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Growth and Inequality: A study of Swedish municipalities[1]

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Abstract

This paper explores the relationship between the growth rate of the average income and income inequality using data at the municipal level in Sweden for the period 1992-2007. We estimate a fixed effects panel data growth model where the within-municipality income inequality is one of the explanatory variables. Different inequality measures (Gini coefficient, top income shares, and measures of inequality in the lower and upper ends of the income distribution) are also examined. We find a positive and significant relationship between income growth and income inequality, measured as the Gini coefficient and top income shares, respectively. In addition, while inequality at the upper end of the income distribution is positively associated with the income growth rate, inequality at the lower end of the income distribution seems to be negatively related to the growth rate. Our findings also suggest that increased income inequality enhances growth more in municipalities with a high level of average income than in those with a low level of average income.

Key words: Growth, inequality, Gini coefficient, panel data model, municipalities.
JEL classification: R11, D31, D63, O47

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1. Introduction

The effect of income inequality on economic growth has attracted much interest among economists, as well as in popular debate (Stiglitz, 2012). A key issue in the literature refers to the possible trade-off between equality and economic growth. With the expansion of the welfare state, Sweden experienced a significant decrease in income inequality, measured in terms of taxable income, after World War II (Lindbeck, 1997) followed by a slight increase in the last decades. It is not surprising, therefore, that Sweden, thanks to its tradition as an egalitarian society, has attracted interest from scholars (Roine and Waldenström, 2008). Recent research based on county level data for Sweden suggests that increased income inequality leads to increased income growth, supporting the idea of a trade-off between growth and equality (Nahum, 2005; Gromark and Petersson, 2010).

Economists typically address the relationship between growth and inequality by adding a measure of income inequality as an additional explanatory variable in a growth regression model. Based on this approach, and by focusing on cross-country data, an extensive literature has explored how the distribution of income affects the growth rate of an economy's gross domestic product (GDP)[2]. Several earlier studies on the growth-inequality relationship examine a single cross-section of countries and typically find a negative and significant relationship between GDP growth and income inequality (Persson and Tabellini, 1994; Alesina and Perotti, 1996). Other studies, such as Forbes (2000), instead report a significant and positive relationship based on cross-country panel data using fixed effects estimation. Similarly, Partridge (1997) finds a positive correlation between GDP growth and the Gini coefficient based on panel data for the US states. Li and Zou (1998) find that the relationship between income inequality and economic growth becomes significantly positive when using panel data (along with appropriate methods for handling such data), while a negative relationship is typically found for single cross-section data. There is also evidence suggesting that the relationship between growth and inequality may vary systematically between countries: Barro (2008) finds that inequality appears to encourage growth only within rich countries and to slow down growth in poorer countries. His paper covers data from 1960 to 1990 for 84 countries.

In the literature, at least three arguments have been put forward for a positive relationship between growth and inequality. The first argument is that inequality enhances growth through greater investment opportunities. This argument assumes that investments are characterised by large set-up costs and that there exists credit-market imperfections, i.e. there are limits to borrowing money. In

[2] The opposite causality is the Kuznets' Hypothesis, which postulates that income inequality first rises and then falls during the course of economic development (Kuznets, 1955).

that set-up, an initial amount of personal wealth is needed to be able to invest in a project. With an unequal wealth distribution, therefore, one may find more wealthy people who are able to invest and initiate new industrial activity, which would enhance economic growth (Aghion *et al.*, 1999). The second argument is based on the idea that individual savings rates increase with the level of income. Therefore, a redistribution of resources from rich to poor people may lower the aggregate rate of savings. Through this channel, increased inequality tends to increase investment (Aghion *et al.*, 1999). This effect is primarily relevant for closed economies, where domestic investments equal the domestic savings. Finally, the last argument is that equal wages would discourage people from exerting 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; Voitchovsky, 2005). In a similar way, there are also arguments for a negative relationship between growth and inequality. Accordingly, a more equal income distribution may enhance growth by reducing corruption, crime, and social unrest, and by alleviating credit constraints, allow for investment in human and physical capital (Alesina and Rodrik, 1994; Persson and Tabellini, 1994; Alesina and Perotti, 1996; Aghion *et al.*, 1999; Barro, 2000).

The present study attempts to explore the relationship between average income growth and income inequality at the municipal level in Sweden from 1992 to 2007 using different measures of income inequality. This is accomplished by estimating a growth-inequality model to test whether and how income inequality affects income growth, conditional on a set of control variables. Data on income inequality refer to population shares in different income classes for each municipality and year, which can then be used to calculate measures of income inequality such as the Gini coefficient and different top income shares. Following Voitchovsky (2005), we also estimate a growth model including measures of inequality both at the lower and upper ends of the income distribution. Furthermore, we examine if the relationship between income growth and income inequality varies with the income level by allowing for an interaction effect between the Gini coefficient and the level of average gross income (see Barro, 2000, 2008, for a similar approach based on cross-country panel data).

To our knowledge, there are no earlier studies dealing with the relationship between income inequality and growth at the municipal level in Sweden. Instead, previous studies are based on data at the county level (Nahum, 2005) or labour market regions (Rooth and Stenberg, 2012) whereas our study focuses on a panel data set covering 283 municipalities. Nahum (2005) explores the relationship between growth and inequality measured by the Gini coefficient using panel data at the county level from 1960 to 2000. She estimates the effects of inequality in growth regressions with 1, 3, 5 and 10-year growth periods, where the growth rate depends on explanatory variables measured at the beginning of each growth period. Using fixed effects panel 2SLS estimations, she finds a positive effect of inequality on 1 to 5-year economic growth rates (when significant), whereas the corresponding effect based on 10-year growth periods is typically not significant.

Rooth and Stenberg (2012) analyse the relationship between growth and income inequality based on data for 72 labour market regions in Sweden during the period 1990-2006. The labour market regions are based on commuting patterns of the labour force, which have been constructed by Statistics Sweden, collapsing 289 municipalities into 72 regional labour markets. The model is estimated by using cross-sectional OLS, panel (pool) OLS, panel with region specific fixed effects and system GMM[3]. The main results show that increased overall inequality (through an increase in the Gini coefficient) and increased inequality in the upper end of the income distribution (measured by the ratio between the 90th and the 50th income percentiles) lead to increased growth, while they find no evidence that inequality in the lower end of the income distribution (measured by the ratio between the 50th and the 10th income percentiles) affects the income growth rate.

However, the results presented in Rooth and Stenberg (2012) are sensitive to the choice of estimation method and sample size. In a cross-sectional estimation, which includes one observation per region, the Gini coefficient is positively related to growth, while in a pooled OLS model the Gini coefficient has a negative effect on growth when combined with the measure of inequality in the upper end of the distribution. Also, the effect of the Gini coefficient changes from being positive to negative when the time span of the model changes from 1990-2006 to 1994-2006. Finally, when a system GMM model is estimated for the period 1990-2006, the Gini coefficient has a negative effect on growth, while for the period 1994-2006 the Gini coefficient has a positive effect if combined with the measure of inequality in the upper end of the income distribution.

