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Income Inequality and Growth:

a Panel Study of Swedish Counties 1960-2000*

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Abstract: This paper explores the relationship between income inequality and growth using panel data on Swedish counties from 1960-2000. Compared to standard methods of estimating this relationship yearly regional level data are used, and inequality is allowed to be endogenous. We find a significant positive impact of inequality on growth, but the magnitude of the effect decreases with the length of the growth period studied. When allowing income inequality to be endogenous, using a panel 2SLS IV estimation, we find positive effect of inequality on 1 to 5-year growth rates, when significant, whereas the effect on 10-year growth rates are not clear cut.

Sammanfattning: Denna studie utforskar sambandet mellan inkomstojämlikhet och tillväxt baserat på paneldata på svenska län från 1960-2000. Till skillnad fran gängse estimationsmetoder i området används här årliga data på regionalnivå och inkomstojämlikheten tillåts vara endogent bestämd. Vi finner en signifikant positiv effekt av inkomstojämlikhet på tillväxt. Storleken på effekten avtar dock med längden på tillväxtperioden. Den positiva effekten av inkomstojämlikhet på 1 till 5 års tillväxttakter kvarstar när inkomstojämlikhet tillåts vara endogen med en panel 2SLS IV estimation. Effekten på 10-års tillväxttakter blir dock inte entydiga.

Keyword: Income inequality, regional economic growth, panel data

JEL classification: O40, O15, D31

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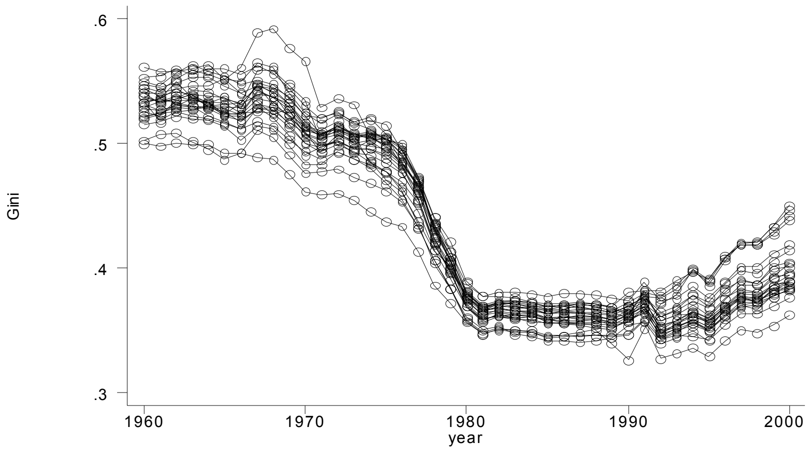
I. Introduction

With the expansion of the welfare state, Sweden experienced a remarkable decrease in income inequality in the post-war era. As noted in Lindbeck (1997): " Two broad targets of economic and social policy seem to have been taken more seriously in Sweden after World War II than in most other developed countries: economic security, including full employment, and egalitarianism, including both a general compression of income differences and the mitigation of poverty." When looking at income distribution in terms of the Gini coefficient both within and across the Swedish counties, the evolution has been dramatic since the 1960s, as can be seen in figure 1.

Figure 1: The Gini-coefficient in the Swedish counties
from 1960-2000



Notes: The data is based on taxable individual income from the population aged 20 and over. Each line in the figure refers to a county. The Gini coefficient is an index between 0 and 1, and is a measure of inequality, in the sense that a larger index implies a larger degree of inequality, and vice versa. *Source*: Original data from Statistics Sweden, further revised and adjusted as explained in Appendix A

Income inequality may be of interest in its own right or it may be relevant because of its perceived consequences. In light of the dramatic changes in income distribution in Sweden it is of interest to investigate what impact this decrease in inequality has had on economic growth in Sweden. Little has been done studying the Swedish experience in this context.
The standard method of estimating the relationship between inequality and growth in the literature is to assume that inequality is exogenous in determining growth. Moreover, country-level data often forms the basis of these studies. Finally, averaging the data over five

or ten year periods is commonly applied. In this paper, we argue that all of these procedures are questionable and may have important drawbacks.

This study explores the relation between inequality and income growth in Sweden based on county-level data from 1960 to 2000. The data on income inequality is based on taxable individual income for the population aged 20 years and above.[1] This study differs from the prior literature in several respects. We limit our analysis to counties within a country and can thus abstract from country heterogeneity. Moreover, our high quality yearly data on income distribution and growth enables us to study both the short run and longer run relationships between income inequality and growth. Furthermore we deal with the endogeneity problem of income inequality in the growth regression by estimating the growth regression using 2SLS instrument variable estimation.

When estimating a standard growth equation as a function of inequality and standard control variables, our results indicate that inequality has a positive and decreasing effect on 1 to 10-year average annual growth rates. When allowing for the endogeneity of the inequality variable using 2SLS IV estimator, including age structure as instrument variables, the magnitude of the inequality coefficient remains positive in the 1-5 year growth period, whereas the effects on the 10 year growth rates are not as clear cut.

In what follows, section II presents a brief survey of economic theory about the relation between inequality and growth. Section III discusses three issues relating to the empirical design of the inequality growth relationship. The data as well as an overview of the development of inequality during the period studied is presented in Section IV, followed by the empirical specification in section V. The results are presented in section VI. The last section summarises and provides some concluding discussion.

II. Positive or negative relation between inequality and growth: a brief literature survey.

In the 1950s, Kuznets (1955) developed the idea that during a country's transition from an agricultural to an industrial economy, inequality would first rise and then fall back, giving

[1] The data is from Statistics Sweden and has been compiled and further adjusted by Mats Johansson, Institute for Future Studies. See Appendix A.

rise to the inverted-U relationship between inequality and growth. This pattern seemed to fit both the American and the OECD experience up to the 1970s, but has failed to explain the increase in inequality which took place after the 1980s. Based on a broad panel of countries, Barro (2000) finds that higher inequality tends to retard growth in poor countries and encourage growth in richer countries, and finds in a sense support for the Kuznets curve. The modern line of research has however come to focus on the reverse causality, that of inequality on growth.

Economic theory has put forward arguments in favour of a positive relationship between growth and inequality. The three main arguments, reviewed in Aghion et al (1999), are the following. The first argument is that if the growth rate is positively related to the proportion of national income that is saved, more unequal economies are bound to grow faster than economies with a high level of income distribution, since the marginal propensity to save of the rich is higher than that of the poor. The second argument is related to the issue of investment indivisibility. Investments often involve a large sunk cost, which presupposes that wealth needs to be concentrated for such investment projects to be undertaken - in the absence of well developed credit markets. The third argument relies on the effects of incentives through distribution. Besides the fact that a redistribution of wealth creates a more equalised distribution of income, if redistribution is financed by income taxes, this would also diminish the incentives to accumulate wealth.

Persson and Tabellini (1994) offer an explanation in a political economy context, of a negative relationship between inequality and growth. In their model, physical and human capital accumulation are the determinants of growth. Agents' incentives and ability to accumulate these are directly affected by regulatory and tax policies. Assuming that voters are allowed to vote and, directly or indirectly, choose tax rates, then the level of inequality would decide the extent of redistribution and thus have an effect on the growth rate. More unequal societies would opt for a higher level of redistribution, in turn affecting growth negatively due to reduced incentives. In a democratic political set-up, this inverse relationship between income inequality and growth would be expected to be stronger if the income distribution is tilted to the left, giving lower-income groups more political power.

Aghion et al (1999) point out channels through which inequality would have a negative effect on an economy's rate of growth under the assumption that wealth and human capital endowments are heterogeneous across individuals and capital markets are imperfect. Based on microeconomic theories of incentives, basically credit market incentives and moral hazard, they argue that inequality reduces investment opportunities, worsens borrowers' incentives and generates macro economic volatility. They underline that when capital markets are imperfect there is a scope for growth enhancing redistributive policies.

Cross-country growth studies have typically found a negative relationship between inequality and growth.[2] Studies based on panel-data estimations have tended to find a positive relationship (see Forbes(2000)). Panel-data estimations differ from cross-section analysis in that they control for country effects that are fixed over time, and study within-country variations. The positive effect of inequality on growth in panel data estimation is understood as the relationship between inequality and growth on average being positive when looking within a country. The time spans studied in the literature differs, with panel data estimations tending to look at the effects of initial inequality on averaged 5 or 10 year growth rates, whereas cross country studies have generally looked at the effects on long run 40-year growth rates.

Regarding the role played by redistribution in the interplay between inequality and growth, there is no strong evidence in the literature that inequality has led to a higher level of redistribution, however evidence has been pointing at a positive relationship between redistribution and growth.[3]

Controlling for country differences by looking at regions within a country, panel-data studies looking at the relation between income and inequality across US states have found varying results depending on the measure of inequality used.[4]

When studying the relation of inequality and growth in regions within a country all the above mechanisms could be expected to be at work given that there is variation across geographical areas. However, the mechanisms at work vary in terms of the dynamic horizons involved and underlying assumptions need not all be as important in a within county framework. For example, the fiscal independence across counties is more limited than across countries.

[2] See Benabou (1996) for a survey on this empirical and theoretical work of cross-country studies.
[3] Easterly and Rebelo (1993) and Perotti (1996) both find that redistribution, measured in terms of marginal tax rates, has if anything a positive effect on growth.
[4] Panniza (2002) and Partridge (1997)

One mechanism linking inequality to growth is the higher propensity to save among the rich, in combination with investment indivisibilities. In a closed economy framework this could be an important mechanism at work. However it is unlikely that domestic savings play a central role at the county-level in Sweden, other than for smaller scale investments. In any case the time span for this mechanism to have an effect is more of a short to medium term effect. The other mechanisms relate to the role played by redistribution. Redistribution is negative in the sense that it worsens incentives to accumulate wealth. In the long run however, and when capital markets are imperfect, redistribution is good to the extent that it enables the correct use of talents and increases human and physical capital.

