distribution have different effects on economic growth in Sweden. Previous empirical research made on Swedish counties has found a positive net effect of inequality using growth in incomes as the measure of growth (Nahum, 2005). Nahum also finds that this effect is stronger in the short run. However, Nahum does not use growth in GDP and she does not account for the possibility of different effects of inequality on growth in different parts of the income distribution. With regards to the theories presented in the previous section, and to Voitchovsky's arguments, it may be important to account for different parts of the income distribution. To explore the aim of this thesis, the following questions are investigated.

- What net effect does inequality has on real GDP growth in Sweden, and is this result consistent with previous findings?
- How does the inequality in different parts of the income distribution affect economic growth in Sweden?
- How do the observed effects of inequality on growth depend on the length of the growth period studied?

To answer the research questions, this study first tests if inequality still has a positive effect on growth when instead using real GDP growth as the measure of growth. It thereafter investigates if the effect of inequality on growth can be attributed to certain parts of the income distribution. To investigate this, the thesis uses the same measures as Voitchovsky, who uses the percentile ratio 90/75 as the measure of inequality in the upper part of the income distribution and the ratio 50/10 as the measure of inequality in the lower part.

This thesis looks at the effect of inequality in counties in Sweden during the time period 1991-2006. It does not attempt to explain through which exact mechanism that inequality affects growth. Instead, the thesis evaluates the validity of Nahum's study and explores if there is support for Voitchovsky´s hypothesis in a different setting.

4 Data

In this section follows a description and discussion of the data used, what variables are used and how the variables are measured.

4.1 Data selection

In this thesis data on Swedish counties is used to evaluate the research questions. As been stated in section 2.1 studies made on cross-country data may be criticized because they do not account for differences in the institutional framework. Countries may differ in the "level of democracy, human rights, type of economy, education system etc, which does not make it reasonable to expect that one model holds for all countries" (Nahum, 2005, p. 6). This problem is much less severe between counties because much of the institutions are similar between counties. Another problem often pointed out is that data on income statistics may differ significantly between countries both concerning quality and definition. Therefore, it can be difficult to reliably compare inequality measures between countries (Pardo-Beltrán, 2002, pp. 8-10). This issue is also less severe when using data within a country. In this thesis all data used, has been collected from Statistics Sweden. This greatly improves comparability in the data. Statistics Sweden is an administrative agency, which is the coordinator of the official statistics of Sweden. Therefore, this source can be considered reliable. A further description of each statistics used is done when discussing each variable used.

There are, however, some problems with using within-country data. Firstly, the lack of variation between counties may be a problem, because it can be difficult to get precise and significant results. Secondly, using counties may increase the difficulties of controlling for the flow of investments that may occur between counties in Sweden. One of the theories mentioned in section 2.2 assumed that savings are equal or similar to the amount of investments in an

economy. This assumption may not be applicable within counties in Sweden, since counties can be considered as very open economies where capital moves freely. A high degree of inequality in a certain county may increase savings in that region, but may not enhance investments in the same region. Hence, if investments are not allocated to the region where the inequality exists, it will not enhance growth in that region. The effect inequality has on growth according to this theory is, therefore, difficult to observe. Thus, this specific theory may be less applicable to explain the results found in this study. This can be seen very problematic when using counties as the unit of observation. However, this problem may also apply for studies made between countries. Since the capital markets in the world has become more open, interconnected and integrated in recent years, it also exists an extensive flow of capital between countries. Finally, not only capital moves freely between counties, but a possible problem is that people may work and live in different counties. This may affect the results in different ways. This occurrence is probably less of a problem when studying cross-country data.

4.2 Variables

In table 1 the main variables used in the thesis are presented. In recent growth literature these variables are considered to affect both economic growth and inequality. In the sections below, arguments for including these variables and how to measure them are presented.

Table 1: List of variables.

Variable	**Measure**
Economic growth	Real economic growth in regional GDP per capita
Inequality	Gini-index
Inequality in the upper end of the income distribution	90/75=the income of the 90^{th} percentile divided by the income of the 75^{th} percentile
Inequality in the lower end of the income distribution	50/10=the income of the 50^{th} percentile divided by the income of the 10^{th} percentile
Human capital	Share of population with above high school education
Urbanization	Share of population living in urban areas
Age structure	Share of adult population over 65 years
Initial income	Initial real regional GDP per capita

4.2.1 Economic growth

Earlier research has used different measures of economic growth. One possible measure of economic growth is the growth in incomes, which for instance was used by Nahum (2005) when studying Swedish data. This measure is not a perfect measure for economic growth, but according to Nahum (2005, p. 10) there exists a strong correlation between growth in GDP and growth in incomes. This thesis instead uses growth in real GDP as a measure of growth and it tests how comparable these two measures are. When studying the effect of inequality on growth it is more interesting to see how inequality affects the economy at large. Moreover, most studies use growth in real GDP as a measure of growth and the growth in incomes is often used as a proxy, when real GDP growth is unavailable. For the time period 1991-2006 regional GDPs for each county in Sweden are available and it is, therefore, possible to use that measure as a measure for economic growth. The data on regional GDP originates from two different time series, one with data from 1985-1993 (SCB, 2009k) and the other with data from 1993-2006 (SCB, 2009b). These time series are not directly comparable. The regional GDP for years 1991 and 1992 have, consequently, been approximated by taking the ratio between the two series for the year 1993 and using that ratio to convert the values 1991 and 1992 to the later series. This is done based on the assumption that the calculated ratio is constant over time. To be certain of this assumption, the results are controlled for by excluding these years. All the values of GDP are nominal, and have, therefore, been deflated using CPI (SCB, 2009f). Furthermore, the growth has been estimated over different time periods. To calculate these growth periods, the annual growth over 1, 3, 5 and 10 years have been estimated.

4.2.2 Inequality

In most research the inequality measure used is the Gini-index. This is a well-known measure of inequality, which takes a value between 0 and 1 where a higher value represents a more unequal distribution. As suggested by Voitchovsky (2005), by using just one inequality measure it is not possible to fully evaluate the effect of inequality on growth. Instead, the shape of different parts of the income distribution should be considered. To account for the shape of the income distribution, Voitchovsky uses the income of 50^{th} percentile divided by the income of the 10^{th} percentile as a measure of inequality in the lower part of the distribution. The income of the 90^{th} percentile divided by the income of the 75^{th} percentile is used to account for inequality in the top

of the distribution. This thesis also uses these percentile ratios to indicate inequality at the top-end of the distribution and inequality at the bottom of the distribution.

It is also important to reflect on how the measures of inequality are constructed. In this thesis, the inequality-measures used are based on the total sum of income statistics (SCB, 2009a), which is a statistics that include pre-tax income from wages, business operation, pensions, unemployment payments and some transfers but not income of capital (Lundberg, 2009, pp.8-9). Using this measure has the advantage of being more accurate than survey data. It also makes it possible to calculate both the percentile ratios and the Gini-index. Finally, it is the measure with the longest consistent time series available. Another advantage of using pre-tax incomes is that there will be a greater variability in the data compared to using after tax incomes (Panizza, 2002, p. 27).