Compared to other studies based on Swedish data (Nahum, 2005; Rooth and Stenberg, 2012), we use a broader set of inequality measures to study the relationship between income growth and income inequality. We consider the Gini coefficient (as a measure of the overall inequality) as well as the income shares of the 25%, 15%, 10%, 5% and 1% top income earners (not included in the above studies). Moreover, we follow Rooth and Stenberg (2012) by analysing the effects of inequality at the lower end of the income distribution, measured by the ratio between the 50th and 10th income percentiles (referred to as 50/10), and inequality at the upper end of the income

[3] Cross-sectional regressions are based on average annual growth 1990-2006 and 1994-2006, Pool and system GMM used data measured in 4-year intervals.

distribution measured by the ratio between the 90th and the 75th income percentiles (referred to as 90/75). This allows us to cover most of the inequality measures used in the literature. A further important contribution is to examine the simultaneous effects of different measures of income inequality, i.e. the joint effects of the Gini coefficient and the 90/75 and 50/10 measures, in terms of municipal income growth, which facilitates comparison with the results for labour market regions presented by Rooth and Stenberg (2012).

Our data covers 15 years, from 1992 to 2007 and are collected from the same source, Statistics Sweden (SCB), in a uniform manner across municipalities to reasonably ensure comparability and minimise measurement errors. This is the most recent and longest period from which we could find comparable data at the municipal level, that is, all variables are measured in a consistent way over time. An advantage with our data is the high degree of homogeneity in terms of democratic functions, public transfer systems, educational systems, and labour market institutions across municipalities in the same country; a similar argument was made by Rooth and Stenberg (2012) in the context of labor market regions. In fact, a problem with cross-country studies is that the data on income statistics may differ significantly between countries regarding both the quality and definitions (Pardo-Beltrán, 2002). Moreover, countries may also differ in the "level of democracy, human rights, type of economy, education system etc., which does not make it reasonable to expect that one single model holds for all countries" (Nahum, 2005). These issues could be less severe when using data for a single country, where much of the institutions are the same.

The paper is structured as follows: Section 2 provides the empirical framework where the model is presented together with data. In Section 3, the results are presented and discussed. The last section, Section 4, provides the conclusions.

2. Empirical framework

This section presents a regression model for studying the relationship between income growth and income inequality, conditional on a set of other control variables that may affect the growth rate. The analysis follows the 5-year panel data growth model examined in several recent papers such as Li and Zou (1998), Voitchovsky (2005) and Barro (2008), as well as the set-up and explanatory variables used in earlier studies on economic growth at the regional/local level in Sweden (e.g. Aronsson *et al.*, 2001; Lundberg, 2003; and Nahum, 2005).

The basic regression model, with income inequality measured by the Gini coefficient, is given by the following equation, where the dependent variable, $y_{i,t}$, denotes the growth rate of the average income among the municipal residents between periods $t-T$ and t:

$$
\begin{aligned}
y_{i,t} = {} & \alpha_i + \beta Y_{i,t-T} + \delta_1 G_{i,t-T} + \delta_2 Tax_{i,t-T} + \delta_3 Exedu_{i,t-T} + \delta_4 Exfam_{i,t-T} \\
& + \delta_5 Exchil_{i,t-T} + \delta_6 Exeld_{i,t-T} + \delta_7 Exp_{i,t-T} + \delta_8 Edu_{i,t-T} + \delta_9 Herf_{i,t-T} \\
& + \delta_{10} Cons_{i,t-T} + \delta_{11} Age65_{i,t-T} + \delta_{12} (G \cdot Y)_{i,t-T} + \varepsilon_{i,t}
\end{aligned}
\qquad (1)
$$

where *i*=1,…*N* refers to cross-section unit (municipality), while α_i, β, and the δ s are parameters to be estimated. The variable $\varepsilon_{i,t}$ represents an independently and identically distributed error term. In the estimations, $T = 5$ years.[4] Taking five-year averages will reduce the short-run fluctuations and therefore the influence of the economic cycle. The five-year time lag also facilitates comparison of our analysis with other similar studies (e.g. Barro, 2000; Nahum, 2005[5]; Voitchovsky, 2005; Rooth and Stenberg, 2012), which have also used the same time lag. The variables used in the estimation include a broad spectrum of potential determinants of average income growth. The list and detailed definitions of the variables are presented in Table 1.

The initial level of average income, $Y_{i,t-T}$, i.e. the average income at the beginning of each growth-period, allows us to control for the relationship between the income level and the subsequent growth, and also address the question of conditional convergence. The latter means that each municipality is converging to its own steady state (see, for example, Barro and Sala-i-Martin, 1992, and Mankiw *et al.,* 1992). Previous studies based on Swedish data have found that regions tend to converge over time (either unconditionally, as in Persson, 1997, or conditionally, as in Aronsson *et al.*, 2001; Nahum, 2005). As a consequence, we control for this mechanism through the initial level of average income in the municipality.

The variable $G_{i,t-T}$ denotes the Gini coefficient for municipality *i* in period *t-T*. As indicated above, we will also consider other measures of income inequality such as different top income shares as well as the measures of inequality in the upper and lower ends of the income distribution. This will

[4] As mentioned in section 3 below, we have also considered 3- and 4-year growth periods.
[5] As mentioned above, she also estimated models based on longer growth periods.

Table 1: Description of the variables

Variable	Description
y	Average income growth $y_{i,t} = \ln(Y_{i,t} / Y_{i,t-T})$ where $Y_{i,t}$ is the average income level (thousands of SEK) measured for the population aged 20 and above in municipality *i* between period *t-T* and *t*.
Y	Log of average income (thousands of SEK) among those aged 20+.
G	The Gini coefficient, which has been calculated using data on income distribution for the population aged 20 and above at the municipal level. For each year and municipality, these data contain information about the population in different intervals of taxable personal income[6]. The formula for the Gini coefficient is presented in Appendix A, Table A2. G is equal to 1 when the inequality is at its maximum and zero with an equal distribution.
Top%	Income shares of top 25%, 15%, 10%, 5% and 1% income earners (our elaboration) i.e. the sum of income for people in the richest group divided by the sum of income over all residents.
90/75	The income of the 90th percentile divided by the income of the 75th percentile (our elaboration).
50/10	The income of the 50th percentile divided by the income of the 10th percentile (our elaboration).
Tax	Local income tax rate given by the sum of the municipal and county income tax rates.
Exedu	The share of expenditure on education
Exchil	The share of expenditure on child care
Exfam	The share of expenditure on family care
Exeld	The share of expenditure on elderly care
Exp	Per capita total expenditure (SEK) given by the sum of expenditure on culture, education, childcare, family care, and on elderly care divided by the population (for computational reasons, divided by 1000).
Edu	The share of inhabitants with at least three years of university education.
Herf	Herfindahl index measuring the political stability in the municipality parliament. The Herfindahl index[7] is measured by the sum of the squared shares of seats in the municipal council occupied by the Conservative Party, Centre Party, Liberal Party, Christian Democrats, Green Party, Social Democrats, Left Party and other parties.
Cons	The share of seats in the local parliament held by the Conservative Party, Centre Party, Liberals and Christian Democrats.
Age65	The share of inhabitants aged 65 and above.
Dens	Population density, measured as the number of residents per square kilometre.

Note: Income and Expenditure are adjusted by Swedish CPI (2005 is the base year). Measures of income inequality are also based on real income.

be described in greater detail below.