III. Issues relating to the empirical design of the inequality growth relationship

Countries or regions?

A problem when looking at countries with disparate features is that the same model specification might not be relevant for all countries. There might be fundamental differences among countries in e.g. 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. Furthermore cross country studies have been plagued with problems related to data comparability both across countries and across time, which is a problem since in a cross country OLS regression countries in different phases of development are basically seen as one country in different periods of time.

Limiting the scope of the study to regions within the same country, in this case Swedish counties (län), still using panel data, could help bring additional light on the relation between inequality and growth. Do we find a positive relationship between growth and inequality when looking at regions within a country as in the panel data cross-country studies? The advantage of looking at regions within a country is that one can achieve a better level of comparability of inequality measures, both in term of quality and in terms of the definition used in constructing these measures, than is the case in cross country studies. Furthermore, as noted in Partridge (1997), growth-reducing distributional conflicts need not only arise at the national level, but could potentially arise at lower levels, making a cross county study relevant. Moreover, counties are similar enough to expect that one model specification holds for all the counties, and the political process could be expected to be equally democratic across regions. However, a drawback of looking at counties is that human and physical capital mobility among regions could limit the ability of local governments to engage in income redistribution making it important to control for variables such as migration across counties. Further, most redistributive programs and tax policies may be administered by the state – possibly making it difficult to capture the presence of any fiscal policy channel in the inequality growth relationship, unless there exists a variation between counties regarding the tax levels and welfare expenditure etc.

A few studies have looked at regions within a country. Partridge (1997) found a positive relationship between Gini and growth when using a panel-data set on the US for the period 1960-1990, but emphasises that different measures of inequality can give different results. Based on a similar data set for the period 1940-1990, Panizza (2002) found evidence of a negative relationship, underlining that the relationship is not robust to different measures of inequality, and to different econometric specifications.

Short or long term effects?

The relationship between GDP growth and income inequality is often estimated in the empirical literature by regressing average GDP growth in a 5 or 10-year period on income inequality and control variables such as human capital accumulation, initial GDP level (to capture economic convergence), and various macro economic indicators.

However, this set-up has a certain number of drawbacks. First of all, using *n*-year averages for growth rates or other variables is not always recommendable. Apart from reasons of data availability, the main argument to use average growth rates is to capture long run variations and abstract from business cycles fluctuations. However, Attanasio et al. (2000) argue the opposite.[5] Firstly, when averaging, information provided in annual data is lost. Secondly, business cycle fluctuations are not necessarily eliminated by averaging over arbitrarily set fixed intervals, since their length vary over time and across regions. Thirdly, averaging "prevents the possibility of considering cross-sectional heterogeneity in the parameters". Finally, focusing only on long-run effects prevents the analysis of short-run effects, where significant but opposing effects may be acting with different lags. Given these reasons, we

[5] Averaging is problematic if there is autocorrelation and persistence in the series

choose to consider non-averaged information as well as averaged information. That is, we estimate 1, 3, 5 and 10-year growth regressions, still using yearly data observations. Instead of estimating the effect of initial conditions on the following 5 years growth rate, using distinct non overlapping intervals we estimate the growth regression using overlapping intervals, and in this way we are not as sensitive to business cycle variations in the initial conditions which could otherwise affect the results. This procedure also has the advantage of increasing the degrees of freedom. However, we have had to interpolate part of the data on the human capital stock which we do not have annual data on. These variables have little short-run variation and exhibit more of a trend over time, although the trend differs in the beginning and the end of the period. Interpolating them should not pose a large problem.

The problem of simultaneity?

There is a fundamental problem of endogeneity in the growth regressions that needs to be addressed. Apart from reasons of possible omitted variable bias that could lead to endogeneity bias, it is plausible to assume that income inequality is jointly determined with the economics growth rate. If the RHS variables are endogenous and thus correlated with the error term, the OLS / FE coefficient estimate is biased and inconsistent

The fact that the RHS variables are dated at the beginning of the growth period naturally minimises the problem of endogeneity. But these variables are highly persistent (large inertia in these variables) so the problem of endogeneity may still persist.

One such variable is the Gini coefficient. That Gini and economic growth may be jointly determined is not difficult to claim. On the one hand, the modern line of research which has come to focus on the reverse causality, that of inequality on growth, has found empirical evidence that growth is affected by the level of inequality. On the other hand, as mentioned earlier, Kuznets' hypothesis suggests that income distribution is systematically affected by the level of economic development, giving rise to an inverted u-shape between inequality and growth. Even though Kuznets' hypothesis relates to the transition from an agricultural to an industrial society, one could argue that similar forces may be at work in the transition from an industrial to a service economy.

There may also be a shorter run causality relation between growth and income inequality, in the sense that income inequality may vary as a result of economic recessions and expansions.

IV. Data

Until 1997 Sweden was divided into 24 counties (including Gotland's municipality which is its own county) and a total of 289 municipalities (see map in Appendix). Two mergers have since taken place.[6] In this study we stick to the pre-1998 division of counties and maintain a panel of 24 counties. Data on income and income inequality are available for the years 1951 and onwards. However due to data availability of other variables this study focuses on the period 1960-2000.

The data on income inequality as well as the underlying income data is based on taxable individual income based on the population aged 20 and over. There is a risk that the inequality measure based on individual income may overstate the actual level of inequality, since it does not take into account the reallocation taking place within a household. Data on income inequality is measured in terms on Gini index. Gini is a measure of inequality, the larger the index, the larger the level of inequality. The fiscal legislation as well as the definition of the income that is presented in the tax register has changed a few times and various adjustments have been made to account for this in the data.[7] Other county-level data is a measure of human capital stock (*college*) referring to the share of the population aged 25-59 having a college education. The share of the population living in the county's largest city (*urban*) is used as a proxy for urbanisation.[8] In order to control for the age structure we divide the adult population aged 20 years and above into four age groups, keeping the age group 20-39 as our reference group.[9] See Appendix A for further information on the inequality variable and Appendix B for the definition and source of the remaining variables used in this study.

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[6] In 1997 Kristianstad and Malmöhus counties formed Skåne county, and in 1998 Älvsborg's, Skaraborg's as well as Göteborg's and Bohus' county merged into Västra Götaland's county.

[7] The Gini coefficient has been adjusted for various breaks in the trend. The main trend breaks are 1973/1974 and 1990/1991. The first is due to various social insurances becoming taxable and the second is due to the 1991 tax reform.

[8] According to the rank-size rule this measure may also capture the overall urban structure in the area. Zipf (1949) first devised the theory of rank-size rule to explain the size of cities in a country. He explained that the second and subsequently smaller cities should represent a proportion of the largest city. Zipf stated that the second largest city in a country would contain 1/2 as many as the first. The third would contain 1/3 and so on, with the rank of the city representing the denominator in the fraction.

[9] We limit the analysis to the composition of the adult population over 20 years of age since our inequality measure is based on this group. Since this age structure data is observed the 31st of December each year, we have lagged the data one period.

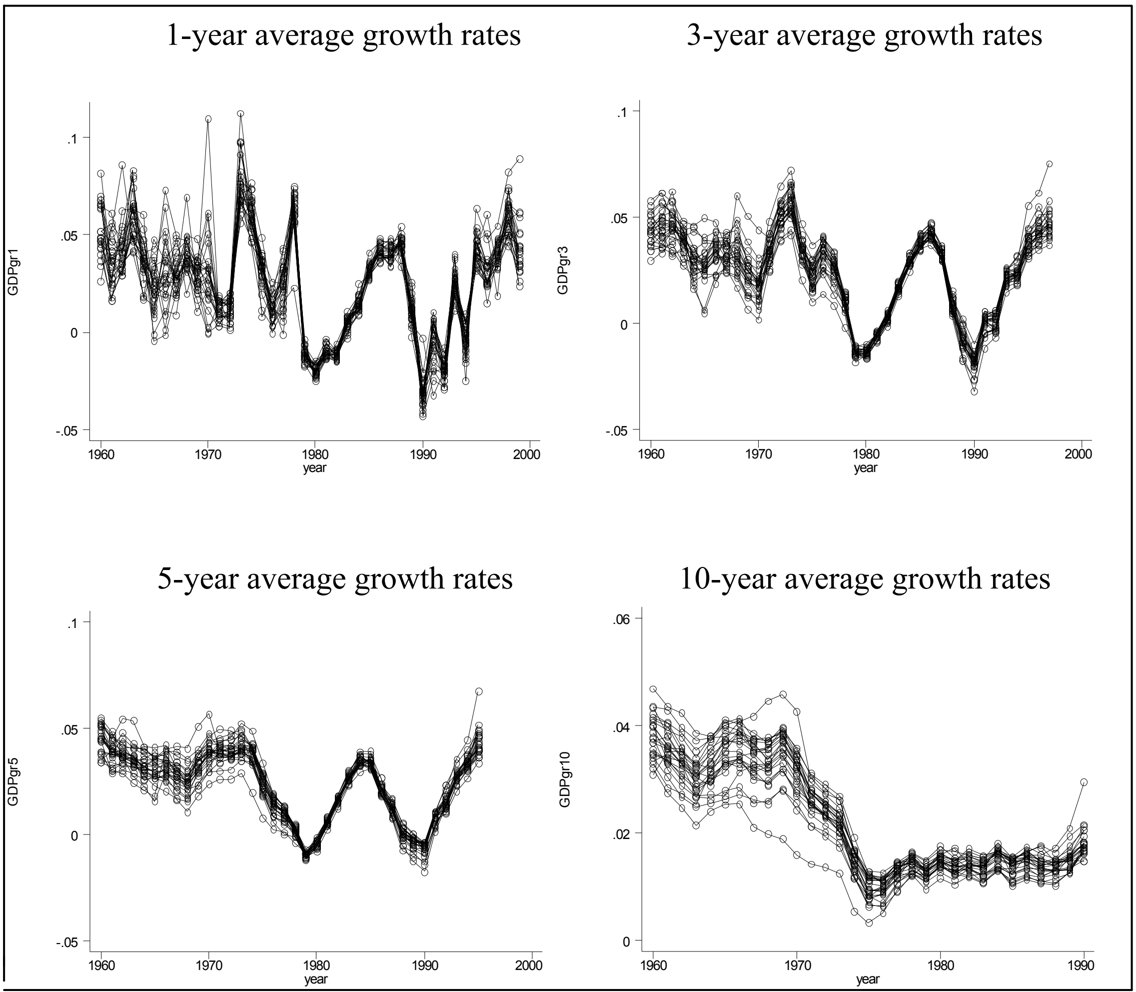
Our income variable refers to gross per capita taxable income of the population aged 20 years, and is contingent on the definition of taxable income, which after 1974 has come to include various transfer payments. Given this, our county level income measure is to be interpreted as total per capita taxable income, and only a proxy for GDP rather than a direct measure of it. However, comparing the data with national GDP, the level and annual rate of change of the sum of the counties' income in real terms is highly correlated with that of real national GDP for the period studied. The correlation in levels is 0.99 over the whole period, and the correlation in 1 to 10-year annual growth rate ranges between 0.64 and 0.85.