The statistics used, divide the population into different income classes for each county. These income classes have been used to approximate the area under the Lorenz curve in order to calculate the Gini-index. Using this approximation method just gives small errors for the Gini-index if the number of income classes is large enough (Gastwirth, 1972). The percentiles have been estimated from the same statistics. When estimating the percentiles it has been assumed that each income class is uniformly distributed.[1]

There are, however, some problems with using this measure as a foundation for the inequality measures. One problem is that our measure does not include capital incomes, which can give a misrepresentation of the true income distribution. Furthermore, some researchers emphasize that the measure of income should be based on household surveys and "must be comprehensive, including income from self-employment, nonwage earnings, and nonmonetary income" (Forbes, 2000, p. 871). A possible income measure would, then, be net disposable income per individual based on household data (Voitchovsky, 2005, p. 279). The advantage with this measure is that it clearly reflects the inequality that the population faces, since it measures the incomes that people can use. However, the percentiles ratios for this measure are not available for this thesis and the Gini-index for the measure is only available for a shorter period of time. Another possible measure to base inequality on is the wealth distribution. As mentioned in section 2, some theoretical arguments indicate that wealth may be an important factor in determining economic

[1] See Appendix A for a more detailed description of these calculations

growth. However, data on the distribution of wealth is generally difficult to obtain and distribution of income is a possible proxy for wealth distribution (Perotti, 1996, p. 154).

4.2.3 Controls

This section discusses the use of different control variables and how they are measured. In previous literature it is suggested that the variables that are important to control for are human capital, urbanization, age structure and initial income.

Human capital is believed to be correlated with both economic growth and inequality and must, therefore, be controlled for. This variable is controlled for by measuring the share of population in ages 25-64 years that have a higher education than high school (SCB, 2009e). The majority of the previous research has used this measure and uses similar definitions of human capital (Nahum, 2005; Partridge, 1997; Panizza, 2002). It is not clear where to draw the line of higher education, but the definition of people with above high school education is a reasonable definition. Furthermore, this definition is used to control for a change in measurement in the data that took place between 1999 and 2000 (Wass, 2002). Previous research, which uses cross-country observations, sometimes controls for lower level of education (Persson and Tabellini, 1994; Alesina and Rodrik, 1994). However, because of the similarity in the school system between counties in Sweden, the level of education in Sweden does not differ that much in the lower end of the distribution.

The level of urbanization appears to be an important variable affecting growth (Henderson, 2000). Earlier studies (Nahum, 2005; Panizza, 2002) have calculated this measure by using the amount of people living in the most populated city in the region. This measure can possibly be misleading, because it is possible for a county to have several cities with similar population and not just one big city. Therefore, the measure used in this thesis is the share of people living in urban areas (SCB, 2009j). An urban area in Sweden is defined as regions where more than 200 people live. However, the definition of an urban area varies and 200 people are a low number compared to how previous studies define urban areas (Nahum, 2005). Therefore, in this thesis the share of people living in areas with more than 10 000 people is used. This measure only had data for every fifth year and the missing years have been approximated by a linear interpolation. This should not affect the results noticeably, because urbanization varies little over the short period of time that is studied in this paper.

The age structure is also a variable that can affect economic growth and inequality and is therefore controlled for (Perotti, 1996, p.161). To measure this variable the population over 65 years as a share of the population over 20 years is used (SCB, 2009i).

Furthermore, research has shown that regions converge economically, at least regions of similar culture. That is, poorer regions tend to grow faster than richer regions because they are converging (Mankiw, 2006, pp. 221-222). This phenomenon has also been shown for Swedish counties (Persson, 1997). Consequently, we control for the convergence effect by measuring the initial GDP in the region (SCB, 2009b; SCB, 2009k).

4.2.4 Variables used in sensitivity analysis

In Table 2 there is a list of control variables used in the sensitivity analysis. As discussed in section 4.1, these variables could potentially affect the results and should be taken into account.

Table 2: List of control variables used in the sensitivity analysis

Variable	**Measure**
Outflow of workers	Share of workers in the work force that work in another county
Inflow of workers	Share of workers in the work force that live in another county
Investments	Gross investments as a share of regional GDP

As stated in section 4.1, a potential problem is the outflow and inflow of workers. To control for the outflow of workers a variable capturing the number of people working outside the resident county as a share of total number of workers aged 20 years or older is used. To control for the inflow of workers the number of people living outside the county, but working in the county, is measured. To obtain this variable, this number is divided by the total number of workers aged 20 years or older. These measures are calculated on a yearly basis at first. However, in the regressions the averages of these shares, over the growth period studied, are used. Because it only existed data for the years 1993-2003 (SCB, 2009g) the remaining years have been estimated by linear extrapolation.

According to economic theory the amount of capital is a variable that affects economic growth. Previous research controls for this variable by using the amount of investments divided by GDP (Voitchovsky 2005). Unfortunately, data on investments have only been available in larger

regions and for a shorter time period (SCB, 2009d). To approximate the amount of investments in each county the investments made in each larger region is distributed between the counties that the region consists of. This has been done by, firstly, calculating each counties share of the larger regions GDP in a certain sector (SCB, 2009c). Secondly, this share is multiplied by the investments made by the larger region in that sector. Finally, the investments of the counties in the different sectors are summed together to get total investments for each county. The total investments are then divided by regional GDP to get the desired variable.[2]

4.3 Summary statistics

This part presents and discusses the summary statistics for the main variables used in this thesis during the time period studied. Summary statistics are presented in Table 3. Moreover, in figure 1 to 4 the development of the Gini index, the ratios 90/75, 50/10 and the per capita regional GDP are displayed.

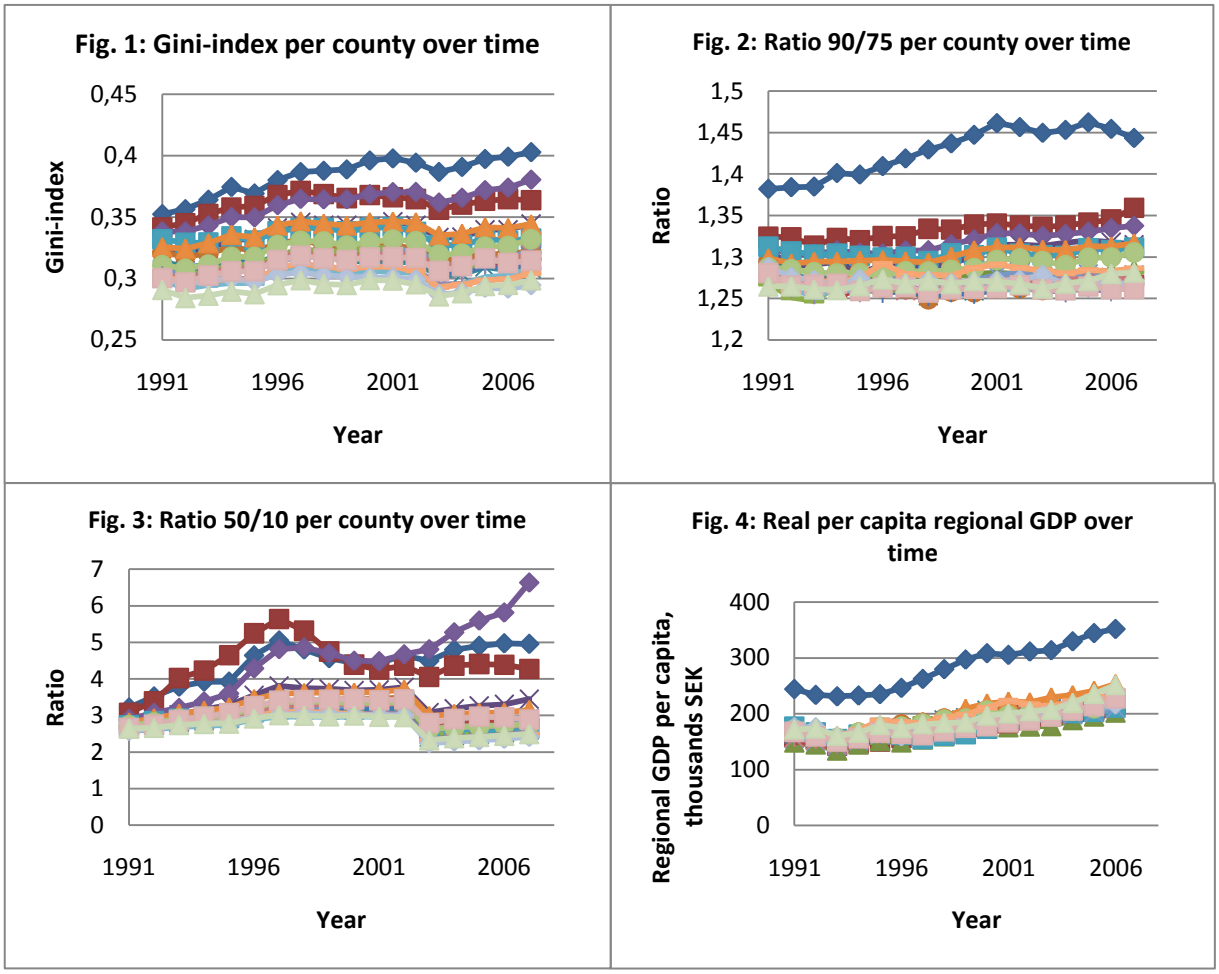
Table 3: Summary statistics for the different inequality measures and real per capita regional GDP