As suggested in earlier studies, the growth rate of average income also depends on local and national policy decisions (see Glaeser *et al.*, 1995; Helms, 1995; Aronsson *et al.,* 2001). The effects of local

[6] The best available data are based on taxable personal income. We also use taxable personal income, like Nahum (2005), for reasons of comparison. Taxable income was also used by Persson and Tabellini (1994) and Perotti (1996).

[7] The Herfindahl index is defined as $\sum_{p=1}^{P} SH_p^2$ where SH_p is the share of seats from party p. The Herfindahl index ranges from a minimum of $1/P$ to a maximum of 1 if a single party holds all seats in the local council, where P is the number of different parties.

policy variables are captured by the parameters $\delta_2 - \delta_7$. The local income tax rate, Tax, given by the sum of the municipal and county income tax rates, serves to capture differences in the tax-wedge between municipalities. Helms (1985) found a negative effect of the income tax rate on economic growth based on data from 1965 for 48 states, whereas the effect of the local income tax rate is typically insignificant in earlier studies of income growth at the regional and municipal level in Sweden (Aronsson *et al.,* 2001; Lundberg, 2003).

We control for the effects of the public expenditure pattern via different municipal public expenditure shares: $Exedu$, the share of local public expenditure on education; $Exfam$, the share of local public expenditure on family care; $Exchil$, the share of local public expenditure on childcare; and $Exeld$, the share of local public expenditure on elderly care. The variable Exp denotes the per capita total expenditure (in SEK), reflecting public spending on education, family care, child care, elderly care and culture. The effect of local public expenditure per capita may capture effects of productive expenditure as well as disincentives associated with revenue collection. Aronsson *et al.* (2001) find that local public expenditure per capita does not significantly affect the economic growth based on income data at the county level, whereas Lundberg (2003) finds that the local public expenditure per capita has a negative impact on average income growth within the major city areas (Stockholm, Malmö and Goteborg) based on income data at municipal level.

Human capital is typically expected to enhance economic growth. In the present study, we try to control for human capital by including the variable Edu, i.e. the share of the population between 25 and 65 with three years or more of university education, among the regressors. Several earlier studies have used the same definition of human capital (Partridge, 1997; Aronsson *et al.*, 2001; Panizza, 2002; Lundberg, 2003; Nahum, 2005).

Average income growth may also depend on factors related to the political preferences and stability of the local council. As such, and following Lundberg (2003), we include the Herfindahl index, $Herf$, and a dummy variable for liberal/conservative party majority, $Cons$, among the regressors. The Herfindahl index is an indicator of political stability in the sense that an increase in this index means less fragmentation in the municipal parliament. As such, a decrease in the Herfindahl-index is expected to reduce the income growth rate, due to that a fragmented parliament makes it difficult to reach long-term agreements (see Roubini and Sachs, 1989a, 1989b; Alesina and Perotti, 1995; and Alesina *et al.*, 1996). On the other hand, we have no prior expectations regarding the effect of the share of seats in the local parliament held by the liberal and conservative parties. Finally, we also control for the demographic composition as represented by the share of the population aged 65 and above, $(Age65)$, and population density, $Dens$; see, for example, Perrotti (1996), Forbes (2000), Panizza (2002), and Nahum (2005).

2.1 Descriptive Statistics

In this section, we discuss the descriptive statistics for the main variables as displayed in Table A2, Table A3, Figure A1 and Figure A2 in the appendix. The dataset originates from Statistics Sweden and covers 283 out of 290 municipalities[8], during the period 1992-2007. The measures of income inequality are calculated by using information about the distribution of personal taxable income in each municipality and year. More specifically, the population in each municipality is divided into 18 income classes; by assuming that each individual has the average income in his/her income class, it is then possible to calculate the Gini coefficient and the top income shares (top 25%, 20%, 15%, 10%, 5%, and 1%). The inequality measures also include the top and bottom end inequality. More precisely, top end inequality is measured by the income percentile ratio 90/75, and bottom end inequality is measured by the income percentile ratio 50/10.

Looking at Table A2, income growth, y, is on average 2% for the entire period, and the standard deviation of income growth rate is larger within, than between, municipalities. The variability of the average income, Y, measured by the standard deviation within municipalities is almost the same as the standard deviation between municipalities. Municipalities in the county of Stockholm such as Danderyd, Lidingö, Täby, Sollentuna, and Vaxholm, appear to have the highest average income every year. The average Gini coefficient is 0.16 for the overall period with a standard deviation of 0.05; the standard deviation is larger between (0.045), than within (0.031), municipalities. By comparing extremes, we have observed that the largest average income is in the municipality of Danderyd in 2007 (439.6 thousand SEK), which also has the largest Gini coefficient (0.55) in the same year. The smallest average income (115 thousand SEK) can be found in Bjurholm in 1992, while the lowest Gini (0.07) is found in Överkalix in 1992. Thus, in line with earlier studies, most of the variation in the Gini coefficients at the municipal level is cross-sectional rather than temporal (e.g. Deininger and Squire, 1996; Partridge, 2005; Voitchovsky, 2005).

Turning to the other measures of inequality to be used below, notice first that the municipalities with high top income shares typically are those situated in the Stockholm region. The municipality with the highest top income shares is Danderyd. The ratio 90/75 seems to show some variation

[8] The municipalities Nykvarn, Knivsta, Gnesta, Trosa, Gotland, Bollebygd, and Lekeberg were excluded from our analysis because borders were changed during 1992-2007.

both between and within municipalities during 1992-2007. On the other hand, the ratio 50/10 varies greatly, both over time and across municipalities. The inequality measures also have an increasing trend towards the end of the sample period (see Fig. A1 in the appendix). The same pattern can also be noticed for average income in some municipalities (see Fig. A2 in the appendix). The similarity of the trends suggests that there is some type of relation between inequality and economic growth at the municipal level.

2.2 The endogeneity issue

The estimation of the effect of income inequality on economic growth raises some problems of endogeneity. First, there is a correlation between $Y_{i,t-T}$ on the right side of (1) and the fixed effect. Another potential endogeneity problem is associated with the income inequality measures; the estimated effect of income inequality on the income growth rate might be biased by a correlation between the measure of inequality and the error term. If the RHS variables are endogenous and thus correlated with the error term, the OLS/FE coefficient estimate is biased and inconsistent[9]. Yet, the fact that the RHS variables are dated at the beginning of the growth period naturally minimises the problem of endogeneity.

A number of authors cope with these problems by using 3SLS (Barro, 2000, 2008) or System-GMM (Castelló-Climent, 2004). The GMM procedure of first-differencing, using lags as instruments, requires more data points than in our case study. Yet, based on the Monte Carlo simulations in Judson and Owen (1999), it is not necessarily incorrect to treat income variables as exogenous: they show that for panels with a short-time dimension (as in our case), the bias of the coefficient on the lagged dependent variable can be significant, while the bias of estimates of the other coefficients may still be minor[10]. Nevertheless, the endogeneity problem may persist.