Table 1: Correlation between national GDP and the sum of the counties' income, in level and growth rates, 1960-2000

Annual growth rates	
1-year	0.6410
3-year	0.7473
5-year	0.7494
10-year	0.8584
Level	
level	0.9937

Figure 2: Income growth rates in the Swedish counties

from 1960-2000



Notes: The income growth data is based on taxable individual income from the population aged 20 and over. Each line in the figure refers to a county. *Source*: Original data from Statistics Sweden. See Appendix A for further information.

Regarding the income growth rates across counties, as shown in figure 2, there is less variation across counties in the period post mid-70s, when various transfers became taxable and got included in the data. A closer look at the data also shows that urban counties had among the lowest growth rates up to the mid 70s, and the same counties (except Malmö) including the adjoining counties had the highest growth rates after mid-70s. The variation across time decreases the longer the growth period considered. It is also to be noted that the 10 year growth rates have a very similar trend to that of the Gini coefficient.

The evolution of income inequality in Sweden can be divided into four phases. (See figure 1). The level of income inequality within counties remained high during the 1960s, despite a gradual decrease, and with a high variation across counties. During the 1970's the level of inequality diminished drastically, as well as the variation across counties. In the 1980's the level was held relatively constant, and with a small variation across counties. It is to be noted that most studies dealing with income inequality in Sweden, or cross country comparisons of income inequality including Sweden, have focused on the 1980s and part of the 1990s, a period of low and stable inequality compared to the large variations income inequality has shown over the past five decades.

Looking closer at the cross-county dimension, the largest drop in inequality between the years 1960 to 2000 is found in the northern counties, (29% decrease) whereas urban counties - counties with the largest cities - have the lowest drop in inequality (14% decrease).[10] The urban counties have gone from having the lowest levels in inequality in 1960, relative to the other counties, to having the highest level of inequality in the year 2000, whereas the northern counties have changed their position from high to low inequality relative to other counties.

The drop in income inequality over time can be explained partly by the increased female labour supply and by the expansion of social security and the pension system. The differences across counties may depend on factors such as differences in age structure, in education levels, in the initial industry set-up leading to more or less favourable infrastructure. These differences could give rise to differences with respect to the volume and variation of transfer payments across counties over time. Similarly, counties may also differ with respect to how they adjust to tax reforms.

V. Empirical framework

This paper estimates a model similar to that used in most empirical work on inequality and growth. Income growth is estimated as a function of a set of initial conditions including inequality, income, human capital and a set of other controls. The basic model to be estimated is the following:

$$\frac{y_{i,t+n} - y_{i,t}}{n} = \beta y_{i,t} + \gamma \Delta_{i,t} + \theta X_{i,t} + \alpha Z_t + u_i + \varepsilon_{i,t}, \qquad (1)$$

[10] The northern counties – so called Norrlandslän - refer to Norrbotten, Västerbotten, Västernorrland and Gävleborg, and are characterized by lower population density compared to the rest of the country. The counties of Stockholm, Gothenburg and Malmö are referred to as urban cities.

where $y_{i,t}$ is the log income per capita in county *i* at date *t*, and *n* is the length of the time period chosen for measuring growth. The left hand side in equation (1) is thus the growth rate of income. Δ_i is a variable denoting a measure of county *i*´s income distribution, X_i is a matrix of controls which are time variant and county-specific, whereas *Z* is a matrix of time controls which do not vary over counties, u_i is the county fixed effects and $\varepsilon_{i,t}$ is the error term. The initial level of per capita income in the beginning of each period is used to control for economic convergence across counties. In line with the convergence literature, the implicit assumption is that growth is converging to an equilibrium growth path that is a function of the initial conditions.[11] The first control variable is the stock of human capital measured in terms of the percentage of the adult population at various education levels. In line with Perotti's (1996) specification, also used in Panizza (2000) in a cross state study we control for the degree of urbanisation and the age structure, measured in terms of the portion of the adult population above the age of 65. We use the share of the population living in the largest city as a proxy for urbanisation. Our growth equation is estimated using predetermined variables as independent variables, so a direct reverse causality problem between inequality and growth should not arise. The problem of endogeneity which is often encountered in the cross country growth literature due to lack of data is thus alleviated here. (see Persson and Tabellini 1994, Alesina and Rodrik 1994). However, given that inequality is an inertial variable, inequality and growth can still be considered to be jointly determined.

Ignoring the endogeneity of the right-hand side variables when running the growth regression, as is commonly done in the literature, leads to a bias in the coefficient estimates of these right-hand side variables. In the later part of the paper, we estimate the growth regression using 2SLS instrument variable estimation on panel data with fixed effects.[12] We choose to estimate a single equation rather than a simultaneous equation system. For the 2SLS to be consistent it is enough that the first equation is correctly specified and that the instruments are exogenous. For an equation system to be consistent and asymptotically more efficient than single equation estimation all equations in the system need to be correctly

[11] Persson (1997) has shown that convergence is a fact across Swedish counties.
[12] It is to be noted that the fixed effects estimator deals with endogeneity problems that can be traced to unobservable time-invariant county-fixed effects. The regression is estimated using the 2SLS IV for panel data with STATA´s xtivreg command

specified. If this is not fulfilled, none of the estimated parameters are consistent. Hence we prefer the single equation procedure since it is more robust to specification errors.

A note on the direction of causality between Gini and income-growth is appropriate in a time series framework before heading on to the estimation results. To check the direction of causality we perform a simple Granger causality test, a means of statistically determining whether the direction of causality can be detected.[13] The Granger causality test does not give us much guidance in the direction of causality between income inequality and growth. We can not reject the null hypothesis, at any reasonable significance level, that the average growth rates of year *(t-n, t)* does not Granger cause Gini at time *t*. We can neither, in the majority of cases, reject the null that initial Gini at time *t* does not Granger cause the average annual growth rates of the following years *(t, t+n)*.[14] In the case of 1 and 2-year growth rates, the null can however be rejected at the 10 % level, when using 2-3 lags. When looking at the Granger causality between income inequality and income level, the test indicates that the causality goes from Gini to income, but not the opposite.

VI. Results

The growth equations are based on *n*-year growth periods. The coefficients in the growth equation should be interpreted as the effect of initial conditions (inequality, human capital…) on the average growth rate the following *n* years. We present 1, 3, 5 and 10- year growth period results.

We start out by presenting the single equation estimation results of equation (1) so as to have a benchmark comparison with earlier literature on the relationship between inequality and growth, disregarding any endogeneity bias that may exist. For reasons of comparison with the literature we also present the estimations with distinct windows, that is where the intermediate years are not included in the set of observations. We then proceed to the 2SLS IV estimation results where income inequality is considered endogenous.

[13] The test assumes that the information relevant to the prediction of the respective variables is contained only in the time series data of these variables.

[14] The Granger causality test is performed using STATA's gcause command with 1-3 lags. These results are based on Stockholm county, but the results are similar across counties.

VI.1 The growth regression – standard fixed effects estimation – all RHS variables exogenous

Fixed effects regressions are estimated on both distinct and on overlapping windows. We start by restricting time effects to zero, i.e. do not include any time dummies. The results are presented in Tables 2a and 2b. Random-effects specifications are presented in Appendix C

Table 2a: Fixed effects growth regressions without time dummies
Estimated without the intermediate year observations - distinct window

	Growth periods			
variable	1year	3years	5 years	10 years
y	-0.058**	-0.085**	-0.112**	-0.029**
	(5.33)	(7.48)	(8.58)	(8.72)
Gini	0.329**	0.259**	0.177**	0.143**
	(11.62)	(8.33)	(4.58)	(12.54)
college	0.275**	0.331**	0.383**	0.110**
	(9.20)	(10.14)	(9.17)	(8.51)
urban	0.116**	0.146**	0.179**	0.010
	(3.22)	(3.86)	(3.77)	(0.88)
age_65+	0.331**	0.263*	0.176	0.101**
	(3.36)	(2.48)	(1.32)	(3.00)
constant	0.419**	0.768**	1.124**	0.262**
	(3.64)	(6.34)	(8.30)	(7.13)
Observations	960	336	192	96
Nbr of counties	24	24	24	24
R-squared	0.25	0.46	0.54	0.96

Notes: The dependent variable is annual per capita growth rates in 1,3,5 and 10 years growth periods. R-squared refers to the within-R-squared for fixed effects. Absolute value of t statistics in parentheses. * denotes significance at the 5% and ** denotes significance at the 1% level. Regarding the independent variables, y is the log of income per capita, *Gini* is the Gini coefficient, *college* is the percentage of the population aged 25-59 with a college education, *urban* is the share of the population living in the county's largest town, *age_65+* is the share the adult population aged 65 and over.