Variable	Obs	Mean	Std. Dev.	Min	Max
Gini-index	357	0.3221865	0.0238378	0.2842446	0.4030207
90/75	357	1.287553	0.0383841	1.247121	1.462316
50/10	357	3.160352	0.6708805	2.245418	6.636967
GDP/capita	336	188.2145	32.54433	134.3101	351.6966

Looking at figure 1, the Gini-index has varied slightly over time and the variation between counties has increased. For counties with a high initial Gini-index, the index has increased over time, while it appears to be stable for those counties with a low initial index. Still, all counties seem to follow a similar trend.

The ratio 90/75 seems to be stable over time, except for the county of Stockholm, where the ratio has increased. Moreover, the county of Stockholm appears to be an outlier, with a distinct higher ratio throughout time. Even though the ratio has been stable it is possible to see that the variation between counties is larger in 2007 compared to 1991. The apparent lack of variation in this measure could make it difficult to find significant results for this ratio in the regressions.

[2] A more detailed description of the calculations can be seen in Appendix B



Source: Figure 1-3 are processed from data from Statistics Sweden (2009a) and figure 4 is processed from data from Statistics Sweden (SCB, 2009b; SCB, 2009k; SCB, 2009f)

The ratio 50/10 varies greatly both over time and between counties. The ratio increased during the beginning of the 1990 and started to decline in the end of the 1990's, but a general pattern for all counties is difficult to distinguish. Towards the end of the time period a slight increase can be seen in most counties, with a drastic increase for the county of Skåne.

As can be seen in figure 4 the real regional GDP has a positive trend over time. After the crisis in Sweden in the beginning of the 1990's there has been a steady increase in the per capita GDP. Again, the county of Stockholm appears to be an outlier with a clearly higher per capita GDP for every year, while the other counties are grouped more together. This measure increases steadily until 2000 where the growth diminishes. Finally, the GDP increases during the later part of the 2000's.

If all diagrams are compared simultaneously it is possible to see that all of them follow a similar trend. There is an increase in all inequality measures during 1990's until around 2000, where they instead decrease. This could perhaps be explained by the crisis in the internet-sector during this period. The inequality measures, in most counties, also have an increasing trend towards the end of the sample period. The same pattern can be seen in the development of the real per capita regional GDP. The similarity between the four measures suggests that there is some type of relation between inequality and economic growth.

5 Method

To evaluate the research questions, this thesis uses a regression analysis. The general model that is considered can be written as:

$$Growth_{i,t+n} = \alpha_0 + \alpha_1 * y_{i,t} + \beta_k * \Delta_{i,t} + \delta_l * A_{i,t} + u_i + \varepsilon_{i,t} \qquad (1)$$

In the equation, $Growth_{i,t+n}$ is a measure for the annual economic growth for the period $t+n$; $y_{i,t}$ is the log of regional GDP per capita; $\Delta_{i,t}$ represents a set of different inequality measures that is considered and β_k are the corresponding coefficients for the inequality-measures Δ_i; A is a matrix of control-variables and δ_l are the coefficients for these controls. Finally, u_i is the unobserved effect for each county, which is controlled for by using fixed effect regressions, and $\varepsilon_{i,t}$ is an error term that has an expected value of zero. This model has been used in several of the studies made on the effect of inequality on growth (Nahum, 2005; Panizza, 2002).

5.1 Estimations discussion

To estimate the model (1) several alternative methods can be used. Early research used cross-sectional analysis (Alesina and Rodrik, 1994; Perotti, 1996). Later research has used different types of fixed effect regression to control for observation-specific traits (Nahum, 2005; Panizza, 2002). The problem with using fixed effects regressions is that the variation across observations is lost. It has been found that variation in income and income inequality is mostly cross-sectional; thus, losing that variation could result in less precise estimations (Voitchovsky, 2005, pp. 283-284; Li, Squire and Zou, 1998, pp. 34-35). At the same time, OLS regressions have the

problem of omitted variable bias. This means that there can be time constant unobserved attributes of the counties being studied, which are not controlled for by normal OLS (Wooldridge, 2008, p. 445). Hence, there is a risk that the coefficients do not reflect the true effect and are biased. Nonetheless, the possible unobserved attributes present within Sweden is likely not as large as between countries and the effect is probably smaller. For instance, institutions, culture and norms are attributes that probably do not differ as greatly across counties in Sweden as between countries. Still, obtaining data on control-variables on a county level is difficult and the data found may not be reliable. Because of the difficulties in obtaining reliable data on the control variables needed this thesis focuses on using fixed effect regressions to estimate the effect of inequality on economic growth. By doing a Hausman test to see if one should use fixed effects or random effects regressions, the test shows that fixed effect regressions is the preferred method.[3]

Another problem when estimating the effect of inequality on economic growth is the problem of endogeneity. There is a risk that there exists reverse causality in the relationship between inequality and economic growth. In other words, economic growth could have a causal effect on the income distribution. To make the independent variables exogenous in the model, the variables are measured at t_1 and the dependent variable is measured for the time period t_{1+n}. This method should control for a direct reverse causality problem and is the general way of controlling for this problem. (Nahum, 2005, p.13; Partridge, 1997, p. 1021; Panizza, 2002, p. 29) However, it is possible that inequality is an inertial variable and that inequality changes slowly over time. This implies that inequality still would be an endogenous variable, which could make the estimators biased. This could be controlled for by using instrument variables. However, those types of estimations are outside the scope of this thesis. Therefore, it is assumed that inequality is exogenous when measured at the beginning of each growth period. Still, it should be noted that Nahum (2005, p. 28) finds that using instrument variables still results in positive coefficients for the Gini-index in the short run, but that the results are more sensitive in the long run.

