UNIVERSITY OF GOTHENBURG
SCHOOL OF BUSINESS, ECONOMICS AND LAW

Income Inequality and Crime: Evidence from Sweden

Sara Lindgren

June 2019

Abstract

In this thesis, I examine the relationship between income inequality and different crime rates in Sweden using a panel of Swedish municipality-level data between year 2004 and 2016. Income inequality is mainly measured by two different ratios between the share of people in different fixed income brackets. To account for a possible reverse causality between income inequality and crime rates, I calculate predicted income inequality measures based on the national income growth rate, to use as instrument for the actual income inequality measures. According to my findings there is a robust relationship between income inequality and violent crimes, and a fairly robust relationship between income inequality and property crimes where an increase in income inequality is associated with an increase in criminal activity.

Supervisor: Anna Bindler
Keywords: Income inequality, criminal activity, instrumental variable

Master's Thesis in Economics
Graduate School

Acknowledgement

I wish to express my most sincere gratitude to my supervisor Anna Bindler at the Department of Economics who has provided me with valuable and constructive feedback and given me support throughout the process. Your willingness to give your time has been very much appreciated, without your guidance this thesis would not have been possible. I would also like to show my greatest appreciation to Pedram Shirmohammad for technical assistance when constructing my datasets.

Table of Contents

List of Tables

List of Figures

Abbreviations

2SLS Two-stage Least Squares

FBI Federal Bureau of Investigation

IV Instrumental Variables

OLS Ordinary Least Squares

SCS The Swedish Crime Survey

SEK Swedish krona

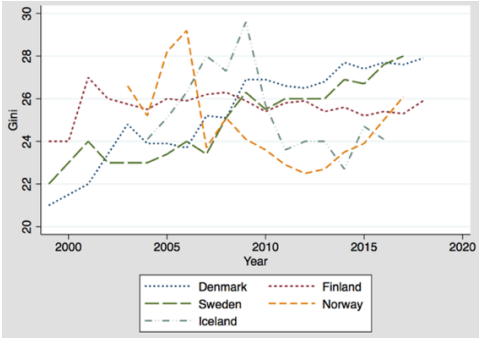
TKR 1000 SEK

1 Introduction

Criminal activity is a negative externality causing large costs to the society (Buonnano, 2003). In a report about street violence in Sweden, Nilsson and Wadeskog (2012) estimate the social costs for one single robbery to be around 225 000 SEK, and one year of street violence in a larger Swedish municipality can have long-term social costs on over 200 million SEK. To design effective policies to prevent criminal activity, the determinants of crime must be investigated. According to the economic theory of crime, income inequality may be one determinant of criminal activity (Becker, 1968). The aim of this study is therefore to examine the impact of income inequality on crime rates in Sweden between 2004 and 2016.

Income inequality has been on the rise in Sweden and measured by the Gini coefficient, the degree of income inequality is currently at the highest level since the beginning of the 2000s, as shown in Figure 1. Additionally, people living at risk of poverty (earning less than 60 percent of the national median income) in Sweden have increased from a level around nine percent in the early 2000s up to a level around 14.5 percent in 2016 (Statistics Sweden, 2018). As shown in Figure 1, the income inequality in Sweden measured by the Gini coefficient has changed from one of the lowest to one of the highest in about 20 years, compared to the other Nordic countries Denmark, Finland, Norway and Iceland, which makes it an interesting case. Denmark has experienced a similar development in the income inequality as Sweden, whilst Finland has been relatively stable with a downward trend. The income inequality as measured by the Gini coefficient in Norway and Iceland has been volatile during the years. However, Norway experienced an overall decrease in the Gini coefficient and Iceland is back at the same level in year 2016 as in 2004.

Figure 1. Gini coefficients in the Nordic countries



Note: Gini coefficient of equivalised disposable income is measured in a scale from 0 to 100. Source: Eurostat (2019)

During the 2000s, reported crimes increased from around 1.2 million to around 1.5 million and the vulnerability and exposure to crime also increased according to the victimization survey SCS carried out by the National Council for Crime Prevention. A majority of Swedish inhabitants believe that crime rates have increased in Sweden, and if crime rates have increased or not is currently a widely discussed topic (National Council for Crime Prevention, 2017). According to the latest report from the

Swedish National Council for Crime Prevention (2018) regarding crime trends, where reported crimes are compared to the yearly victimization survey SCS, crimes like burglaries, frauds (mainly on the internet), threats, robberies, and deadly violence (mainly lethal gun violence) have increased, whilst auto thefts instead decreased. However, trends in the crime rates are not uniform across the country and there exist regional differences (National Council for Crime Prevention, 2017).