The inequality measured in period $t-T$ may be correlated with the same unobserved characteristics as the income growth rate between periods $t-T$ and t. Some of the previous works (Alesina and Rodrik, 1994; Nahum, 2005)[11] discuss whether the Gini coefficient should be considered as an exogenous or an endogenous variable. Alesina and Rodrik (1994) assume that the Gini coefficient is

[9] The estimation of the growth-inequality link is plagued by omitted variable bias, where unobserved time invariant characteristics may correlate both with the lagged dependent variable and the fixed effect. Nonetheless, the possible effects of unobserved attributes in a single country context are most likely not as important as in a multi-country framework, since institutions, culture and norms are largely similar across municipalities in Sweden. Therefore, omitted variable bias should be alleviated as municipalities have similar redistributive policies and institutions (Rooth and Stenberg, 2012).

[10] We have also estimated our model considering income as exogenous. The signs and significance of the coefficients were consistent with the results presented in Table 2, so we have not presented these results.

[11] They argue that income inequality and income growth might be jointly determined.

an endogenous variable and use 2SLS to estimate the growth equation. Nahum (2005) addresses the endogeneity problem by using 2SLS, where the Gini coefficient is regressed on variables reflecting the age structure of the population in the first stage. She also compares the second stage results for the growth equation with those that follow if the Gini coefficient is treated as exogenous, and finds no important differences in the results. Assa (2012) also examines the relationship between economic growth and income inequality using data for 141 countries between 1992 and 2005. He estimates a 2SLS regression and uses primary school enrolment as an instrumental variable for the Gini coefficient.

So, following the works mentioned above, we estimate the growth regression of our panel data model with fixed effects and instrument $Y_{i,t-T}$, with a one period income lag $Y_{i,t-T-1}$, (Green, 2011). In a way similar to Nahum (2005), who also addresses the endogeneity of income inequality, we estimate our model using 2SLS to instrument inequality, where the first stage regression for the Gini coefficient, top income shares, 90/75 and 50/10, respectively, uses the share of age groups (such as $Age24\_44$, $Age45\_64$, $Age65$) in the adult population as explanatory variables. The age structure has a direct effect on the income distribution, since it captures the shares of the population in various parts of their life cycle.

3. Empirical results

As indicated above, we have performed first stage regressions with the inequality measures as dependent variables. We investigate the strength our instruments using the first stage F-statistic as suggested by Bound *et al.* (1995) and Steiger and Stock (1997). Based on the F-test, we find that the instruments have significant effects in each of the first stage regressions[12]. Our F-statistics exceed the rule of thumb value of 10[13]; this implies that our instruments offer a good explanation of the variation in the endogenous variables[14].

The results of estimating model (1) are summarised in Tables 2 and 3. In Table 2, we report in column (i) the relationship between the average income growth rate and the Gini coefficient without

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[12] To save space, the results from the first stage regressions are not presented here, although available from the author upon request.

[13] Stanger and Stock (1997) provide a theoretical analysis of the properties of the IV estimator and provide some guidlines about how large the F-statistic should be for the IV estimator to be a valid instrument. For the rule of thumb, see also Stock and Watson (2005, Ch.10)

[14] We also test if the inequality measures are endogenous by applying the Durbin–Wu–Hausman test. See Hausman (1978), and also Durbin (1954) and Wu (1973). See also Green (2011). We have endogeneity if the 2SLS estimates differ significantly from the OLS estimates. We reject the null hypothesis, so we have an endogenenity issue.

any interaction effect between the Gini coefficient and the level of average income. In column (ii), we follow Barro (2000, 2008) and Forbes (2000) and add such an interaction effect to examine whether the income growth rate in municipalities with a high level of average income responds to income inequality in a different way than the income growth rate in municipalities with a lower level of average income. In columns (iii) and (iv) and in columns (v) and (vi), respectively, we carry out the same analysis with the modification that income inequality is measured by top income shares (top 25 and top 15) instead of by the Gini coefficient. Results for other top income shares can be found in the appendix, Table A4. Finally, in Table 3, we present the estimation results for a more comprehensive model, which contains an overall measure of income inequality (given by the Gini coefficient) as well as measures of inequality in the lower (50/10) and upper (90/75) ends of income distribution.

Table 1 shows that the effect of the Gini coefficient and top income shares, respectively, on the income growth rate is always positive and significant in all columns. These results are in line with Nahum (2005), who finds that an increase in the Gini coefficient leads to an increase in the average income growth rate at the country level in Sweden. Although we use a different inequality measure for the upper part of the income distribution, our results are also consistent with Voitchovsky (2005), who finds that inequality in the upper part of the income distribution has a positive effect on the growth rate.[15]

Furthermore, notice that the parameter of the interaction variable $(Y \cdot G)$ is significant and has a positive sign, suggesting that the relationship between the growth rate and the Gini coefficient is stronger in municipalities with a high level of average income than in municipalities with a low level of average income, *ceteris paribus*. This result is also confirmed for the specification with $(Y \cdot Top\%)$. As such, it appears as if the trade-off between growth and equality is stronger in rich municipalities, although the trade-off is also present in poor municipalities. The positive effect of the interaction variable is in line with Barro's (2000, 2008) earlier findings on cross-country data and is also found by Forbes' (2000).

Turning to the effects of the other regressors, the results show that the initial level of real average income, Y, has a negative and significant effect on the income growth rate, suggesting conditional

[15] As mentioned in the introduction, the positive relationship between growth and income inequality is also consistent with previous studies based on cross-country panel data (Forbes (2000) and Li and Zou (1998)), as well as results presented in Partridge (1997) based on income data for the US states. On the other hand, based on similar data for the period 1940-1990, Panizza (2002) found evidence of a negative relationship between income inequality and economic growth.

convergence in the sense that municipalities with a low level of initial income tend to grow faster than municipalities with high income levels, conditional on the other explanatory variables. A similar result has been found in studies using data on US states (Barro and Sala-i-Martin, 1992; 1995) and studies based on data for Swedish counties and municipalities (Aronsson *et al.,* 2001; Lundberg, 2003).