Finally there are differences in how to treat the growth periods used as the dependent variable. Previous research has used average growth rates over a certain time period, and has treated each time period as a specific observation. However, because of the limited time period in the data of

[3] See Appendix C for a further analysis

this thesis, overlapping growth periods are used. According to Nahum (2005, pp. 7-8) using overlapping growth periods could be better because one needs to worry less about business cycles and one gets more degrees of freedom. One possible drawback could be that there will be a high degree of serial correlation between the time periods. This is controlled for by making the standard errors robust to serial correlation, using Newey West standard errors.

6 Results

This section presents the regression results of the growth model presented in section 5. The section is divided into four parts. The first part answers the question about the consistency of the effect of inequality on growth in Sweden. The second part analyzes how different parts of the income distribution affect growth. The third part discusses how the observed effects depend on the length of the growth period studied. Finally, the last part summarizes the results.

6.1 How do our results compare with previous research on Sweden?

To answer the question about consistency, a comparison is made with Nahum's results. This comparison is presented in table 4. Both regional GDP growth and growth in incomes as dependent variable are presented alongside Nahum's results. As a first step, Nahum's results are compared to ours, using growth in incomes as the dependent variable. In a second step, the results, using growth in GDP, are compared to the results using growth in incomes. This comparison indicates if Nahum's results are sensitive to changes in the time period studied[4] or the growth measure used.

6.1.1 Comparison when using growth in incomes

When comparing the results with Nahum's, using growth in income as the measure of growth, it is possible to see that they are similar in many aspects. Concerning the Gini-index, the coefficient is positive and significant in both studies for the 1, 3 and 5-year growth periods. However, our study differs when looking at the 10-year growth period, where we find that the Gini-index has a negative effect and Nahum finds a positive effect. Still, Nahum (2005, p. 28) concludes that the effect of inequality on growth is not clear in the long run, which could explain

[4] This thesis studies the time period 1991-2006, while Nahum studies the time period 1960-2000

the difference between the results. Another difference between the studies is that our results suggest that the size of the coefficient for the Gini-index is larger. With 1 and 3-year growth periods the coefficient is approximately 3 times as large compared to Nahum's, but with 5-year growth periods the coefficient is of similar size. This could be an effect of the different time periods studied.

Table 4: Regression results of the effect of inequality on growth in different time periods

Growth period:	**1 year**			**3 years**			**5 years**			**10 years**		
	Nahum´s result	**Our result**		**Nahum´s result**	**Our result**		**Nahum´s result**	**Our result**		**Nahum´s result**	**Our result**	
Dependent variable:	Δincomes	Δincomes	ΔGDP	Δincomes	Δincomes	ΔGDP	Δincomes	Δincomes	ΔGDP	Δincomes	Δincomes	ΔGDP
Independent variables:												
Initial income	-0,058 **	-0,095 **	-0,536 **	-0,099 **	-0,233 **	-0,324 **	-0,102 **	-0,238 **	-0,237 **	-0,045 **	-0,077 **	-0,088 **
Gini-index	0,329 **	1,044 **	0,841 **	0,258 **	0,725 **	0,280 *	0,135 **	0,204 **	0,008	0,019 **	-0,133 **	0,067
Education	0,275 **	0,286 **	1,955 **	0,338 **	0,717 **	1,163 **	0,307 **	0,739 **	0,927 **	0,089 **	0,328 **	0,353 **
Urban 10000	0,116 **	0,138	-0,236	0,154 **	0,071	-0,117	0,140 **	0,001	-0,130	0,015	0,005	0,180 **
Age 65+	0,331 **	0,069	-0,161	0,364 **	0,052	0,087	0,165 **	-0,038	0,197	-0,064 *	0,052	0,326
Constant	0,419 **	0,003	2,191 **	0,906 **	0,719 **	1,359 **	1,044 **	0,963 **	1,035 **	0,541 **	0,351 **	0,214 **
Observations	960	336	315	912	294	273	864	252	231	744	147	126
No. Of counties	24	21	21	24	21	21	24	21	21	24	21	21
R-squared	0,25	0,34	0,40	0,45	0,60	0,64	0,55	0,71	0,79	0,80	0,90	0,85

* Significant on the 10% level

** Significant on the 5% level

The regressions are done with overlapping growth periods. All regressions are made with fixed effects and the independent variables are all measured at the beginning of each growth period.

Looking at the other variables, one can see that the results, for the variables initial income and education, are in general similar in significance and sign. Again, the sizes of the coefficients are larger in this study. For the variables age65+ and urbanization the results differs also in significance, where Nahum gets significant effects and we get insignificant effects. This can perhaps be partly explained by the different measures used for urbanization and education. Furthermore, Nahum has a larger sample from a partly different time period, which could further

explain these differences. This is because, with a larger sample the variation in the observations is likely greater.

In summary, even though there are some differences between the results in this study and that of Nahum, the overall results are similar in that they show that inequality has a positive effect on growth and that this effect is stronger in the short run.

6.1.2 Comparison between growth in incomes and growth in GDP

Moving on, when comparing the results of using growth in income and growth in GDP, it is also possible to see a similar trend as discussed above. In the short run of 1 and 3-year growth periods the Gini-index has a positive and significant effect on GDP growth. This effect turns insignificant, but is still positive, when using longer growth periods.

Furthermore, the variables initial income and education have the same sign and significance when using growth in GDP as dependent variable. The sizes of the coefficients for these variables are larger in the short run compared to the coefficients using growth in incomes. However, the sizes are more similar with 5-year growth periods. Finally, the variables urbanization and age65+ are mostly insignificant and varies in sign depending on which growth measure used.

In conclusion, this comparison supports the results found by Nahum. Using another time period and another measure of economic growth does not invalidate the positive effect inequality has on growth. However, the results in this thesis indicate that the short run effect is even stronger than suggested by Nahum, and that the effect is not clear when looking at 5 and 10-year growth periods.

6.2 How do different parts of the income distribution affect growth?

The next step in the analysis is to see if the positive effect inequality has on growth can be attributed to a certain part of the income distribution. This is done, in line with Voitchovsky (2005), by adding the percentile ratios 90/75 and 50/10 to the regression and looking at 5-year growth periods. The results of these regressions are presented in Table 5.

Table 5: Regressions results of how different inequality measures affect growth

	Inequality measures included in the regression						
	Gini	**50/10**	**90/75**	**Gini + 90/75**	**Gini + 50/10**	**50/10 + 90/75**	**Gini + 50/10 + 90/75**
Variable							
Initial income	-0,237	-0,233	-0,231	-0,230	-0,231	-0,228	-0,228
	***	***	***	***	***	***	***
Gini-index	0,008	-	-	0,081	-0,224	-	-0,122
					*		
50/10	-	0,004	-	-	0,007	0,004	0,005
		**			***	**	**
90/75	-	-	-0,119	-0,131	-	-0,114	-0,094
			**	***		**	*
Education	0,927	0,873	0,936	0,910	0,904	0,882	0,897
	***	***	***	***	***	***	***
Urban 10000	-0,130	-0,132	-0,212	-0,207	-0,171	-0,210	-0,217
			**	**	*	**	**
Age 65+	0,197	0,263	0,172	0,190	0,256	0,237	0,238
Constant	1,035	1,001	1,205	1,187	1,069	1,162	1,171
	***	***	***	***	***	***	***
Observations	231	231	231	231	231	231	231
No. of counties	21	21	21	21	21	21	21
R-squared	0,79	0,80	0,80	0,80	0,80	0,80	0,80

* Significant on the 10% level
** Significant on the 5% level
*** Significant on the 1% level
The dependent variable in the regressions is the average annual growth in real regional GDP per capita for a 5-year growth period. The growth periods are overlapping. All regressions are made with fixed effects and the independent variables are all measured at the beginning of each growth period.