In 1968, Becker developed a model where he expresses criminal activity as a rational choice made by utility maximizing individuals. An individual will commit an offence if the expected return from it exceeds the expected return from legal activities. According to Becker, the supply of offences depends on the probability of conviction, punishment and other variables such as the income from legal or illegal activities, and some individuals simply become criminals because they have different benefits and costs. The mean income in the lower quartiles should affect the tendency to commit crime, and the mean income of the highest quartile could be seen as a measure of the payoff for crimes (Fleisher, 1966). In sociology, Merton (1938) argued in his strain theory, that when individuals are faced with others success but lack access to the means needed to achieve the same success, they may instead use illegal criminal ways to attain it. Hence, when inequalities increase, low-status individuals at the margin may get increased incentives to commit crimes.

The relationship between income inequality and crime has been thoroughly examined, mainly in the US. However, previous studies are showing ambiguous results. In an early study on the topic, Ehrlich (1973) examine variations in state-level crime rates in 1940, 1950 and 1960 in the US based on Becker's economic theory of crime with some own extensions. The author finds a strong positive relationship between people below one half of the median US family income and violent crimes such as murder and assaults, and property crimes such as burglary. Moreover, that an increased probability of arrest or imprisonment and increased average sentence lengths reduce criminal activity. All crime rates were also found to increase with the share of non-white people in the population. Further, Ehrlich argues that since crimes, property crimes in particular, are positively related to the income inequality of a community, there should be incentives to make education and income more equal.

Kelly (2000) also uses Becker's economic theory of crime to examine the relationship between inequality and crime in the US in 1991, using data for metropolitan counties. Inequality are measured both in terms of a ratio of the mean to the median household income and differences in human capital, with robust results for both specifications. Kelly find no significant effect of income inequality on property crimes, but a strong and robust impact of inequality on violent crimes. In 2008, Choe also presented a study investigating the relationship between income inequality and crime in the US using panel data between 1995 and 2004. Choe found a strong and robust positive impact on burglary and robbery, but no impact on other types of crime or on the overall rates of violent and property crimes.

Apart from studies in the US, Machin and Meghir (2004) uses data from the police force areas of England and Wales between 1975 and 1996. In a time with a rapid increase in crimes, mainly property crimes, and an increasing wage inequality in the United Kingdom, the authors examine the relationship between increasing crime rates and worse labour market opportunities of low skilled workers. Labour market opportunities are mainly measured by the 25th percentile of the wage distribution, and the crime variables included are property and vehicle crimes. According to their findings, lower wages in the bottom end of the wage distribution is associated with higher property crime rates. They also find a positive impact from lagged crime rates and a negative impact from the probability of being convicted.

In Sweden, there has not been much previous research on the topic. Some studies have examined the relationship between unemployment and crime and found significant positive impact of unemployment, mainly on property crime. Nilsson and Agell (2003) examine the relationship between municipality-level unemployment, unemployment programs, and crime between year 1996 and 2000 in Sweden. According to their results, the decline in unemployment during this time have a significant negative impact on burglaries and auto thefts, in other words, when unemployment decreases, criminal activity also decreases. They estimate the effect both using a fixed effects model and an instrumental variable approach where the results remain robust but the coefficients from the two-stage least squares estimation are larger than the ones from the fixed effects estimation. To instrument for the unemployment, they use a measure of the change in labour demand. Nilsson and Agell find no effect of unemployment on their main category of violent crime, assaults. Edmark (2005), examine the effects of county-level unemployment on property crimes, between year 1988 and 1999. The results are similar to the ones of Nilsson and Agell, a significant impact on burglary and auto theft and insignificant impact on violent crimes. Unemployment is also found to have a significant impact on aggregate property crimes, bike thefts and frauds, but these results are not robust to alternative specifications such as when including county-specific time trends.

For the relationship between income inequality and crime Nilsson (2004), examine the effect of income inequality on overall crime rates in 21 Swedish counties during the period 1973-2000, with a main focus on property crimes. Nilsson does not find a relationship between relative income inequality measures such as the Gini coefficient or the ratio between the 90th and the 10th percentile and crime rates, but, finds a strong positive effect of the proportion of relatively poor on the overall crime rate and on property crimes. Moreover, the amount of earnings in the high-income groups are found to be determinants of property crimes. Nilsson also tries to identify an effect of unemployment on overall crime, burglary and auto theft by including the proportion of unemployed as a control variable and finds that a decrease in unemployment reduces the overall crime rate. No significant relationship is found between income inequality or unemployment and the violent crime assault. Males aged 15-24 was the only variable with an impact on assaults.