Table 2: Fixed Effects estimations

	Gini[16]		Top25		Top15	
	(i)	(ii)	(iii)	(iv)	(v)	(vi)
	ln(y)					
Constant	-0.040 (-0.76)	-0.005 (-0.09)	0.322*** (5.23)	0.404*** (6.53)	0.335*** (5.66)	0.404*** (6.83)
G_{it-T} or $Top\%_{it-T}$	0.517*** (10.80)	0.564*** (11.80)	0.703*** (8.88)	0.799*** (10.08)	0.731*** (10.63)	0.800*** (11.65)
Y_{it-T}	-0.215*** (-6.00)	-0.624*** (-9.77)	-0.284*** (-8.21)	-0.701*** (-10.97)	-0.274*** (-8.00)	-0.690*** (-10.83)
Tax_{it-T}	-0.059 (-0.90)	-0.088 (-1.35)	-0.0316 (-0.48)	-0.061 (-0.92)	-0.067 (-1.01)	-0.097 (-1.48)
$Exedu_{it-T}$	0.246*** (4.32)	0.231*** (4.10)	0.236*** (4.10)	0.224*** (3.94)	0.246*** (4.31)	0.231*** (4.09)
$Exfam_{it-T}$	0.681*** (11.03)	0.667*** (10.90)	0.651*** (10.51)	0.636*** (10.37)	0.652*** (10.60)	0.635*** (10.42)
$Exchil_{it-T}$	0.362*** (5.76)	0.317*** (5.08)	0.383*** (6.05)	0.341*** (5.42)	0.366*** (5.82)	0.321*** (5.14)
$Exeld_{it-T}$	0.399*** (7.68)	0.382*** (7.41)	0.382*** (7.29)	0.367*** (7.08)	0.388*** (7.49)	0.370*** (7.21)
Exp_{it-T}	-0.086*** (-14.16)	-0.093*** (-15.29)	-0.091*** (-14.59)	-0.097*** (-15.61)	-2.267*** (-21.31)	-0.093*** (-14.97)
Edu_{itT}	2.403*** (21.64)	2.300*** (20.77)	2.165*** (20.51)	2.052*** (19.46)	0.086*** (13.87)	2.153*** (20.25)
$Herf_{it-T}$	0.104*** (5.79)	0.117*** (6.58)	0.101*** (5.61)	0.114*** (6.36)	0.107*** (5.98)	0.121*** (6.78)
$Cons_{it-T}$	-0.328*** (-24.74)	-0.327*** (-24.91)	-0.327*** (-24.50)	-0.326*** (-24.71)	-0.325*** (-24.57)	-0.324*** (-24.73)
$Age65_{i,t-T}$	-0.048 (-0.52)	0.001 (0.01)	0.018 (0.19)	0.078 (0.82)	0.052 (0.55)	0.111 (1.18)
$Dens_{i,t-T}$	-0.089* (-2.55)	-0.074* (-2.12)	-0.148*** (-4.31)	-0.135*** (-3.99)	-0.127*** (-3.72)	-0.115*** (-3.39)
$(G*Y)_{it-T}$ or $(Top\%*Y)_{it-T}$		0.895*** (7.70)		0.908*** (7.73)		0.898*** (7.71)
N of observations	3113	3113	3113	3113	3113	3113

Note: t-values in parentheses. Significance level: "*"p<0.05, "**", p<0.01, "***" p<0.001

[16] We also estimated this model using three lags. We noticed that the sign and significance of the effect of the Gini coefficient did not change, and the changes in magnitudes and significance levels of the other regression coefficients were very small, so we did not report these results.

The local income tax rate, Tax, is negatively associated with the income growth rate, although the estimated coefficient is insignificant. In addition, the initial level of local public expenditure per capita has a negative and significant effect on the subsequent income growth rate. These results are comparable to some of the findings presented in earlier studies based on Swedish data (Aronsson *et al.*, 2001; Lundberg, 2003) discussed above. Yet, notice also that the effects of the local policy variables are not robust across different versions of the model: in Table 3 the estimated effect of the local income tax rate is negative and significant, while the local public expenditure per capita has a positive and significant effect on the income growth rate. It is difficult to give interpretations of these results as local councils were not required to balance their budget each year during this period[17]. Consequently, local government expenditure and income tax rates may not solely reflect the current service level and cost for taxpayers. The shares of local public expenditure on education, family, children, and elderly are all significantly and positively correlated with income growth in all models.

It is expected that economic growth and human capital are positively correlated. In accordance with these expectations, we find that the share of the population with a university education of three or more years, Edu, is positively correlated with the growth rate in all columns. This result is consistent with theory, and indicates the importance of human capital for municipal income growth. The Herfindahl index, $Herf$, has a positive and significant effect in the growth equation. Therefore, a more fragmented municipal parliament (as represented by a lower index value) tends to lower the income growth rate, *ceteris paribus*. Although expected, this result is in contrast to what is found in Lundberg (2003), where the coefficient of $Herf$ is negative and significant. The results also indicate that municipalities with a liberal and/or conservative majority, $Cons$, in the local parliament are characterised by a lower growth rate than other municipalities, *ceteris paribus*. Finally, the effect of the share on inhabitants aged 65 and above, $Age65$, in the growth equation is insignificant, whereas the population density, $Dens$, has a significant and negative effect on the subsequent growth rate.

Returning to the effects of income inequality, we perform a robustness check, as in Barro (2000), by dividing the sample into one group with high-income municipalities and another with low-income municipalities, where the sample mean constitutes the break point. In this case we can estimate two separate coefficients. The results of our investigation, based on fixed effects models, are presented in the appendix in Table A5. As we can see, the coefficients of G are positive and significant for

[17] Some other studies find a negative relationship between public expenditure and economic growth (Barro, 1991; Gwartney, Lawson and Holcombe, 1998). These studies look at spending beyond certain core functions and conclude that growth will be retarded if public expenditure is too high.

both rich and poor municipalities although they differ in term of magnitude; the coefficient of G for rich municipalities is larger than the coefficient for the poor municipalities, which is consistent with the results presented above. We also test for significant differences between the rich and poor municipalities with respect to the effect of the Gini coefficient, by including all observations in the same regression and using a dummy variable to indicate the rich municipalities. We reject the hypothesis that the effect of the Gini coefficient is the same in both types of municipalities (*t*-value 6.98; 95% CI: 1.132 to 2.016), and conclude that the effect is larger for rich municipalities than for poor municipalities.

The next step is to follow Voitchovsky (2005) and test whether top end and bottom end inequality affect income growth in different ways, and also examine the simultaneous effects of the Gini coefficient and the 90/75 and 50/10 ratios. These results are presented in Table 3, where the 90/75 ratio is found to have a positive and significant effect on the income growth rate, while the effect of the 50/10 ratio is negative and significant. A joint test shows that the 90/75 and 50/10 measures jointly contribute to the municipal income growth rate. When we consider the three inequality measures (Gini, 90/75 and 50/10) simultaneously, our results show that both the Gini and the 90/75 ratio have positive and significant effects on the income growth rate, while the 50/10 ratio has a negative effect. The effects of the Gini coefficient and the 90/75 ratio may reflect some of the mechanisms discussed in Section 1. More inequality at the top may indicate that more individuals are wealthy enough to carry out investment projects with high fixed costs. It may also imply stronger incentives to undertake effort. Moreover a further explanation of this result is provided by Galor and Tsiddon, (1997) and Hassler and Mora, (2000) who argue that a concentration of talented and skilled individuals with a high income share (in advanced technology sectors) may be conducive to technological progress, and therefore to growth.

Inequality outside the top range of the income distribution, after controlling for the effect of the Gini coefficient, seems to have a negative effect on the income growth rate and may be associated with channels such as credit constraints and investment in human capital, as well as increased crime and insecurity. As a result of limited funds, some individuals might not be able to exploit their skills and talent, and fewer productive investments will be undertaken (Galor and Moav, 2004). Still, Persson and Tabellini (1994) argue that the negative effect of inequality on economic growth coexists with imperfect credits markets; poor people may be unable to invest in their human and physical capital with negative consequences for growth.

In summary, we can see that all specifications suggest that the ratio 50/10 has a negative effect on growth and the ratio 90/75 has a positive effect on growth in Sweden. The estimated effect of the 90/75 ratio is in line with the findings in Rooth and Stenberg (2012), whereas the effect of the 50/10 ratio differs from their results. Results from Tables 2 and 3 thus indicate that inequality in different parts of income distribution have different effects on the income growth rate.