Table 2b: Fixed effects growth regressions without time dummies - overlapping window

	Growth periods			
variable	1year	3years	5 years	10 years
y	-0.058**	-0.099**	-0.102**	-0.045**
	(5.33)	(13.45)	(18.34)	(17.81)
Gini	0.329**	0.258**	0.135**	0.019**
	(11.62)	(13.37)	(8.93)	(2.61)
college	0.275**	0.338**	0.307**	0.089**
	(9.20)	(16.25)	(17.24)	(7.33)
urban	0.116**	0.154**	0.140**	0.015
	(3.22)	(6.39)	(7.56)	(1.68)
age_65+	0.331**	0.364**	0.165**	-0.064*
	(3.36)	(5.39)	(3.14)	(2.58)
constant	0.419**	0.906**	1.044**	0.541**
	(3.64)	(11.61)	(17.86)	(20.99)
Observations	960	912	864	744
Nbr of counties	24	24	24	24
R-squared	0.25	0.45	0.55	0.80

Notes: See Table 2a

Applying the Hausman (1978) test we can reject the null that the difference in coefficients is not systematic, in favour of the fixed effects, irrespective of growth period studied and irrespective of whether time dummies are included. The coefficient estimates are however similar in terms of sign and significance level in the random and fixed-effects estimations, although the coefficient of the Gini variable in the random-effects estimation is lower in magnitude.

Since we clearly do not have stationary series it is important to test for cointegration of the series. If the error term in our fixed-effects estimation is stationary, the right hand side variables are said to be cointegrated. Estimating the panel unit root test developed by Levin, Lin and Chu (2002), we can reject the null hypothesis of non-stationarity of the error term using 1-2 lags. This test assumes that each individual unit in the panel shares the same AR(1) coefficient. Testing for the number of cointegrating vectors in the system by using Johansen's maximum likelihood cointegration rank test and checking if it varies across panels we cannot reject the null hypothesis that we have a cointegrating vector of rank r = 2, and the same rank holds across panels. Using a likelihood-ratio test we can reject the null hypothesis that one or more of the variables in the VAR do not enter in the cointegrating relationship.[15]

[15] We use the lrjtest command in STATA. As noted in Phillips and Moon (1999, 2000), however, spurious regressions need not be as big an issue in panel data framework.

The fixed effects estimations may be inconsistent due to the presence of the lagged income term on the right-hand side. Monte Carlo simulations in Judson and Owen (1996) have shown that, for panels with a short time dimension, the bias of the coefficient on the lagged dependent variable can be significant, but that the bias for the coefficient on the other right-hand side variables tends to be minor. Running a GMM estimation suggested by Arellano and Bond (1991) that corrects for this bias introduced by the lagged endogenous variable we do not find evidence of any significant bias neither in the Gini coefficient or in the lagged income coefficient in the 1-year growth regression with no time dummies.

Restricting the time effects to zero, irrespective of whether we look at distinct windows or overlapping windows, Tables 1a and 1b show that, as predicted by models implying conditional convergence, the estimates show a significant and negative coefficient on initial income. The share of the population with a college education has a significant positive effect on income growth.[16] The share of the population aged 65+ has, a positive effect on short run growth, and a negative effect on longer term growth in the overlapping window case.[17] Urbanisation has a positive effect on income growth, and the effects are significant in the short and medium run. This result is in line with Agglomeration Theory which states that a large concentration of individuals leads to a higher degree of specialization and enables economies of scale thus paving the way for economic growth.

Income inequality in terms of Gini has a significant positive effect in all growth periods studied and decreases over the length of the growth period studied irrespective of whether we look at distinct or overlapping windows. In the 10-year growth periods the difference in the coefficients between the estimations using overlapping and distinct windows is large. We give more weight to the estimations using overlapping windows since they include more observations and are less sensitive to business cycle variations. However there is a risk that overlapping windows exhibit a large degree of autocorrelation in the residuals. To deal with this issue we apply Newey West corrected standard error, in an OLS with county dummies, allowing for autocorrelation in the residuals. We choose a lag corresponding to the length of the growth period studied. That is, e.g. in the specification using annual 10-year growth rates

[16] We choose to omit the share of secondary educated since the two variables are highly correlated especially during the first 15 years of our study.

[17] The positive effect of age_65+ on growth is not expected. This is a group with negative savings, which demands low productivity services in the public sector. An increase in this variable also corresponds to an outflow from the labour force.

we correct for autocorrelation up to the 10th lag. The coefficient of the Gini variable in the 10-year growth rates specification turns insignificant at the 5% level. The results are presented in Appendix D.

How do we relate our findings to earlier studies? The positive effects of inequality on growth confirm Barro's (2000) findings that the positive relationship between income inequality and growth is a high income country feature. The results further confirm Forbes' (2000) findings, that when looking within a country, and controlling for all the country specific and time invariant features, we find a positive relationship, at least in the short and medium run.[18] The fact that the effect decreases in the 1- to 10-year growth period and is insignificant in the 10 year Newey West specification indicates that the positive relationship is basically a short to medium term one.[19] The fact that the Gini coefficient is insignificant in the 10-year growth specification could depend on the relationship not being stable over time, since explanatory variables post-1990 are not included in the 10-year specifications. However, when estimating the 1-10 year growth regression on the pre-1990 period, we still get a coefficient estimate on the Gini coefficient of the same magnitude**.**

The economic impact of income inequality on growth is significantly lower in our study compared to both cross state studies in the US, and cross country studies. Our estimations indicate that a one standard deviation increase in the Gini coefficient is associated with a 0.32 percent increase in the growth rate over the following year, a 0.13 percent increase in the average annual growth rate over the following five years and a 0.02 percent increase in the growth rate over the following 10 years. Forbes (2000) found that a one standard deviation increase in the Gini coefficient is correlated with a 1.3 percent increase in average annual growth over the next five years. In a study of US states Panizza (2002) found a one standard deviation increase in the Gini coefficient to cause a 0.2 percentage decrease on growth rates during the following decade.

The fact that our results are much smaller in magnitude than those found in cross country studies is not surprising, since higher labour and capital mobility in combination with the role played by the central government are important reasons for income distribution to have a

[18] The positive effects found in Forbes (2000) on cross country panel data are also based on 5 year growth effects.
[19] However even if the magnitude of the long run effects are much smaller it does not imply that the effects are negligible since there is an accumulation effect to be considered as well. An annual effect of 0.019% over 10 years has an accumulated effect of 0.21%.

smaller impact on growth. The magnitude of our inequality coefficient is also much smaller than that found in the US cross state studies. But one could argue that the US states are population and economy-wise much larger than that of Swedish counties and that the income inequality dynamics studied here may be more comparable to that of regions within a US state.

For reasons of policy implications it is of interest to compare the effects of inequality on growth to that of other control variables. The magnitude of the effect of college education on growth is comparable to that of inequality in the 1- to 3-year growth periods. In the longer run, college education has a stronger effect on the growth rate than inequality and remains significant even in the 10 year growth specification.

The exclusion of time dummies puts a restriction on the steady state assumption in the model tested by assuming a time-invariant Steady State, and thus no long run growth, and is also likely to create an omitted variable bias. Including time dummies does to an extent control for technological change/overall trend but it also exacerbates the problem of multicollinearity in a fixed effects estimation. If the variation over time of variables is similar across counties (e.g. with variables with a big trend component), there is a risk that the year dummies capture too much of the variation of certain variables. [20]

The results of the specification including year dummies are presented in Table 3a and 3b for the overlapping and non-overlapping cases respectively. [21] Although the significance level of College decreases, as expected, the fact that it turns negative need not be surprising. College is an attempt to measure human capital accumulation, however given the increase in education level among younger cohorts compared to older cohorts, an increase in College could as well mean a larger share of youngsters with less experience, and thus a lower level of human capital accumulation**.** The estimates of the Gini coefficient remain positive, although lower in magnitude, compared to the specification without time dummies. In the 10-year growth specification the coefficient of the Gini index remains positive and significant

[20] Alternative ways of dealing with trends in the variables is to divide income with the average income across counties, or just include a time trend. In the first case, we only capture the trend problems in the initial income variable, whereas the second alternative results in problems of multicollinearity

[21] Alternative specifications have also been estimated using decade dummies, 5 year-dummies and regime dummies to account for the three main exchange rate regimes of the period. The magnitude in the variables of interest are however similar in magnitude irrespective of the choice of time dummy variables.

even with Newey West adjusted standard errors, as can be seen in Appendix D, Table D2. The magnitude of the effect of income inequality on growth is not as clearly diminishing with the length of the growth period studied, however the effects of the 10-year specification are still much lower than the shorter run specifications.

Table 3a: Fixed effects growth regressions with year dummies
Estimated without the intermediate year observations - distinct window

	Growth periods			
variable	1year	3years	5 years	10 years
y	-0.060**	-0.058**	-0.055**	-0.043**
	(3.97)	(4.56)	(4.09)	(3.35)
gini	0.270**	0.279**	0.294**	0.185**
	(7.55)	(8.73)	(8.42)	(3.92)
college	-0.037	-0.043	-0.012	0.060*
	(1.32)	(1.78)	(0.46)	(2.31)
urban	0.069**	0.069**	0.061**	0.021
	(4.25)	(5.22)	(4.40)	(1.68)
age_65+	0.076	0.079*	0.074	0.035
	(1.66)	(2.11)	(1.83)	(0.88)
constant	0.546**	0.510**	0.476**	0.411*
	(3.08)	(3.41)	(2.95)	(2.55)
Observations	960	336	192	96
Nbr of lan	24	24	24	24
R-squared	0.90	0.96	0.97	0.96
(R-squared)	(0.13)	(0.37)	(0.55)	(0.61)

Notes: See Table 2a. (R-squared) is the R-squared of an OLS regression on within and cross-county transformed data, and thus captures the R2 which does not accrue to time dummies.