To further extend the study by Nilsson (2004), I use municipality-level crime data for different categories of crimes in Sweden between 2004 and 2016. My main measures of crime are total crimes, violent crimes, property crimes and frauds, where I expect a positive relationship between income inequality and crime rates. Additionally, there is a possible reverse causality between income inequality and crime due to for example richer individuals moving out of areas with higher crime rates, which Nilsson does not take into account. To control for this, I use a predicted income inequality measure as an instrument for the actual measure. My main measure of income inequality is a measure of absolute income inequality in terms of two ratios between the share of people in different fixed income brackets, such as the ratio between the share of people with earnings above 799 000 SEK and the share of people with earnings below 39 000 SEK. The income bracket ratios will increase if the share of people in the top income brackets increase and decrease if the share of people in the bottom brackets increase. When the ratio is equal to one it is considered to be less income inequality than when the ratio is above or below one. This implies that both an increase and a decrease in the ratio is associated with an increase in income inequality, depending on the starting point. I deal with this issue by estimating a restricted sample only including ratios below one, where an increase in the income bracket ratio is interpreted as a decrease in income inequality. I also include a measure of relative income inequality, in terms of a ratio between the 90^{th} and the 10^{th} percentile. In several robustness checks I include different measures of education, lagged dependent variables and unemployment as additional regressors. Moreover, I estimate a population weighted specification and a specification with standard errors clustered at the municipality level. In addition to this, I include a district-level analysis where I examine the relationship between income inequality and different crime rates within Sweden's biggest city, Stockholm. In the Stockholm specification I measure income inequality by using a ratio between different income brackets, and also the ratio between the 90^{th} and the 10^{th} percentile, where the results, to some extent, go in the same direction.

My main findings indicate that there is a robust inverse correlation between my two income bracket ratios and violent crimes, where a one standard deviation increase in the income bracket ratios is associated with a 14.52 percent and 43.28 percent decrease in violent crimes, respectively. I also find significant positive relationships between the income bracket ratios and property crimes, where a one standard deviation increase in the income bracket ratios is associated with a 3.61 percent and 6.85 percent increase in property crimes, respectively. Additionally, for one of my income bracket ratios I find a significant inverse relationship with total crimes, where a one standard deviation increase in the income bracket ratio is associated with a 4.63 percent decrease in total crimes. However, the results for property crimes and total crimes are not robust to all alternative specifications. In order to interpret an increase in the income bracket ratios in terms of a change in income inequality I also estimate my baseline specification using a restricted sample. The results from this estimation further suggest that there is a positive relationship between an increase in income inequality and criminal activity.

The remainder of the paper proceeds as follows. The next section presents a simple theoretical model of the relationship between income inequality and crime rates. Section 3 describes the data, Section 4 presents the instrumental variable and the empirical specification is presented in Section 5. The first stage results, the reduced form results and the IV results are presented in section 6. The district-level analysis for Stockholm is included in Section 7, and section 8 concludes.

2 Theoretical Framework

In the economic theory of crime, individuals determine an optimal allocation of time in legal or illegal activities based on expected returns. In 1968, Becker developed a model where he expresses criminal activity as a rational choice made by utility maximizing individuals who seek financial reward from legitimate or illegitimate activities, considering the probability that they are arrested. The number of offences depends on the probability of conviction per offence, the punishment per offence and a combination of other variables such as shifts in incomes from legal or illegal activities, education, penalties and the willingness to commit crimes. The supply of offences can be represented as

$$O_j = O_j(p_j, f_j, u_j) \tag{1}$$

where O_j is number of offences, p_j is probability of conviction per offence, f_j is punishment per offence and u_j is the other variables which may affect the supply of offences.

Ehrlich (1973) developed the model by Becker and expresses the supply of offences as a utility maximizing choice between the expected return from legal work and the expected return from illegal work. The expected return from legal work, $E(W_l)$, is an increasing function of working time, t_l,

$$E(W_l) = W_l(t_l) \tag{2}$$

and the expected return from illegal work, $E(W_i)$, is a probability-weighted function of working time, t_i, the probability of getting arrested p_i, the probability of getting away with the crime, $(1 - p_i)$, and the value of the penalty if caught, $F_i(t_i)$, which can be expressed as

$$E(W_i) = (1 - p_i)W_i(t_i) + p_i\big(W_i(t_i) - F_i(t_i)\big) \tag{3}$$

With increased inequalities in the society, there will be individuals with low expected returns from legal work who instead could gain more from illegal work, and with high-income individuals present the expected returns from illegal work would further increase, which may lead to an increase in criminal activity (Kelly, 2000). By including measures of income inequality where the top shares of the income distribution and the bottom shares of the income distribution are included, both the demand side and the supply side are taken into consideration. A higher income level would reduce the supply

of offences since an individual could earn more from legal work, however it will also increase the demand for crime since there are more assets to take.