Table 3: Fixed Effects estimations with top and bottom end inequality

	Top only	Bottom only	G and Top	G and bottom	Top and Bottom	G and Top and bottom
	ln(y)					
Constant	-0.206*** (-4.08)	-0.139** (-3.14)	-0.206*** (-4.13)	-0.141** (-3.21)	-0.198*** (-3.94)	-0.201*** (-4.02)
G_{it-T}			0.331*** (6.31)	0.314*** (5.93)		0.314*** (5.95)
$90/75_{it-T}$	0.050* (2.51)		0.0497* (2.55)		0.0484* (2.47)	0.0490* (2.51)
$50/10_{it-T}$		-0.006** (-3.12)		-0.005* (-2.30)	-0.006** (-3.08)	-0.005* (-2.26)
Y_{it-T}	-0.362*** (-34.31)	-0.367*** (-34.27)	-0.437*** (-27.44)	-0.438*** (-27.44)	-0.368*** (-34.33)	-0.438*** (-27.50)
Tax_{it-T}	-0.333*** (-7.04)	-0.340*** (-7.19)	-0.378*** (-7.95)	-0.381*** (-8.03)	-0.335*** (-7.09)	-0.377*** (-7.94)
$Exedu_{it-T}$	0.255*** (5.78)	0.256*** (5.81)	0.237*** (5.41)	0.240*** (5.47)	0.253*** (5.74)	0.237*** (5.40)
$Exfam_{it-T}$	0.275*** (5.72)	0.272*** (5.65)	0.250*** (5.22)	0.250*** (5.22)	0.268*** (5.57)	0.246*** (5.14)
$Exchil_{it-T}$	0.439*** (9.11)	0.436*** (9.05)	0.432*** (9.04)	0.432*** (9.03)	0.431*** (8.96)	0.427*** (8.93)
$Exeld_{it-T}$	0.256*** (6.33)	0.257*** (6.36)	0.224*** (5.53)	0.227*** (5.62)	0.253*** (6.26)	0.223*** (5.52)
Exp_{it-T}	0.024*** (4.25)	0.024*** (4.40)	0.027*** (4.83)	0.027*** (4.91)	0.024*** (4.38)	0.027*** (4.90)
Edu_{itT1}	1.549*** (19.44)	1.535*** (19.23)	1.363*** (16.14)	1.362*** (16.13)	1.534*** (19.24)	1.361*** (16.13)
$Herf_{it-T}$	0.026* (2.04)	0.025 (1.93)	0.020 (1.56)	0.018 (1.46)	0.026* (2.07)	0.020 (1.60)
$Cons_{it-T}$	-0.156*** (-15.75)	-0.157*** (-15.89)	-0.146*** (-14.72)	-0.148*** (-14.90)	-0.156*** (-15.75)	-0.147*** (-14.76)
$Age65_{i,t-T}$	-0.467*** (-5.94)	-0.471*** (-6.00)	-0.615*** (-7.55)	-0.613*** (-7.52)	-0.461*** (-5.88)	-0.603*** (-7.40)
$Dens_{i,t-T}$	-0.081 (-1.11)	-0.080 (-1.08)	-0.110 (-1.51)	-0.107 (-1.47)	-0.08 (-1.07)	-0.107 (-1.46)
N of observations	3113	3113	3113	3113	3113	3113

Note: t-values in parentheses. Significance level: "*"p<0.05, "**", p<0.01, "***" p<0.001

As such, our results corroborate the findings of Voitchovsky (2005). The results also suggest that a single measure of income inequality (such as the Gini coefficient) may be insufficient to capture the effects of income inequality on the income growth rate.

We also performed a sensitivity analysis to test the robustness of the results; our concern was that the crisis in Sweden during the early 1990s could potentially affect the estimated relationship between income inequality and income growth. Therefore, it is important to consider the downturn in the Swedish economy during 1990-1993. Hence, we checked the robustness of the results by excluding the data for 1992-1994, as they potentially can influence the estimated growth-inequality relationship, and re-estimated our models for the period 1995-2007 using a four-year lag instead of five-year lag[18]. The most important findings are summarised as follows.[19] When measuring income inequality solely by using the Gini coefficient or the different top income shares, the results are consistent with those presented in Tables 2 and A4. However, when the Gini coefficient, the 90/75 ratio, and the 50/10 ratio are examined simultaneously, we notice that the effect of the 50/10 ratio becomes positive but not significant. Therefore, the effect of the 90/75 ratio seems to be fairly stable, while the effect of the 50/10 ratio is more sensitive to the choice of time period for estimation. However, except for this difference, the results do not change much by comparison with those based on the original data. Therefore, we have not found any strong evidence suggesting that including the crisis years 1992 and 1993 leads to serious problems.

4. Conclusions

The main objective of the present paper is to investigate the effects of income inequality on the income growth rate using panel data from 283 Swedish municipalities during the years 1992-2007. We use several measures of inequality: the Gini coefficient, different top income shares, as well as measures of inequality in the lower (measured by the 50/10 ratio) and upper (measured by the 90/75 ratio) ends of the income distribution. We estimate a single equation panel data fixed-effects model, which relates the income growth rate to income inequality, and other control variables indicating local policy decisions, human capital, and socio-economic and demographic structures.

The main finding is that income inequality has a positive effect on the subsequent income growth at the municipal level in Sweden. The positive effect of the Gini coefficient supports previous findings

[18] We use a 4 year lag in order to have the same number of points of observations as our previous analysis; the 4 year lag also allows us to check the robustness of the results based on 5 year lags discussed above.

[19] The results of the sensitivity analysis are not reported in this study but they are available from the author upon request.

based on Swedish panel data at the county level (Nahum, 2005). It also supports earlier results based on cross-country panel data. We also find that inequality measured as $Top25$, $Top15$, $Top10$, $Top5$ and $Top1$, respectively, has a positive effect on the income growth rate. A striking result is that the estimated interaction effect between the Gini coefficient and level of average income is positive and significant. As such, the larger the average income, the stronger will be the positive growth-effect of increased income inequality, ceteris paribus. A similar result was found on cross-country data by Barro (2000). Furthermore, and in line with Voitchovsky (2005), the results show that top end inequality measured by the 90/75 ratio has a positive effect on the income growth rate, while the bottom end inequality measured by the 50/10 ratio has a negative effect.

Several important questions remain to be addressed in future research. A natural next step of this empirical investigation would be to try to identify the different channels through which inequality in different parts of income distribution influences the growth process. In addition, an important limitation of the current analysis is the time span of the data that is used to estimate our model. It would be interesting to replicate our study for a longer time series to check more thoroughly if the estimated relationship between income inequality and income growth is sensitive to the choice of estimation period.