Table 3b: Fixed effects growth regressions with year dummies
- overlapping window

	Growth periods			
variable	1year	3years	5 years	10 years
y	-0.060**	-0.069**	-0.070**	-0.067**
	(3.97)	(8.82)	(12.89)	(22.71)
gini	0.270**	0.247**	0.206**	0.072**
	(7.55)	(12.76)	(14.40)	(8.01)
college	-0.037	-0.050**	-0.037**	0.001
	(1.32)	(3.36)	(3.45)	(0.10)
urban	0.069**	0.067**	0.058**	0.023**
	(4.25)	(8.07)	(10.05)	(7.29)
age_65+	0.076	0.079**	0.058**	0.026**
	(1.66)	(3.37)	(3.53)	(2.81)
constant	0.546**	0.650**	0.696**	0.737**
	(3.08)	(7.04)	(10.71)	(20.62)
Observations	960	912	864	744
Nbr of counties	24	24	24	24
R-squared	0.90	0.96	0.97	0.98
(R-squared)	(0.13)	(0.36)	(0.50)	(0.68)

Notes: See Table 2a. (R-squared) is the R-squared of an OLS regression on within and cross-county transformed data, and thus captures the R2 which does not accrue to time dummies.

VI.1.2 Sensitivity analysis

These results are robust to the exclusion of a year, or a county at a time, and are thus not driven by any outliers.

The relationship between income inequality and growth remains positive and significant when looking at various subsets of periods, when controlling for year dummies. We study the period before and after 1980 separately. It gives us not only a comparable time span in each sub-period, but catches different trends in inequality. Inequality showed a steady decrease up until 1980, followed by an increase in inequality in the 1990s. The results remain stable across time periods. Given that the definition of taxable income has changed in 1974 and 1991 we estimate the relationship before and after these dates, and find the sign, significance and magnitude of the Gini-coefficient to be relatively stable across time periods. This assures that our results are not very sensitive to whether our estimations are based on pre or post transfer income. We study the period before and after 1974 separately, and include year dummies to control for period specific effects. Both time periods show a significant and positive effect of inequality on growth. The only exception is the 10-year growth rates specification post-1974 which turns insignificant, although it is to be noted that we are dealing with a small sample. The magnitude of the effect of inequality on the 1 to 5 year growth rate in the post 1974 era is somewhat lower that in the pre 1974 era, although not significantly lower.

To check whether our results hold for other measures of income inequality we use both the share of the third quintile (Q3) an the Theil's Entropy Index (*theil*) as alternative measures of income inequality. The share of the third quintile is often used as a measure of the median voter in political economy contexts and is closely related to the Gini index to the extent that observations around the median affect the Gini measure more than observations around the tails. Theil's entropy index is more sensitive to observations in the upper tail of income distribution. We do not consider measures which are more sensitive to the bottom of the income distribution, since there have been changes over time in the lower limit at which income is subject to taxation has varied over time, and using a measure sensitive to this part of the income distribution may lead to biased results.

The coefficients from the fixed effects estimations where Theil's index and the share of the third quintile are used as inequality measures are presented in Table 4, together with the coefficients of the estimations with the Gini index.[22] The results of the Theil's entropy index and the share of the third quintile are in line with that of the Gini index. We find a similar decrease in the magnitude of the coefficient, the longer the growth period. The coefficients of the third quintile are negative, in line with the earlier results that more equality leads to less growth, but turn insignificant at the 5% level in longer run growth periods.

Table 4: Fixed effects growth regressions with year dummies
- overlapping window

Growth periods			
1year	3years	5 years	10 years
	Gini		
0.270**	0.247**	0.206**	0.072**
(7.55)	(12.76)	(14.40)	(8.01)
	Theil		
0.158**	0.140**	0.115**	0.039**
(7.39)	(12.16)	(13.66)	(8.11)
	Q3		
-0.180*	-0.152**	-0.055	-0.002
(2.20)	(3.48)	(1.78)	(0.15)

Notes: The dependent variable is annual per capita growth rates in 1,3,5 and 10 years growth periods. Absolute value of t statistics in parentheses. * denotes significance at the 5% and ** denotes significance at the 1% level

VI.2. Income inequality as an endogenous variable

VI.2. 1. Choice of instruments

In this section we consider inequality as endogenous for reasons mentioned above. The instrument variables have two basic requirements to fulfil: they should be correlated with the endogenous variable(s) they are to explain, and they should be orthogonal to the error process. We test these criteria by examining the fit of the first stage regressions and by applying Sargan's test of over-identifying restrictions, which gives an indication of the validity of the set of instruments.

We use the age structure of the population aged over 20 as instrument variables. It is to be noted that we here, to a larger extent, capture the inequality between rather than within age

[22] The complete estimations, both with and without year dummies are presented in Appendix E.

groups. The age structure is an exogenous variable, or at least a predetermined variable in this context. It has a direct effect on income distribution since it captures the shares of the population in various parts of their life cycle. Pensioners and young adults are likely to decrease inequality, mature adults and middle-aged would have the opposite effect by increasing inequality. The structure of the entire adult population is a more exogenous measure than age structure in the labour force, to the extent that contemporary earnings profiles for different education levels would affect the education choice of the young, thus affecting their entrance in the labour market. Even though there may be direct effects of the age structure on growth, as has been shown in the literature, it ought to be other mechanisms which give an effect on the Gini coefficient.[23]

VI.2. 2. First stage regressions

Table 5 : First stage regressions in the 1-year growth rate regression

	No time dummies	Decade dummies	Year dummies
y	-0.002	-0.069**	-0.167**
	(0.13)	(7.17)	(12.76)
College	-0.131**	0.140**	0.182**
	(3.00)	(3.93)	(6.53)
urban	0.014	-0.040	-0.076**
	(0.34)	(1.41)	(5.15)
age_20_34	-0.384**	-0.161*	-0.176**
	(5.62)	(2.58)	(3.42)
age_50_64	0.368**	0.120	-0.290**
	(4.87)	(1.87)	(5.11)
age_65+	-1.924**	-0.904**	-0.227**
	(21.08)	(11.99)	(4.94)
Constant	0.913**	1.493**	2.563**
	(7.23)	(14.66)	(15.61)
Observations	960	960	960
Nbr of counties	24	24	24
R-squared	0.88	0.94	0.99

Notes: The dependent variable is the Gini coefficient. R-squared refers to the within-R-squared for fixed effects. Absolute value of t statistics are in parentheses. * and ** denote significance at the 5 and 1% level respectively. For the independent variables, *y* is the log of income per capita, *age_20_34, age_50_64* and *age_65+* are the share of the respective age groups in the adult population, *urban* is the share of the population living in the largest city, *college* is the percentage of the population aged 25-59 with a college education.

[23] In line with previous studies, Perotti (1996), Forbes (2000) and Panizza (2002) we do however include the share of the adult population aged 65 and over in the growth specification. Adding the remaining age structure variables to the growth equation does not add to the explanatory power of the estimation. The fact that the age structure refers to that of the adult population and not to that of the labour force further weakens the link between growth and age structure.

The first stage regression results are presented in Table 5a with Gini as a dependent variable. We choose to present the results of the first stage regression from the 1-year growth specification, since it includes all observations.

The validity of the IV estimator requires that the instruments describe the variation in the instrumented variable. One measure of the degree of correlation suggested by Staiger and Stock (1997) is the joint significance of the instruments in the first stage regression, in this case *age_20_34* and *age_50_64*. A large F-statistic implies that the instruments offer a good explanation of the variation in the endogenous variables. Our F-statistics are in excess of 10 even in the specifications including time dummies.

Applying Sargan's test of over-identifying restrictions we cannot reject the null hypothesis that the instruments are valid instruments (i.e. uncorrelated with the error term) when we do not include time dummies. When controlling for year dummies only the 1-year growth regression has valid instruments. When including decade dummies 5 and 10-year growth regressions have valid instruments.

Compared to our reference 35-49 age group, pensioners, *age_65+*, have an equalising effect on income distribution, as well as the 20-34 age group. The share of mature adults "situated in the top" of their age-income profile (*age_50_64*) contribute to an increase in inequality, although this result is not robust to the inclusion of time dummies. Human capital stock measured as the share of the population aged 25-65 having a college education (*college*), has a negative effect on inequality, as long as time dummies are not included. [24] Urbanisation has a significant equalising effect on income distribution, when controlling for year dummies, but is otherwise positive and insignificant.

[24] When including secondary education in the specification, the coefficient has a negative but insignificant effect on inequality, and omitting this variable does not have an effect on the coefficients of the remaining variables. A higher overall level of human capital would be expected to have an equalising effect on income inequality. The reverse causality, that of income inequality on education levels, would not be a big issue in Sweden. Income inequality would be expected to have a relatively weak effect on human capital accumulation in Sweden. Both secondary and college education is entirely subsidised by the state, and the presence of study allowances and grants does not make the individual's private financial background any important obstacle in the choice to pursue an education. Other issues like the presence of a university in ones county could have effects on the choice of post secondary education. But this county-specific variable should however be captured in the fixed-effects term of the specification, given that the college has been there the whole period.

VI.2. 3. 2SLS IV regressions

In the case with no time dummies (Table 6a) the coefficient of the Gini index remains positive and significant in the 1-year growth period, and turns negative and significant in the 10-year growth case.[25] The results are however not as stable across growth periods and are more sensitive to the inclusion of time dummies compared to the case when Gini was considered to be exogenous. When year or decade dummies are included, the positive effect of the Gini index on growth persists, although the coefficients are not always significant. However, one should be cautious in interpreting the results when time dummies are included, since the instrument variables are not always valid according to the Sargan's test.