When looking at the coefficient of the Gini-index, one can observe that it changes sign between the regressions. The sign of the coefficient depends on what other type of inequality measure that is included in the specification. More specifically the coefficient for the Gini-index is negative when controlling for the 50/10 ratio. This indicates that inequality has a negative effect on economic growth, when controlling for inequality in the lower end of the distribution. Analogously, inequality has a positive effect on economic growth when controlling for inequality in the upper end of the distribution. Hence, the Gini-index could be seen as a measure of inequality for the remaining part of the distribution when controlling for inequality in a specific part of the distribution. However, these effects are insignificant in most specifications

and it is only marginally significant together with the ratio 50/10. Hence, it is not possible to make any definite conclusions about this pattern.

Furthermore, the coefficients of the ratios 50/10 and 90/75 are significant in every specification. The ratio 50/10 has a positive and significant coefficient. An increase in the ratio by one standard deviation (0,67) would increase economic growth by approximately 0,3-0,7%. In contrast, the ratio 90/75 has negative and significant effect and an increase by one standard deviation (0,038) in this ratio would decrease economic growth by approximately 0,4-1,4%. In conclusion, the combination of the results indicates that an increase in the inequality in the lower end of the distribution affects economic growth positively, while an increase in the inequality in the upper end of the distribution has a negative effect on growth.

Looking at the other results, the coefficient of education has a consistent positive effect on economic growth. This effect is large and statistically significant. Moreover, initial income has a negative and statistically significant effect on growth. These results are expected and consistent with theory and previous findings. The variable urbanization has a negative effect on growth. The significance of this variable varies between the specifications, but is significant in most cases. This effect is contradictory to previous findings and theory (Nahum, 2005). The variable for the age structure is positive but insignificant in all specifications. This is unexpected, but is in line with Nahum's study.

All the above specifications point to the results that the ratio 50/10 has a positive effect on growth and that the ratio 90/75 has a negative effect on growth in Sweden. This is a sign of robustness. Of these specifications, the one that shows the most significant results are the specification that combines the ratios 50/10 and 90/75. Additionally, with an R-square of 0,8, this specification has an explanatory power at least as good as the other specifications. Therefore, in the remaining of the thesis the focus is on this specification.

6.3 How do the observed effects depend on the growth period studied?

As was concluded in the previous section the ratio 90/75 has a negative effect on growth and the ratio 50/10 has a positive effect. These effects were tested on a 5-year growth period. However, Nahum argues that the effect of inequality on growth would be stronger in the short-run. To test

for the long-run and short-run effects, the specification including the ratios 90/75 and 50/10 are regressed on 1, 3, 5 and 10-year growth periods. The results are presented in table 6.

Table 6: Regression results for different growth periods

Growth period:	1 Year	3 Years	5 Years	10 Years
Variable				
Initial income	-0,503	-0,304	-0,228	-0,088
	***	***	***	***
50/10	0,013	0,009	0,004	-0,001
	**	***	**	
90/75	-0,653	-0,337	-0,114	-0,010
	***	***	**	
Education	2,055	1,179	0,882	0,393
	***	***	***	***
Urban 10000	-0,676	-0,385	-0,210	0,169
	**	***	**	***
Age 65+	-0,355	0,079	0,237	0,282
Constant	3,322	1,875	1,162	0,252
	***	***	***	***
Observations	315	273	231	126
No. of counties	21	21	21	21
R-squared	0,41	0,68	0,80	0,85

* Significant on the 10% level

** Significant on the 5% level

*** Significant on the 1% level

The dependent variable in all regressions is yearly average growth in real regional GDP per capita for the 1, 3, 5 and 10-year growth periods respectively. The growth periods are overlapping. All regressions are made with fixed effects and the independent variables are all measured at the beginning of each growth period.

The results presented in table 6 further supports Nahum's findings that the effect of inequality on growth is stronger in the short run. For the 1, 3 and 5-year growth periods, both ratios are significant, but turn insignificant when looking at the 10-year growth period. Still, the ratio 90/75 is consistently negative for all growth periods, while the ratio 50/10 is positive in the 1, 3 and 5-year growth periods. Furthermore, the sizes of the coefficients for these ratios are larger for shorter growth periods, which suggest that the effects are stronger in the short run.

The same argument applies for the variables initial income and education. Both these variables are significant in all periods, and both variables have a stronger effect in the short run compared to the long run. The variable urbanization has a negative and significant effect in the short run,

which is somewhat unexpected. The effect is positive, however, when looking at the 10-year growth period. The variable age65+ is always insignificant and changes sign depending on the growth period studied. The insignificant results could indicate that the variable has a low variability during the time period studied.

6.4 Concluding remarks

Connecting the results in this section to Nahum's study, it is possible to see that the positive effect found by Nahum could be explained by the positive effect found in the ratio 50/10. Therefore, it appears to be inequality in the lower part of the distribution that creates the overall positive effect inequality has on growth. However, this positive effect is counteracted by the negative effect in the ratio 90/75. Still, since the overall effect of inequality on growth is positive, it is the effect in the lower part of the distribution that is crucial. The observed effects are stronger and more significant in the short run, while uncertain in the long run.

7 Sensitivity analysis

In this section the robustness of the results are tested. As mentioned earlier there are some problems when using counties as the unit of observations. Therefore, the results are analyzed by changing time periods and adding controls for investments and workflows. Moreover, the sensitivity of the results to time trends, outliers and serial correlation is tested.

To check if the results are sensitive to the time period studied, the sample is divided into two subset periods. The first period is 1991-2000 and the second period is 2001-2006. When running the regressions on these two periods the significance level of the results decrease.[5] The coefficient for the ratio 50/10 now becomes insignificant in all regressions, except for the 3-year growth period in the subset period of 1991-2000. Moreover, it also changes sign and becomes negative and insignificant in some regressions. The ratio 90/75 is also insignificant when looking at 1 and 5-year growth periods, but is significant and negative in the 3-year growth period. This indicates that our sample is sensitive for the time period studied. However, the loss in

[5] See Appendix D, Table 7 for the results. Note that the subset periods are too short to estimate the effect using 10 years growth periods.

significance could also be a result of having fewer observations to study. Another possible problem with the time period studied is that the growth in GDP is approximated for the first two years. Excluding these two years from the regression does not affect the results strongly, even though the significance level drops for the ratio 50/10 in the 5-year growth period.