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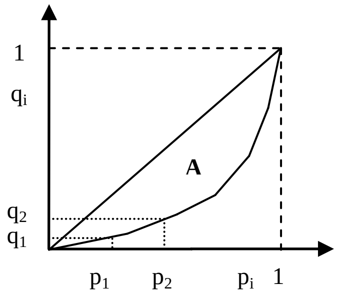
Table A1: Gini coefficient

$$A = \frac{1}{2} - \frac{1}{2}\sum_{i=1}^{k}(q_i + q_{i-1})(p_i - p_{i-1})$$

$$A_{max} = \frac{1}{2}$$

$$G = \frac{A}{A_{max}} \cong 1 - \sum_{i=1}^{k}(q_i + q_{i-1})(p_i - p_{i-1})$$



where:

A_i is the amount of income earned by N_i population in *i* class

q_i is the cumulative share of income, such as $q_1 = \frac{A_1}{A}$, $q_2 = \frac{A_1 + A_2}{A} \ldots q_i = \frac{A_1 + \ldots + A_i}{A} \ldots$ $q_k = \frac{A_1 + \ldots + A_2}{A}$

p_i is the cumulative share of population, such as $p_1 = \frac{N_1}{N}$, $p_2 = \frac{N_1 + N_2}{N} \ldots p_i = \frac{N_1 + \ldots + N_i}{N} \ldots$ $p_k = \frac{N_1 + \ldots + N_2}{N}$

$(i = 1,2,\ldots,k)$ for $k = 18$

Table A2: Descriptive statistics (1992-2007)

Variable		Mean	Std. Dev.	Min	Max
y	overall	1.021	0.016	0.962	1.092
	between		0.003	1.013	1.035
	within		0.016	0.960	1.078
Y	overall	65.840	10.778	45.895	151.325
	between		7.676	55.493	119.110
	within		7.578	37.945	98.056
G	overall	0.159	0.055	0.073	0.552
	between		0.045	0.100	0.464
	within		0.031	0.046	0.255
Taxes	overall	31.349	1.325	25.700	34.410
	between		1.056	27.643	33.198
	within		0.803	28.615	34.406
Exedu	overall	0.368	0.037	0.224	0.561
	between		0.032	0.262	0.504
	within		0.018	0.258	0.445
Exfam	overall	0.065	0.027	0.011	0.215
	between		0.023	0.024	0.163
	within		0.013	0.020	0.183
Exchil	overall	0.148	0.039	0.059	0.326
	between		0.032	0.084	0.256
	within		0.021	0.089	0.256
Exeld	overall	0.357	0.069	0.089	0.532
	between		0.059	0.152	0.491
	within		0.036	0.204	0.443
Exp	overall	12.000	2.177	6.231	22.588
	between		1.084	9.296	15.788
	within		1.889	6.656	21.817
Edu	overall	0.061	0.033	0.020	0.261
	between		0.029	0.029	0.229
	within		0.016	0.010	0.129
Herf	overall	0.283	0.058	0.170	0.560
	between		0.049	0.193	0.489
	within		0.032	0.128	0.430
Cons	overall	0.467	0.123	0.107	0.889
	between		0.116	0.159	0.860
	within		0.042	0.336	0.652
Age7-15	overall	0.118	0.013	0.063	0.164
	between		0.010	0.070	0.146
	within		0.008	0.089	0.138
Age65	overall	0.190	0.038	0.059	0.302
	between		0.037	0.082	0.286
	within		0.008	0.152	0.229
Dens	overall	125.675	414.497	0.241	4228.241
	between		414.762	0.266	3950.624
	within		18.714	169.588	462.611

Note: *Overall* refers to the whole dataset. *Between* refers to the variation of the means to each municipality (across time periods). *Within* refers to the variation of the deviation from the respective mean to each municipality.
Observations: N=4528 for the *overall*, T=16 for *within* sample and n= 283 for *between.*
Between statistics are calculated on the basis of summary statistics of 283 municipalities, regardless of time period, while *Within* statistics are calculated on the basis of summary statistics of 16 time periods, regardless of municipalities (more details in note of Table A3). See Note in the next page the description of the *Overall, Within* and *Between* statistics.

Table A3: Descriptive statistics (1992-2007) top and bottom inequality income distribution

Variable		Mean	Std. Dev.	Min	Max
Top1%	overall	0.020	0.016	0.011	0.026
	between		0.008	0.012	0.019
	within		0.014	0.013	0.017
Top5%	overall	0.027	0.023	0.020	0.032
	between		0.010	0.014	0.029
	within		0.017	0.013	0.024
Top10%	overall	0.150	0.035	0.130	0.226
	between		0.021	0.122	0.252
	within		0.013	0.005	0.025
Top15%	overall	0.211	0.035	0.150	0.432
	between		0.021	0.172	0.252
	within		0.028	0.125	0.430
Top25%	overall	0.304	0.028	0.250	0.432
	between		0.016	0.256	0.380
	within		0.022	0.222	0.428
90/75	overall	1.192	0.019	1.164	1.224
	between		0.012	1.174	1.221
	within		0.015	1.154	1.228
50/10	overall	3.221	0.600	1.639	3.997
	between		0.435	2.187	3.974
	within		0.414	1.628	4.459

Note: *Overall* refers to the whole dataset. The total variation (around grand mean $\bar{x} = 1/NT \sum_i \sum_t x_{it}$) can be decomposed into *within* variation over time for each individual country (around individual mean $\bar{x}_i = 1/NT \sum_t x_{it}$) and *between* variation across countries (for $\bar{x}$ around $\bar{x}_i$). The corresponding decomposition for the variance is

Within variance: $s_W^2 = \frac{1}{NT-1} \sum_i \sum_t (x_{it} - \bar{x}_i)^2 = \frac{1}{NT-1} \sum_i \sum_t (x_{it} - \bar{x}_i + \bar{x})^2$;

Between variance: $s_B^2 = \frac{1}{N-1} \sum_i (x_i - \bar{x})^2$

Overall variance: $s_O^2 = \frac{1}{NT-1} \sum_i \sum_t (x_{it} - \bar{x})^2$

The second expression for s_w^2 is equivalent to the first, because adding a constant does not change the variance, and it is used at times because $x_{it} - \bar{x}_i + \bar{x}$ is centered on $\bar{x}$, providing a sense of scale, whereas $x_{it} - \bar{x}_i$ is centered on zero.