The fact that the results are not robust to the inclusion of time dummies could suggest that we have an omitted variable problem in the case without time dummies. We may have spatial correlation in the residuals. Inter-county migration and intergovernmental grants are a few reasons to believe that spatial correlation may be an issue. Unfortunately we do not have any adequate data on these variables for the time period studied here. In an attempt to deal with this we include the total county population, which in a fixed effects setting can be interpreted as a proxy for migration, under the strong assumption that fertility and mortality rates are homogenous across the country. The results are not presented here, but the coefficient of the Gini index remains highly similar to the results in Table 6, both in terms of magnitude, significance level, and the outcome of the Sargan's test.[26] The results do however suggest that an omitted variable problem relating to spatial correlation does not seem to be driving the results.[27]

[25] The same estimations with Newey West adjusted standard errors are presented in Appendix F

[26] Sargan's test remains rarely satisfied when time dummies are included

[27] Intergovernmental grants play an equalising role in the income redistribution process. When including aggregate total public expenditure as an instrument variable the coefficient of the Gini index remains positive across growth regressions, although insignificant in the 10-year growth regression without time dummies.

Table 6a **:** 2SLS IV growth regression without time dummies – fixed effects estimation

	Growth periods			
variables	1year	3 years	5 years	10 years
y	-0.054**	-0.099**	-0.144*	-0.021
	(4.46)	(12.29)	(2.12)	(1.91)
Gini	0.722**	0.251	-2.887	-0.401*
	(5.98)	(1.81)	(0.72)	(2.56)
college	0.346**	0.336**	-0.973	-0.290*
	(8.86)	(7.82)	(0.57)	(2.01)
urban	0.104**	0.154**	0.118	-0.037
	(2.61)	(6.31)	(0.89)	(1.28)
age_65+	1.109**	0.353	-4.308	-0.554**
	(4.35)	(1.45)	(0.72)	(2.89)
constant	0.019	0.914**	4.008	0.608**
	(0.11)	(5.29)	(1.01)	(9.03)
Obs	960	912	864	744
Nbr of counties	24	24	24	24
Sargan's over-identification test, P-value	0.12	0.98	0.80	0.54

Notes: The dependent variable is annual per capita growth rates in 1,3,5 and 10-years growth periods. Absolute value of z statistics in parentheses . * denotes significance at 5% level and ** denotes significance at 1% level. Gini is endogenous, the set of instruments used are: y, college, urban, *age_65+*, *age_20_34* and *age_50_64.*

Table 6b **:** 2SLS instrument variable growth regression with decade dummies –

	Growth periods			
variables	1year	3 years	5 years	10 years
y	0.033	-0.147*	-0.098**	-0.028**
	(0.87)	(2.52)	(8.25)	(8.12)
Gini	1.826**	0.027	0.475**	0.038
	(3.97)	(0.04)	(4.10)	(1.01)
college	0.380**	0.425**	0.245**	0.039**
	(4.20)	(11.11)	(9.44)	(2.59)
urban	0.220**	0.185**	0.168**	0.004
	(3.83)	(5.90)	(9.18)	(0.47)
age_65+	1.527**	0.032	0.192*	-0.033
	(3.59)	(0.08)	(2.51)	(1.16)
constant	-1.657*	1.619	0.798**	0.332**
	(2.32)	(1.51)	(3.99)	(5.80)
Obs	960	912	864	744
Nbr of counties	24	24	24	24
Sargan's overidentification test P-value	4.3e-13	8.0e-13	0.81	0.43

Notes: See Table 6a

Table 6c **:** 2SLS instrument variable growth regression with year dummies –

	Growth periods			
variables	1year	3 years	5 years	10 years
y	-0.081*	-0.088**	-0.079**	-0.049**
	(2.17)	(5.21)	(7.02)	(5.05)
Gini	0.138	0.137	0.155**	0.181**
	(0.65)	(1.56)	(2.61)	(3.09)
college	-0.017	-0.040*	-0.036**	0.021
	(0.39)	(2.37)	(3.31)	(1.59)
urban	0.058*	0.059**	0.054**	0.030**
	(2.42)	(5.77)	(7.83)	(5.69)
age_65+	0.051	0.064*	0.053**	0.031**
	(0.85)	(2.40)	(3.02)	(2.93)
constant	0.861	0.925**	0.865**	0.480**
	(1.61)	(3.95)	(5.50)	(3.40)
Obs	960	912	864	744
Nbr of counties	24	24	24	24
Sargan's overidentification test P-value	0.36	0.032	0.0029	5.3e-04

Notes: See Table 6a

VII. Concluding discussion

This paper explores the relationship between inequality and growth using panel data on Swedish counties during the years 1960-2000.

Using fixed–effects estimations we find evidence of a positive impact of initial income inequality on annual income growth the following 1 to 10-years growth period, suggesting that inequality has a positive impact on income growth.

We also find that the magnitude of the effect decreases with the length of the growth period studied. The results indicate that the mechanisms at work in this within county framework relationship between initial income inequality and growth are mainly short run mechanisms. This could suggest the capital freed from an increase in income inequality, through a larger concentration of income in the upper tail of income distribution, does not translate into long run investments but rather in shorter run effects such as increased consumption of goods and services.

The magnitude of the effect - the economic impact - is smaller compared to that found in both cross country studies (Forbes 2000) and US cross state studies (Panizza 2002) using similar estimation techniques.

Assuming that income inequality is endogenous, we estimate the growth regression using 2SLS IV, where the Gini coefficient is instrumented using the age structure of the adult population as exogenous instrument variables. In the short run the effect of inequality on growth remain positive, whereas the effect in the long run is not as clear cut and depend on whether time dummies are included or not.

The analysis could as well be extended to include *College*, *Urban* and of course initial income as endogenous variables as well, since they are likely to be affected by contemporaneous growth as well as expectation of future growth rates.[28] It is however difficult to find a set of instrument variables that are available, appropriate and satisfy the Sargan test of overidentifying restrictions.

In this study, the short and long run growth effects are estimated using the same set of explanatory variables. Further research should look closer into which forces are at work, and how the dynamic mechanisms at work vary at the short and long time horizons.

[28] Regarding urbanisation, both fertility rates and in-migration may tend to increase if there is an increase in economic activity in a county. Concerning human capital, there may be a double causality between human capital and economic growth. There is a risk that an individual's choice of whether or not to pursue an education may be affected by the current economic situation. In expansive economic times, young cohorts may be more inclined to work and postpone further education.

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Appendix A[29]:

The data on income inequality is based on taxable individual income. The measure is thus contingent on the definition of taxable income for every year. The data on pre-tax individual income is retrieved from the total sum of income statistics (totalräknad inkomststatistik) published yearly by Statistics Sweden, and has been revised in order to account for a few drawbacks in the data. Our data is restricted to individuals 20 years of age and older in order to get a homogeneous sample where the same age groups are represented across time, irrespective of fiscal rules and method of data collection. The inequality data is thus based on individual data and *not* on household adjusted data on which most international data on inequality rely.

Between 1960 and 1970, as well as in 1990 the income definition refers to total net income. For the period 1971-1990 it refers to total income and from 1991-1999 to the sum of labour and capital income.[30] The fiscal legislation as well as the definition of the income that is presented in the tax register has changed a few times. The lower limit at which capital income is liable to taxation has varied, having implications for who is included in the income statistics.

In 1971 joint taxation of married couples was abolished (in favour of individual taxation), as well as differentiated tax scales for married and unmarried. In 1974, certain social insurances such as sickness benefit and unemployment benefits became taxable, and were thereby included in the tax register. At the same time, the level of compensation for these insurances was increased. The tax reform of 1990-1991 implied a decrease of the tax rate and a widening of the tax base. The lower limit at which capital income is subject to taxation was lowered and various fringe benefits became taxable. The abolishment of joint taxation in Sweden has not given rise to a break in the trend in the income inequality variable since the income measure is based on individual gross-income, even though the abolishment of joint

[29] See Johansson (2004) for more information on the compilation of the data and a summary of adjustments that have been made to account for errors in the original data.

[30] From 1960-1970 the types of income included in the sum of net income is: labour income, capital income, real estate income, temporary employment, farming and farm property, taxable as wells as sea-related income minus deficit in source of income.
From 1971-1990 the definition of income is the same as in the preceding period, apart from the fact that deficit in the source of income is not deducted. From 1991 onwards the definition of income has come to include income from labour, economic activity as well as capital surplus

taxation has probably had an impact on the decision of women to enter the labour market. The two other reforms have given rise to trend breaks, and have been adjusted for. For the years 1974-1977 our income inequality measure has been adjusted using information from the country level, retrieved from LINDA (longitudinal individual data for Sweden) where the definition of income corresponds to that of our data prior to 1974. The inequality measure is multiplied with that of the ratio old-income-definition/new-income-definition for the aggregate data. For the following years, the data is just multiplied by the value of 1977, so as not to create a new trend break.

The trend break of 1990-1991 has been adjusted using HINK (Hushållsinkomstdata) data which provides information on aggregate household income inequality for 1991 and a revised version of 1989 based on 1991 tax assessment rules. We set the variation in income inequality between 1989 and 1991 equal to that in the HINK.

Various other minor adjustments have been made due to trend breaks which arise due to changes in the number of income classes which are at the basis for the inequality measure.