As has been described in section 4.2.1, this thesis uses growth in GDP as a measure for economic growth. A factor that can affect growth in GDP is investments. Investments have been excluded in the original regressions to make the specifications comparable to Nahum's specifications. Furthermore, there are only few observations available for this measure and it is hard to control for cross-county investments using this variable. However, if the time period, for which there are observations for investments, is analyzed the inclusion of the variable for investments does not have any large effect on the other coefficients.[6] For 1 and 3-year growth periods the ratio 90/75 is still negative and significant, while the ratio 50/10 is positive but insignificant. For 5 and 10-year growth periods both ratios turns insignificant and even changes sign. However, this is not a result of adding the variable for investment, but a result of looking at a shorter time period as discussed in the paragraph above.

To control for the potential problem of workflows between counties, the variables outflow and inflow of workers are included in the regression.[7] This does not change the results dramatically in the short run. The sign and value of the coefficients of the ratios 90/75 and 50/10 are similar and they are still significant. However, the significance level for the coefficients drops when looking at 5 or 10-year growth periods.

To control for possible time trends, time dummies have been included in the regressions. Including time dummies decreases the significance level for all the specifications.[8] The only variable that still is weakly statistically significant is the ratio 50/10, which has a positive coefficient for the 1, 3 and 5-year growth periods. The coefficient for the ratio 90/75 is insignificant in all specifications and it even changes sign when using 5 and 10-year growth periods. Hence, the ratio 90/75 seems to be very sensitive to time trends but the ratio 50/10 is more stable. However, even though the significance of the negative effect disappears when using

[6] See Appendix D, Table 8 for the results.
[7] See Appendix D, Table 9 for the results
[8] See Appendix D, Table 10 for the results

time dummies, it still keeps its negative sign in the short run. Furthermore, by using time dummies the problem of multicollinearity increases and there is a risk that the dummies capture too much of the variation in the other variables over time (Nahum, 2005, p. 19).

To check whether the results are driven by outliers, the regressions excluding specific years and counties are done. Dropping the county of Stockholm makes the coefficient for 90/75 insignificant for the 5-year growth period and dropping the county of Uppsala makes the ratio 50/10 insignificant for the same growth period. Regarding years, when dropping either the year 1993 or 2000, the coefficient for 50/10 becomes insignificant when looking at the 1-year growth period. Thus, some counties and years seem to have an important effect on the results.

A final test for the robustness of the equation is to control for serial correlation. This can be a problem since overlapping time periods are used. When running the regression and calculating the Newey West standard errors, the significance changes marginally for the 1, 3 and 5-year growth periods.[9]

8 Conclusion

In this thesis the effect of economic inequality on economic growth has been explored. With the use of fixed effect regressions three questions have been evaluated. First of all, how does the results, using another measure of economic growth and another time period, compare to previous findings? Second of all, how do different parts of the income distribution affect economic growth? Finally, how do the observed effects change depending on the length of the growth period studied?

The results in this thesis support that there is a net positive effect of inequality on economic growth. Furthermore, it is also found that using the GDP as a measure for economic growth does not drastically alter the results. However, the effect can only be established in the short run, and in the long run the effect is uncertain. These results are in line with previous findings made on Swedish data.

[9] See Appendix D, Table 11 for the results. Note that it was impossible to test for the 10-year growth periods due to lack of data

Moreover, considering the second question the results indicate that different parts of the distribution have different effects on economic growth. Inequality at the top of the distribution has a negative effect on growth, while inequality in the bottom has a positive effect on growth. Therefore, it seems like the positive net effect found is driven by the positive effect that inequality in the lower part of the distribution has on growth. In addition, the effects are stronger and more significant in the short run. These results are somewhat sensitive to the time period studied and the results may be driven by a time trend. However, the insignificance in the results, when controlling for these effects, can also be caused by lack of variation or lack of observations in the data.

That different parts of the income distribution have different effects on growth is in line with Voitchovsky´s findings. These results are interesting since it indicates that inequality affects growth through different mechanisms. Nevertheless, the coefficients of the two ratios studied in this thesis have the direct opposite sign compared to what Voitchovsky finds. According to our findings inequality in the lower part of the distribution has a positive effect on growth, while Voitchovsky concludes it has a negative effect. Additionally, Voitchovsky finds a positive effect in the ratio 90/75, while the same ratio has a negative effect according to our results. However, after considering some alternative econometric specifications and using alternative measures the original results of this thesis are less reliable. Still, even though our results are sensitive to alternative specifications, there are no results that support the effects Voitchovsky proposes. In other words, there are no results that suggest that inequality in the lower end has a negative effect on growth, and nothing supports the claim that inequality in the top has a positive effect on growth. Hence, the opposite results found in this thesis imply that the shape of the income distribution cannot solely explain the different results in the empirical literature. Moreover, it appears to be difficult to firmly connect the different effects in theory to certain parts of the income distribution.

9 Discussion and further research

As was stated in the conclusion, our results, to some extent, contradict previous empirical findings. In order to explain the different results, it would be interesting to further study through

which mechanisms inequality affects growth. In the following paragraphs possible explanations for the results, connected to the theories in section 2.2, are suggested. All these issues could be interesting to further investigate.

Voitchovsky argues that a high degree of inequality in the upper part of the distribution would enhance growth by improving incentives. This incentive-effect is perhaps not as important in a wealthy country like Sweden. Instead, the incentives in the upper end may be lower because of a progressive tax-system, where the taxation is increased when income is higher. For instance, there is a close relationship between the tax bracket and the 75th percentile which could be an indication for this explanation.[10] Moreover, wealthy people may already be satisfied with their situation, which could also decrease the incentive-effect in the upper end of the income distribution. However, the countries studied by Voitchovsky are all OECD countries with a similar income and with taxing systems that perhaps do not differ significantly to Sweden. Hence the above explanation may not be convincing enough and further research would be necessary to verify this possible explanation.

Voitchovsky also emphasizes that high inequality in the upper part of the income distribution increase investments and, therefore, growth. As been stated before in the thesis, this may be difficult to control for when studying differences between open economies since investments may not be made in the same region as where the inequality appears. The fact that counties are more open than countries can affect the magnitude of this effect and can perhaps partly explain the discrepancies between our results and Voitchovsky´s. However, the countries studied in Voitchovsky's research are also open economies and the effect of inequality on investments in her study may, therefore, also be limited.

The non-negative effect of inequality in the lower part of the distribution found within Sweden may be explained by the well developed welfare system existing in Sweden. The fact that education is available for almost all people in Sweden may reduce the amount of lost investment opportunities, which theory states should occur if there is a high degree of inequality in the lower end of the income distribution.

[10] See table 12 in Appendix E

Voitchovsky also stresses that a high degree of inequality among the population with the lowest income can cause social distress. However, this effect may be minor in a developed economy, with a well developed welfare system, which would also explain the non-negative sign of coefficient for the 50/10 ratio. In Sweden the 90/75 ratio can instead be more associated with social distress, because it may be more common that people in Sweden get frustrated about the absolute highest wages (high bonuses) than about the median wage.

The positive effect of the 50/10 ratio may also be an indication of that increased differences between wages and unemployment payments enhances growth. If the 50^{th} percentile represents median wage and the 10^{th} percentile is the unemployment payment, an increase in the ratio 50/10 could give incentives for the unemployed to find work. If the search intensity to find jobs increases among the unemployed, it would likely result in a large effect on growth.