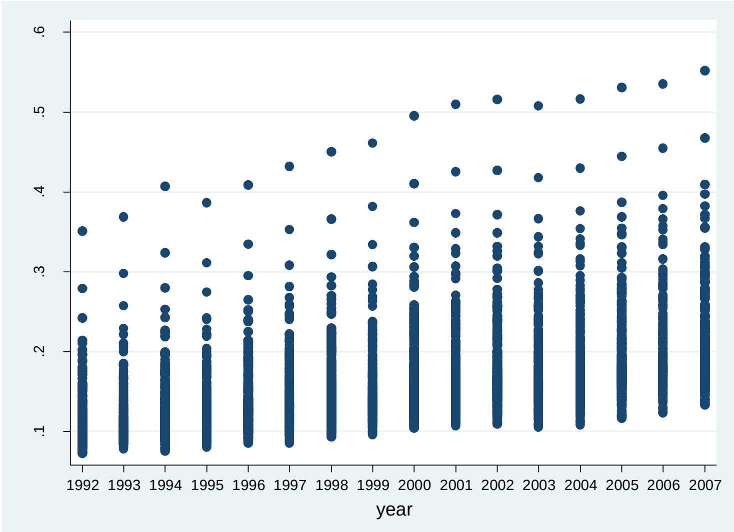


Figure A1: Distributions of Gini coefficients across municipalities 1992-2007

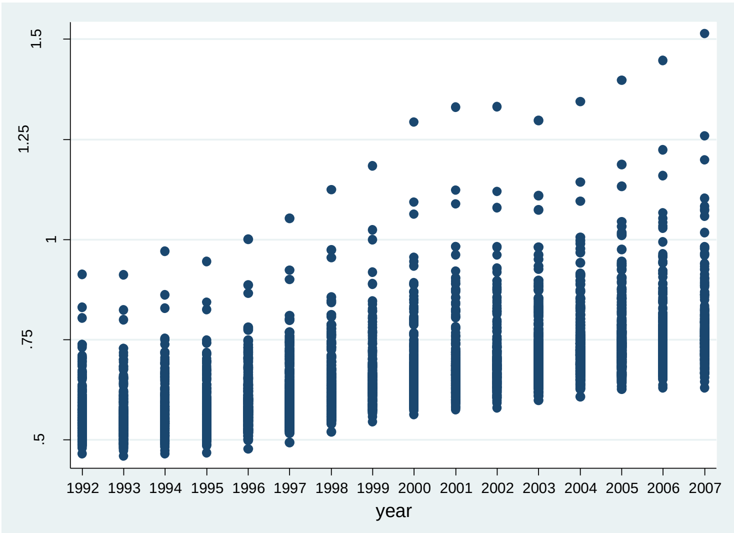


Figure A2: Distributions of Income across municipalities 1992-2007

Note: Each dot represents one municipality. For each year, the Gini coefficient (Fig. A1) and the real average income (Fig. A2) across municipalities is distributed between a minimum and a maximum value. From Fig. A1 we notice that the Gini coefficient increases over time across municipalities; the minimum value in 1992 was lower than the minimum value in 2007. Moreover, the difference between the lowest and the highest values of Gini coefficient has increased from 1992 to 2007. A similar trend is visible in the distribution of average income in Figure A2.

Table A4: Fixed Effects estimations top earners

	Top10		Top5		Top1	
	(i)	(ii)	(iii)	(iv)	(v)	(vi)
	ln(y)					
Constant	0.306*** (5.30)	0.378*** (6.53)	0.228*** (4.01)	0.300*** (5.26)	0.105 (1.95)	0.136* (2.55)
G_{it-T}	0.676*** (-10.78)	0.747*** (-11.92)	0.455*** (-8.66)	0.525*** (-9.94)	0.159*** (-6.65)	0.157*** (-6.61)
Y_{it-T}	0.257*** (-7.42)	0.680*** (-10.71)	0.252*** (-7.05)	0.668*** (-10.44)	0.321*** (-9.37)	0.657*** (-10.12)
Tax_{it-T}	-0.0516 (-0.78)	-0.0814 (-1.25)	-0.0545 (-0.82)	-0.088 (-1.34)	-0.036 (-0.54)	-0.052 (-0.79)
$Exedu_{it-T}$	0.242*** (4.26)	0.228*** (4.05)	0.214*** (3.75)	0.201*** (3.55)	0.164** (2.88)	0.143* (2.53)
$Exfam_{it-T}$	0.650*** (10.58)	0.633*** (10.41)	0.636*** (10.29)	0.620*** (10.13)	0.596*** (9.62)	0.577*** (9.37)
$Exchil_{it-T}$	0.371*** (5.90)	0.326*** (5.22)	0.362*** (5.72)	0.316*** (5.03)	0.335*** (5.26)	0.300*** (4.72)
$Exeld_{it-T}$	0.391*** (7.55)	0.374*** (7.28)	0.357*** (6.87)	0.339*** (6.60)	0.307*** (5.95)	0.285*** (5.53)
Exp_{it-T}	0.085*** (-13.80)	0.092*** (-14.89)	0.092*** (-14.77)	0.098*** (-15.77)	0.109*** (-19.63)	0.117*** (-20.62)
Edu_{itT}	2.274*** (21.37)	2.161*** (20.35)	2.248*** (20.57)	2.150*** (19.75)	2.055*** (19.65)	1.933*** (18.27)
$Herf_{it-T}$	0.101*** (5.64)	0.114*** (6.43)	0.103*** (5.73)	0.116*** (6.50)	0.115*** (6.35)	0.126*** (6.98)
$Cons_{it-T}$	-0.326*** (-24.62)	-0.325*** (-24.81)	-0.325*** (-24.33)	-0.324*** (-24.52)	-0.320*** (-23.91)	-0.319*** (-23.94)
$Age65_{i,t-T}$	0.042 (0.45)	0.103 (1.10)	-0.023 (-0.24)	0.033 (0.35)	0.002 (0.02)	0.040 (0.42)
$Dens_{i,t-T}$	-0.125*** (-3.66)	-0.112** (-3.29)	-0.157*** (-4.58)	-0.145*** (-4.29)	-0.148*** (-4.27)	-0.143*** (-4.15)
$(G*Y)_{i,t-T}$		0.922*** (7.92)		0.919*** (7.80)		0.713*** (6.08)
N of observation	3113	3113	3113	3113	3113	3113

Note: t-values in parentheses. Significance level: "*"p<0.05, "**", p<0.01, "***" p<0.001

Table A5: Estimations for Poor and Rich and municipalities (T=5)

	Split sample		Whole sample	
	FE		FE	
	Rich	Poor	Poor	Dummy
Constant	-2.800** (-3.65)	-0.408*** (-5.17)		
G_{it-T}	1.181* (2.33)	0.736*** (5.56)	1.123*** (7.80)	0.203*** (2.79)
Y_{it-T}	-0.929*** (-5.03)	-0.491*** (-13.83)	-0.534*** (-7.44)	-0.162** (-3.05)
Tax_{it-T}	-0.158 (-0.25)	-0.068 (-0.78)	-2.186 (-1.38)	-0.135 (-1.30)
$Exedu_{it-T}$	2.187** (3.03)	0.140* (2.07)	0. 204 (3.26)	0.103 (2.38)
$Exfam_{it-T}$	2.385** (3.21)	0.105 (1.45)	0. 421** (2.86)	0. 347** (2.60)
$Exchil_{it-T}$	2.176** (3.20)	0.183* (2.29)	0.150** (2.31)	0. 136** (2.55)
$Exeld_{it-T}$	1.862** (2.94)	0.127* (2.02)	0.161* (2.57)	0. 156* (2.02)
Exp($_{it-T}$	0.155* (2.23)	-0.013 (-1.29)	0.382*** (2.70)	0.707*** (2.64)
Edu_{itT1}	2.598 (2.09)	1.862*** (8.05)	0.537*** (2.62)	0.401*** (2.17)
$Herf_{it-T}$	0.041 (0.33)	-0.024 (-0.97)	0.011 (0.03)	0.036 (0.79)
$Cons_{it-T}$	-0.030 (-0.29)	-0.169*** (-9.67)	-0.191*** (-7.60)	0.058** (2.92)
$Age65_{i,t-T}$	0.253 (0.43)	0.310 (1.81)	0.627*** (4.68)	0.175* (2.09)
$Dens_{i,t-T}$	0.064 (0.30)	-0.421** (-3.24)	-0.205 (-1.95)	0.026** (2.87)
N of observations	340	823	1131	

Note: t-values in parentheses. Significance level: "*"p<0.05, "**", p<0.01, "***" p<0.001

In the model for the "whole sample", the parameter estimates for the rich municipalities can be calculated by summing the estimates in the "Poor" and "Dummy" columns. Also, to save space, the fixed effects are not presented.