Appendix B

Variable	Definition	Source	Additional information
y	Ln of per capita taxable income for the population aged 20 and over, 2000 year price level, SEK	Statistics Sweden	See Appendix
Growth rates	averaged (annual) 1 to 10-year per capita income growth rates	Statistics Sweden	See Appendix
Gini	Gini index	Statistics Sweden	See Appendix A
Theil	Theil's Entropy Index	Statistics Sweden	See Appendix A
Q3	Share of the income held by the third quintile	Statistics Sweden	See Appendix A
College	Percentage of population aged 25-59, with a college education	Population and Housing Census (FoB) 1960, 1970, 1985-2000	The values for 1961-1969, 1971-1984 have been interpolated using a cubic spline method in a state space model. See Harvey and Koopman (1999) and Koopman, Shephard and Doornik (1998) for a thorough description of this method.
Urban	Share of the population living in the county's largest city.	Statistics Sweden, 1960, 1970, 1980 , 1995 & 2000	The interpolations are done using the above cubic spline method.
A_35_49 A_50_64 A_65_	Share of various age groups as share of the adult population aged 20+,	Statistics Sweden: 1960 1965 1968-1999	For the intermediate years, the data has been linearly interpolated Observations have been lagged one year since the data is observed Dec 31.

Descriptive statistics:

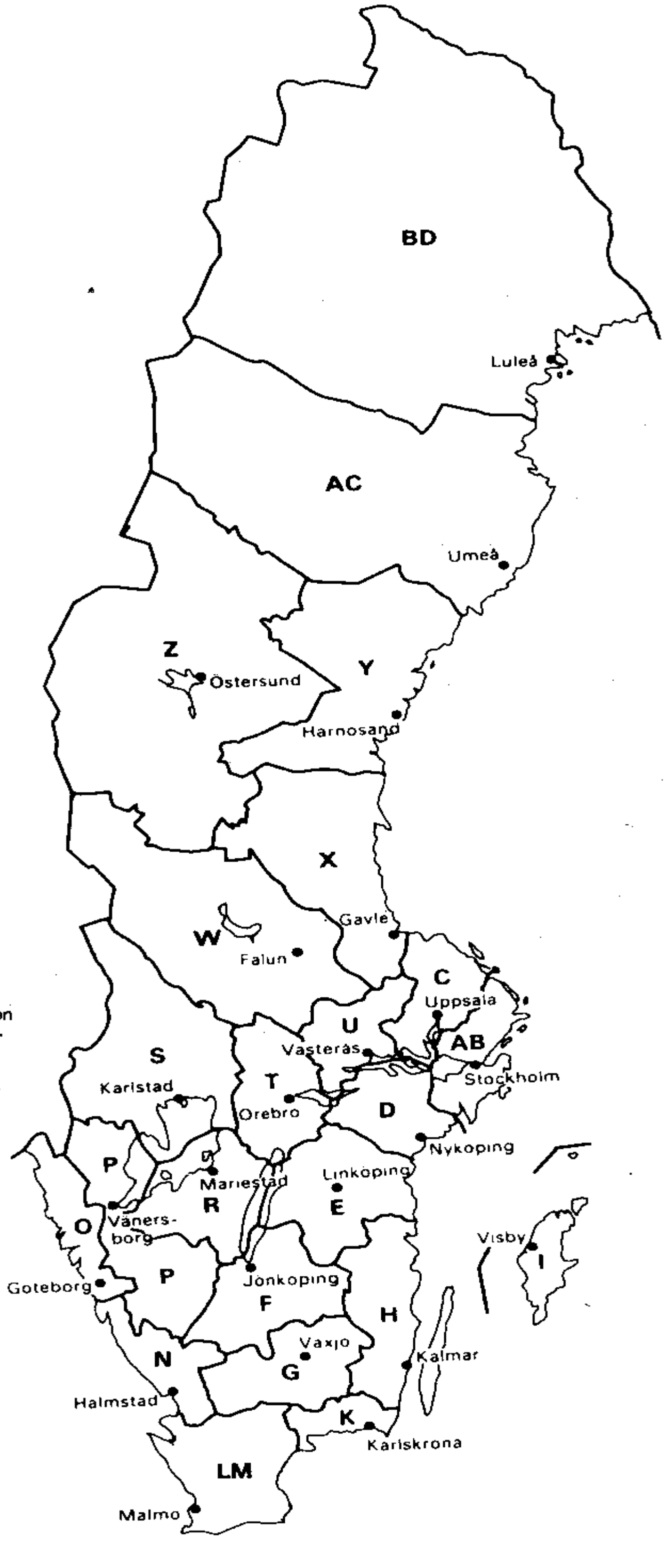
Variable	Obs	Mean	Std.Dev.	Min	Max
average income growth rates					
1-year	960	0.026	0.027	-0.043	0.112
3-year	912	0.024	0.020	-0.032	0.075
5-year	864	0.023	0.016	-0.017	0.067
10-year	744	0.022	0.010	0.003	0.047
y	960	3.513	0.274	2.732	4.119
gini	960	0.408	0.080	0.307	0.563
Q3	960	0.165	0.014	0.123	0.194
Theil's Index	960	0.363	0.115	0.184	0.645
age_20_34	960	0.277	0.023	0.221	0.348
age_50_64	960	0.240	0.026	0.174	0.283
age_65_	960	0.220	0.032	0.120	0.276
college	960	0.141	0.083	0.017	0.392
Urban	960	0.268	0.149	0.091	0.753

Appendix

Sveriges län och residensstäder den 1 januari 1997
Counties and provincial capitals of Sweden

AB = **01** Stockholms län
C = **03** Uppsala län
D = **04** Södermanlands län
E = **05** Östergötlands län
F = **06** Jönköpings län
G = **07** Kronobergs län
H = **08** Kalmar län
I = **09** Gotlands län
K = **10** Blekinge län
LM = **12** Skåne län[1]
N = **13** Hallands län
O = **14** Göteborgs och Bohus län
P = **15** Älvsborgs län
R = **16** Skaraborgs län
S = **17** Värmlands län
T = **18** Örebro län
U = **19** Västmanlands län
W = **20** Dalarnas län[2]
X = **21** Gävleborgs län
Y = **22** Västernorrlands län
Z = **23** Jämtlands län
AC = **24** Västerbottens län
BD = **25** Norrbottens län

[1] Sammanslagning av Kristianstads (L) och Malmöhus (M) län den 1 jan. 1997. – [2] Namnbyte den 1 jan. 1997 från Kopparbergs län.



Source: Statistical Yearbook 1997, Statistics Sweden

Appendix C: Random effects growth regressions - overlapping windows

Table C2: without time dummies

	Growth periods			
variable	1year	3years	5 years	10 years
y	-0.017*	-0.050**	-0.064**	-0.041**
	(2.08)	(8.39)	(14.38)	(22.05)
gini	0.250**	0.170**	0.068**	0.010
	(10.53)	(9.69)	(4.94)	(1.72)
college	0.156**	0.197**	0.168**	0.051**
	(6.53)	(11.38)	(11.81)	(6.22)
urban	-0.015*	-0.011*	-0.007	-0.003
	(2.32)	(2.46)	(1.84)	(1.45)
age_65+	0.077	0.061*	0.005	-0.037**
	(1.81)	(2.06)	(0.24)	(3.43)
constant	0.087	0.495**	0.720**	0.497**
	(0.86)	(6.96)	(13.45)	(23.03)
Obs	960	912	864	744
Nbr of lan	24	24	24	24

Table C2: with year dummies

	Growth periods			
variable	1year	3years	5 years	10 years
y	-0.015*	-0.026**	-0.037**	-0.053**
	(2.06)	(4.81)	(8.16)	(19.39)
gini	0.154**	0.180**	0.165**	0.067**
	(5.84)	(10.18)	(11.77)	(7.62)
college	-0.006	-0.011	-0.010	0.016**
	(0.36)	(0.98)	(1.05)	(2.71)
urban	0.002	0.008**	0.013**	0.012**
	(0.54)	(3.03)	(5.07)	(6.41)
age_65+	-0.014	0.008	0.014	0.008
	(0.58)	(0.43)	(0.99)	(0.90)
constant	0.142	0.239**	0.361**	0.589**
	(1.56)	(3.56)	(6.58)	(17.66)
Obs	960	912	864	744
Nbr of lan	24	24	24	24

Table C3: with decade dummies

	Growth periods			
variable	1year	3years	5 years	10 years
y	-0.018	-0.057**	-0.073**	-0.024**
	(1.76)	(7.83)	(14.55)	(11.85)
gini	0.243**	0.242**	0.164**	0.053**
	(6.58)	(8.94)	(8.52)	(6.87)
college	0.249**	0.157**	0.060**	0.026**
	(7.66)	(6.91)	(3.73)	(3.25)
urban	-0.027**	-0.005	0.008*	-0.003
	(3.86)	(1.09)	(2.51)	(1.75)
age_65+	0.117**	-0.007	-0.104**	-0.018
	(2.61)	(0.23)	(4.99)	(1.72)
constant	0.087	0.553**	0.794**	0.283**
	(0.69)	(6.08)	(12.62)	(11.40)
Obs	960	912	864	744
Nbr of lan	24	24	24	24

Notes: The dependent variable is annual per capita growth rates in 1,3,5 and 10-years growth periods. Absolute value of t-statistics in parentheses . * denotes significance at 5% level and ** denotes significance at 1% level.