In summary several possible explanations for the result may be found. The explanations are also sometimes possible to connect to current theories which make Voitchovsky´s theory less convincing. However, to further evaluate these possible explanations, more research is needed. Still, the fact that our results differ significantly from earlier studies, and that there are no plausible explanations for this difference, suggest that the effect of inequality on growth is even more complex than has been suggested. It is not enough to just consider the shape of the income distribution. Instead, the different effects inequality has on growth may also depend on the structural setting of the regions studied.

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SCB (2009j), *Befolkning: Folkmängden per tätort. Vart femte år 1990-2005*, Statistics Sweden, Stockholm, Available [online]: http://www.ssd.scb.se/databaser/makro/start.asp [2009-05-11].

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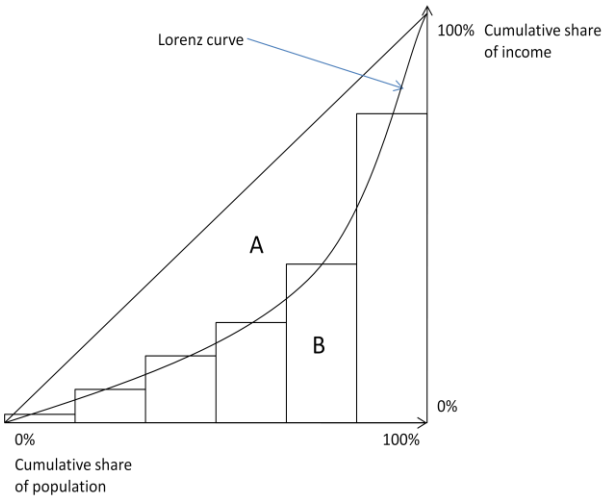
11 Appendix

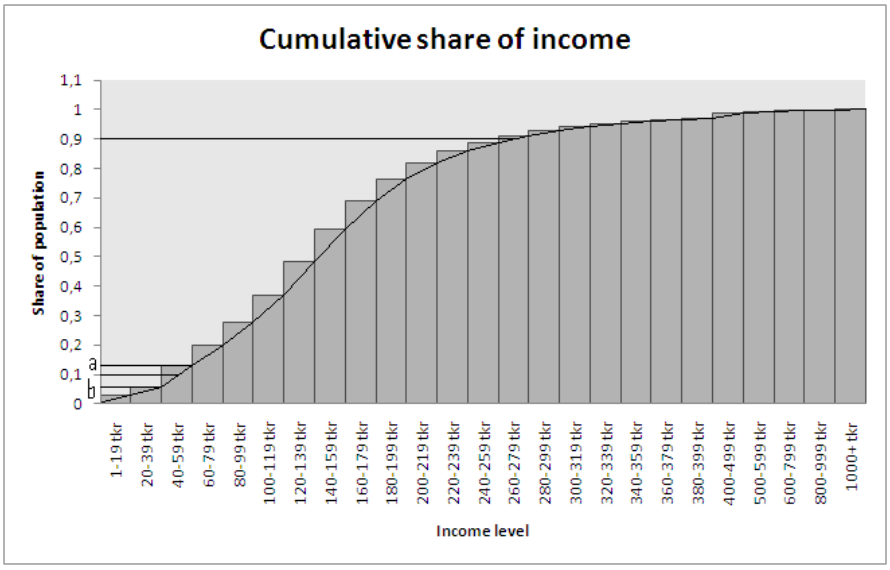
11.1 Appendix A – Calculations of the Gini-index and percentiles



The Gini-index is defined as the ratio $\frac{A}{A+B}$ in the diagram to the left. If $A + B = 0{,}5$, then this expression can be rewritten as $1 - 2B$ (Gastwirth, 1972, p. 307). To estimate the area B (the area under the Lorenz curve), the areas of the bars are calculated and summed together. The base of each bar is the population share for each income class in the statistics. The height of the bars is the mean cumulative income share for each income class.

To estimate the percentiles from the bar chart below, it has been assumed that the distribution inside each income class is uniformly distributed (e.g. a straight line can be drawn inside each income class). The percentiles have then been calculated as follows (using 10th percentile as an example):

Share of people inside the income class that has an income under the 10th percentile: $\frac{0{,}1-b}{a-b} = K$

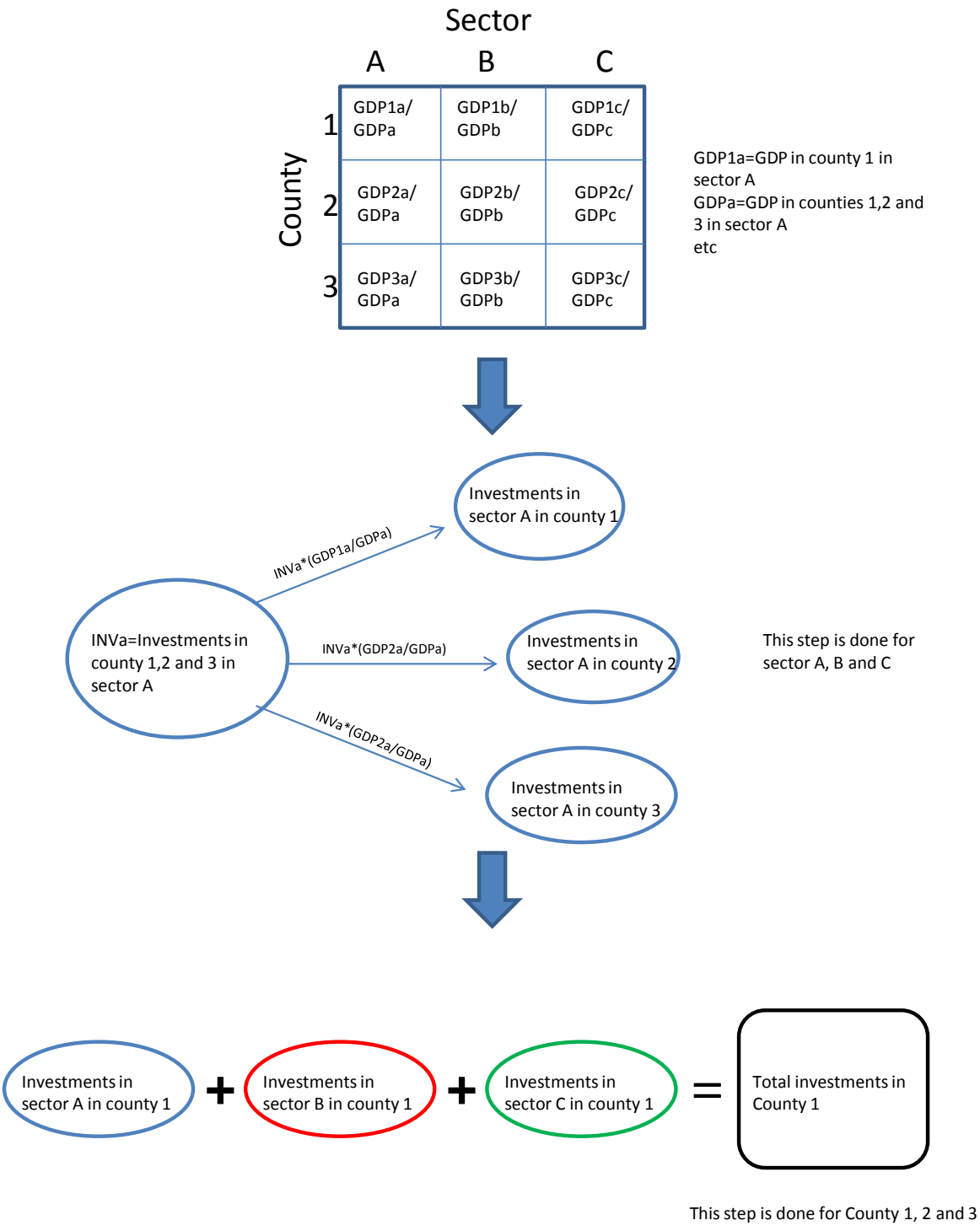


Income level of the 10th percentile:

$K * (60 - 40) + 40,$

where 60 is the upper level of the income class in where the 10th percentile is located and 40 is the lower level of the same income class.