Appendix D

Table D1: growth regressions without time dummies - overlapping windows

	Growth periods			
variable	1year	3years	5 years	10 years
y	-0.058**	-0.099**	-0.102**	-0.045**
	(5.56)	(9.43)	(10.46)	(13.63)
Gini	0.329**	0.258**	0.135**	0.019
	(10.96)	(9.68)	(6.40)	(1.42)
college	0.275**	0.338**	0.307**	0.089**
	(8.86)	(10.57)	(10.55)	(5.44)
urban	0.116**	0.154**	0.140**	0.015
	(3.05)	(4.32)	(4.67)	(1.21)
age_65+	0.331**	0.364**	0.165	-0.064
	(3.01)	(3.40)	(1.93)	(1.58)
constant	0.379**	0.855**	0.992**	0.534**
	(3.54)	(8.33)	(10.23)	(14.37)
Obs	960	912	864	744
Nbr of lan	24	24	24	24

Table D2: growth regressions with year dummies - overlapping windows

	Growth periods			
variable	1year	3years	5 years	10 years
y	-0.060**	-0.069**	-0.070**	-0.067**
	(3.20)	(5.49)	(6.82)	(11.15)
gini	0.270**	0.247**	0.206**	0.072**
	(4.62)	(6.62)	(6.81)	(3.66)
College	-0.037	-0.050*	-0.037	0.001
	(1.08)	(2.08)	(1.92)	(0.05)
urban	0.069**	0.067**	0.058**	0.023**
	(3.50)	(4.04)	(4.21)	(3.11)
age_65+	0.076	0.079	0.058	0.026
	(1.34)	(1.91)	(1.90)	(1.72)
Constant	0.541*	0.648**	0.696**	0.743**
	(2.37)	(4.28)	(5.59)	(10.19)
Obs	960	912	864	744
Nbr of lan	24	24	24	24

Table D3: growth regressions with decade dummies - overlapping windows

	Growth periods			
variable	1year	3years	5 years	10 years
y	-0.072**	-0.117**	-0.118**	-0.027**
	(5.69)	(9.27)	(11.13)	(9.27)
gini	0.342**	0.358**	0.240**	0.059**
	(8.04)	(13.39)	(11.77)	(3.77)
College	0.567**	0.414**	0.223**	0.044**
	(11.34)	(8.57)	(6.09)	(3.07)
urban	0.164**	0.194**	0.158**	0.004
	(4.09)	(5.68)	(6.50)	(0.45)
age_65+	0.234*	0.244*	0.072	-0.023
	(2.07)	(2.28)	(0.99)	(0.72)
Constant	0.477**	0.986**	1.136**	0.303**
	(3.48)	(7.58)	(10.10)	(8.46)
Obs	960	912	864	744
Nbr of lan	24	24	24	24

Notes: The dependent variable is annual per capita growth rates in 1,3,5 and 10-years growth periods. Pooled OLS with county dummies. Newey West corrected standard errors, Absolute value of t-statistics in parentheses . * denotes significance at 5% level and ** denotes significance at 1% level.

Appendix E: Sensitivity analysis with alternative measures of inequality.

Table E1 : Growth regressions without time dummies – overlapping windows
Fixed effects estimations with Theil's Entropy index as inequality variable

	Growth periods			
variable	1year	3years	5 years	10 years
y	-0.051**	-0.093**	-0.099**	-0.045**
	(4.62)	(12.48)	(17.62)	(17.96)
theil	0.213**	0.165**	0.088**	0.017**
	(11.32)	(12.84)	(8.84)	(3.75)
college	0.258**	0.323**	0.299**	0.095**
	(8.67)	(15.61)	(17.04)	(7.97)
urban	0.109**	0.148**	0.137**	0.015
	(3.01)	(6.10)	(7.34)	(1.71)
age_65+	0.287**	0.326**	0.151**	-0.057*
	(2.95)	(4.85)	(2.90)	(2.35)
constant	0.412**	0.901**	1.036**	0.537**
	(3.55)	(11.42)	(17.64)	(20.93)
Obs	960	912	864	744
Nbr of counties	24	24	24	24
R-squared	0.25	0.44	0.55	0.80

Notes: The dependent variable is annual per capita growth rates in 1,3,5 and 10 years growth periods. R-squared refers to the within-R-squared for fixed effects. Absolute value of t statistics in parentheses. * denotes significance at the 5% and ** denotes significance at the 1% level.

Table E2 : Growth regressions with year dummies – overlapping windows
Fixed effects estimations with Theil's Entropy index as inequality variable

	Growth periods			
variable	1year	3years	5 years	10 years
y	-0.056**	-0.066**	-0.068**	-0.066**
	(3.63)	(8.19)	(12.03)	(22.00)
theil	0.158**	0.140**	0.115**	0.039**
	(7.39)	(12.16)	(13.66)	(8.11)
college	-0.013	-0.027	-0.019	0.005
	(0.48)	(1.82)	(1.72)	(0.72)
urban	0.060**	0.058**	0.051**	0.020**
	(3.73)	(7.05)	(8.77)	(6.52)
age_65+	0.064	0.070**	0.052**	0.026**
	(1.42)	(2.96)	(3.13)	(2.77)
constant	0.567**	0.679**	0.723**	0.745**
	(3.21)	(7.32)	(11.05)	(21.28)
Obs	960	912	864	744
Nbr of counties	24	24	24	24
R-squared	0.90	0.96	0.97	0.98

Notes: See Table E1

Table E3 : Growth regressions without time dummies – overlapping windows
Fixed effects estimations with share of third quintile (Q3) as inequality variable

	Growth periods			
variable	1year	3years	5 years	10 years
y	-0.043**	-0.104**	-0.111**	-0.032**
	(3.23)	(10.78)	(15.85)	(11.73)
Q3	-0.425**	-0.024	0.139	-0.312**
	(3.04)	(0.23)	(1.83)	(9.69)
college	0.169**	0.265**	0.259**	0.078**
	(4.85)	(11.13)	(14.35)	(7.98)
urban	0.129**	0.162**	0.138**	0.024**
	(3.36)	(6.12)	(7.08)	(2.88)
age_65+	-0.195*	-0.067	-0.057	-0.051*
	(2.04)	(0.99)	(1.11)	(2.30)
constant	0.579**	1.183**	1.241**	0.438**
	(4.39)	(12.38)	(18.01)	(16.42)
Obs	960	912	864	744
Nbr of counties	24	24	24	24
R-squared	0.15	0.34	0.51	0.82

Notes: See Table E1

Table E4 : Growth regressions with year dummies – overlapping windows
Fixed effects estimations with share of third quintile (Q3) as inequality variable

	Growth periods			
variable	1year	3years	5 years	10 years
y	-0.093**	-0.102**	-0.102**	-0.078**
	(6.16)	(12.54)	(17.51)	(27.15)
Q3	-0.180*	-0.152**	-0.055	-0.002
	(2.20)	(3.48)	(1.78)	(0.15)
college	0.003	-0.027	-0.032**	-0.012
	(0.10)	(1.66)	(2.63)	(1.73)
urban	0.052**	0.054**	0.046**	0.018**
	(3.14)	(6.04)	(7.11)	(5.51)
age_65+	0.025	0.044	0.038*	0.023*
	(0.54)	(1.74)	(2.04)	(2.37)
constant	1.096**	1.180**	1.172**	0.903**
	(6.64)	(13.28)	(18.39)	(28.46)
Obs	960	912	864	744
Nbr of counties	24	24	24	24
R-squared	0.89	0.95	0.96	0.98

Notes: See Table E1

Appendix F : 2SLS IV growth regressions - overlapping windows.

Table F1: without time dummies

	Growth periods			
variables	1year	3 years	5 years	10 years
y	-0.054**	-0.099**	-0.144	-0.021
	(4.13)	(7.69)	(1.31)	(0.99)
Gini	0.722**	0.251	-2.887	-0.401
	(5.30)	(1.16)	(0.43)	(1.24)
college	0.346**	0.336**	-0.973	-0.290
	(8.43)	(5.14)	(0.33)	(0.98)
urban	0.104*	0.154**	0.118	-0.037
	(2.18)	(4.24)	(0.47)	(0.62)
age_65+	1.109**	0.353	-4.308	-0.554
	(4.07)	(1.00)	(0.43)	(1.37)
constant	0.010	0.862**	3.848	0.614**
	(0.05)	(3.15)	(0.60)	(5.63)
Obs	960	912	864	744
Nbr of counties	24	24	24	24

Table F2: with year dummies

variables	1year	3 years	5 years	10 years
y	-0.081*	-0.088**	-0.079**	-0.049*
	(2.21)	(3.77)	(4.25)	(2.41)
Gini	0.138	0.137	0.155	0.181
	(0.65)	(1.20)	(1.70)	(1.45)
college	-0.017	-0.040	-0.036	0.021
	(0.33)	(1.50)	(1.85)	(0.69)
density	0.058*	0.059**	0.054**	0.030*
	(2.37)	(3.26)	(3.62)	(2.57)
age_65+	0.051	0.064	0.053	0.031
	(0.72)	(1.47)	(1.73)	(1.77)
constant	0.948	1.031**	0.824**	0.481
	(1.78)	(3.17)	(3.20)	(1.57)
Obs	960	912	864	744
Nbr of counties	24	24	24	24

Table F3: with decade dummies

variables	1year	3 years	5 years	10 years
y	0.033	-0.147	-0.098**	-0.028**
	(0.77)	(1.61)	(5.85)	(5.75)
Gini	1.826**	0.027	0.475**	0.038
	(3.49)	(0.03)	(2.77)	(0.72)
college	0.380**	0.425**	0.245**	0.039*
	(3.48)	(7.38)	(5.40)	(1.97)
density	0.220**	0.185**	0.168**	0.004
	(2.90)	(3.72)	(6.69)	(0.35)
age_65+	1.527**	0.032	0.192	-0.033
	(3.15)	(0.05)	(1.46)	(0.94)
constant	-1.700*	1.543	0.749**	0.331**
	(2.11)	(0.91)	(2.64)	(4.01)
Obs	960	912	864	744
Nbr of counties	24	24	24	24

Notes: The dependent variable is annual per capita growth rates in 1,3,5 and 10-years growth periods. Absolute value of z statistics in parentheses. Newey West corrected standard errors.* denotes significance at 5% level and ** denotes significance at 1% level. Gini is endogenous, the set of instruments used are:y, college, density, age_65+, age_20_34 and age_50_64. Estimated using pooled OLS with country dummies.

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