11.2 Appendix B – Estimating the investment measure



11.3 Appendix C – Hausman test

Hausman-test for choosing between fixed or random effect regressions. If it is possible to reject Ho fixed effect is the preferred method. Here the p-value for Ho is 0,0000 and it is therefore possible to reject Ho.

	---- Coefficients ----			
	(b)	(B)	(b-B)	sqrt(diag(V_b-V_B))
	fix	ran	Difference	S.E.
L5.ybrp	-0.2368919	-0.1175929	-0.1192989	.
L5.giniexc~x	0.0083756	-0.0529854	0.061361	0.0322683
L5.utbildn~2	0.92712	0.4713932	0.4557268	0.0143417
L5.urb10k	-0.1296473	0.0683278	-0.197975	0.0860881
L5.age65	0.1974718	0.6894874	-0.4920157	0.086281

b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg
Test: Ho: difference in coefficients not systematic

chi2(5) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 565.87
Prob>chi2 = 0.0000
(V_b-V_B is not positive definite)

11.4 Appendix D – Results from sensitivity analysis

Table 7: The results of the regressions in two subset periods

Growth period	**1 year**		**3 years**		**5 years**	
Time period	Year<2001	Year>2000	Year<2001	Year>2000	Year<2001	Year>2000
Variable						
Initial income	-0,520 ***	-0,690 ***	-0,269 ***	-0,430 ***	-0,183 ***	-0,249 ***
50/10	-0,009	-0,003	0,020 ***	-0,002	0,007	0,003
90/75	-0,075	-0,411	-0,297 **	-0,611 ***	-0,031	-0,008
Education	2,975 ***	2,431 ***	1,000 ***	1,380 ***	0,911 ***	0,878 ***
Urban 10000	-0,905	-0,664	-0,397 *	0,031	-0,308 *	0,047
Age 65+	-1,534	2,038	0,426	0,127	0,183	0,337
Constant	2,915 ***	3,356 ***	1,576 ***	2,664 ***	0,871 ***	0,996 ***
Observations	189	126	147	126	105	126
No. Of counties	21	21	21	21	21	21
R-squared	0,50	0,48	0,75	0,76	0,85	0,75

* Significant on the 10% level
** Significant on the 5% level
*** Significant on the 1% level

Table 8: The results of the regressions including investments, compared to original regression for the same time period

Growth Period	**1 year**		**3 years**		**5 years**		**10 years**	
Investments	Without	With	Without	With	Without	With	Without	With
Variable								
Initial income	-0,482 ***	-0,486 ***	-0,352 ***	-0,351 ***	-0,262 ***	-0,264 ***	-0,072 ***	-0,102 ***
50/10	0,009	0,009	0,004	0,005	-0,003	-0,003 *	0,003	0,004
90/75	-0,725 **	-0,898 **	-0,438 ***	-0,376 **	-0,024	0,135	-0,040	0,007
Education	1,814 ***	1,867 ***	1,243 ***	1,211 ***	0,888 ***	0,889 ***	0,331	0,285
Urban 10000	0,789	-0,034	0,056	0,110	0,132	0,161	1,130 **	1,174 **
Age 65+	0,368	0,434	0,205	0,163	0,209	0,167	1,241 **	1,042
Investments	-	0,365 ***	-	-0,084	-	-0,055	-	-0,155
Constant	2,849 ***	3,045 ***	2,016 ***	1,940 ***	1,095 ***	1,065 ***	-0,468 **	-0,310
Observations	231	231	189	189	147	147	42	42
No. Of counties	21	21	21	21	21	21	21	21
R-squared	0,41	0,29	0,68	0,62	0,80	0,78	0,85	0,85

* Significant on the 10% level
** Significant on the 5% level
*** Significant on the 1% level

Table 9: The results of the regressions including variables for workflows

Growth periods	1 year	3 years	5 years	10 years
Variable				
Initial income	-0,534	-0,318	-0,231	-0,085
	***	***	***	***
50/10	0,010	0,008	0,003	-0,002
	*	***		
90/75	-0,487	-0,255	-0,077	0,026
	**	***		
Education	1,933	1,111	0,833	0,324
	***	***	***	***
Urban 10000	-0,567	-0,330	-0,159	0,233
	*	**		***
Age 65+	-0,121	0,282	0,294	0,152
Inflow	1,790	1,228	0,504	-0,065
	**	***	**	
Outflow	0,045	-0,223	0,002	0,545
				**
Constant	3,143	1,760	1,094	0,193
	***	***	***	**
Observations	315	273	231	126
No. Of counties	21	21	21	21
R-squared	0,43	0,70	0,81	0,86

* Significant on the 10% level
** Significant on the 5% level
*** Significant on the 1% level

Table 10: The results of the regressions including time dummies

Growth periods	**1 year**	**3 years**	**5 years**	**10 years**
Variable				
Initial income	-0,424	-0,302	-0,260	-0,091
	***	***	***	***
50/10	0,004	0,007	0,004	-0,003
		*	*	**
90/75	-0,358	-0,086	0,019	0,058
Education	1,003	0,681	0,365	0,099
	**	***	**	
Urban 10000	-0,397	-0,208	-0,126	0,195
		*		***
Age 65+	-0,302	0,004	0,081	0,072
Constant	2,647	1,582	1,287	0,297
	***	***	***	***
Observations	315	273	231	126
No. Of counties	21	21	21	21
R-squared	0,64	0,74	0,84	0,88

* Significant on the 10% level
** Significant on the 5% level
*** Significant on the 1% level

Table 11: The results of the regressions using Newey West robust standard errors

Growth periods	**1 year**	**3 years**	**5 years**
Variable			
Initial income	-0,503	-0,304	-0,228
	***	***	***
50/10	0,013	0,009	0,004
	**	***	*
90/75	-0,653	-0,337	-0,114
	***	***	**
Education	2,055	1,179	0,882
	***	***	***
Urban 10000	-0,676	-0,385	-0,210
	**	**	**
Age 65+	-0,355	0,079	0,237
Constant	3,396	1,914	1,188
	***	***	***
Observations	315	273	231
No. Of counties	21	21	21

* Significant on the 10% level
** Significant on the 5% level
*** Significant on the 1% level

11.5 Appendix E – Income of the 75th percentile and tax bracket for state taxes

Table 12: Income of the 75th percentile and the tax bracket for paying state taxes

Year	Tax bracket	75th percentile
1996	209,1	202,8
1997	209,1	209,9
1998	213,1	218,1
1999	219,3	227,2
2000	232,6	237,4
2001	252,0	248,5
2002	273,8	258,3
2003	284,3	265,8
2004	291,8	272,7
2005	298,6	280,0
2006	306,6	289,9
2007	316,7	302,7