Based on these theoretical predictions, I expect a positive relationship between income inequality and property crimes. However, the effect of income inequality on criminal activity could go in two directions depending on if the supply or demand effect dominates. With an increase in income inequality due to a larger share of individuals with very low income compared to individuals with very high income, the supply effect would be dominant since potential criminals could gain more from criminal activities than from legal work. Moreover, with an increase in income inequality due to a larger share of high-income individuals compared to low-income individuals, the demand effect would be dominant since there would be more theft-worthy assets to take.

This theoretical model is mainly applicable to property crimes since they are associated with financial gains, and not directly applicable to violent crimes. Violent crimes may instead be better explained by theories from criminology, such as Merton's strain theory from 1938. Strain is usually defined as the difference between an individual's ideal goals and the expected level of goal achievement (Agnew, 1992). Merton argues that individuals may feel stress to reach socially desirable goals, mainly the goal of accumulating wealth. However, if individuals lack access to the legal means to achieve this goal, they will have incentives to use illegal means and may engage in criminal activities such as fraud or corruption.

Agnew (1992) extended the early strain theory by Merton in his general strain theory. In the general strain theory, Agnew emphasises the negative emotions from experiencing strain such as anger, rage, dissatisfaction and unhappiness. He also points out several new sources of strain, one of them is strain from unfair outcomes. He argues that individuals will feel strain from outcomes if they expect that resources should be allocated in a certain way and this does not occur. In this case, individuals will likely feel anger and frustration and may engage in different criminal activities to increase their outcome by theft or to lower the outcome of others for example by vandalism, theft and assault. Based on the theoretical predictions, I also expect a positive relationship between income inequality and violent crimes.

3 Data

This section presents the data for the dependent variable, the independent variable and the control variables. Section 3.1 reviews the data for the dependent variable (crime rates), Section 3.2 reviews the data for the independent variable (income inequality) and the control variables are presented and discussed in Section 3.3.

3.1 Crime Data

I use a panel data set of municipality-level crime data available at the National Council for Crime Prevention for total number of crimes reported to the police per 100 000 residents on a yearly basis,

from year 2004 to 2016[1] for 290 Swedish municipalities. The data do not reflect the crimes actually committed, only the crimes reported to the police, which is a common problem in the literature. However, a comparison of reported crimes and the victimisation survey SCS carried out by the National Council for Crime Prevention (2017) shows that the number of reported crimes is a relatively accurate reflection of the actual crime rates. Particularly for auto theft and burglary due to financial incentives such as collection of insurance benefits. Yet, some types of crime such as minor offences, crimes against persons such as rape or violence in close relationships or offences without a victim such as narcotics crimes, suffer from severe underreporting.

To account for trends in the propensity to report crimes, I include municipality fixed effects in the econometric specification to control for measurement error that differ across municipalities but are constant over time, and year fixed effects to control for measurement error that change over time in all municipalities. However, underreporting of crimes that varies systematically across municipalities and over time may still bias the results. Since different types of crimes likely are driven by different factors, I use several categories of crime as dependent variables. I include a measure of total crimes reported, overall property crimes, overall violent crimes and frauds. In my robustness checks I also estimate my baseline specification using robberies and assaults as dependent variables.

Table 1 shows descriptive statistics for the crime variables. Total crime includes all crimes reported each year per 100 000 inhabitants. Property crime includes the categories burglary, auto theft, theft, fraud and vandalism. Violent crime includes the categories assault and robbery, according to the definition by U.S. Department of Justice (2017)[2]. Assault includes all assaults and attempted murders but not assaults with fatal ending[3]. Robbery includes all robberies, with and without the use of firearms. All burglaries except from theft of firearms are included in the variable burglary. Auto theft is all auto thefts, both attempted and completed while theft includes all other thefts. Fraud include all different types of frauds and dishonesty, and vandalism includes all types of vandalism and destruction, such as vehicle fires. As shown in Table 1, the average number of total crimes is about 9920 per 100 000 inhabitants, the average number of property crimes is about 5092, the average number of violent crimes is about 741 and the average number of frauds is about 424. The average number of assaults is about 702 per 100 000 inhabitants, the average number of robberies is about 38, the average number of burglaries is about 959, the average number of auto thefts is about 327, the average number of thefts is about 2217 and the average number of vandalisms is about 1165. The descriptive statistics shows a large variation in total reported crimes between municipalities with a minimum amount of 2748 crimes per 100 000 residents and a maximum of 24 021 crimes per 100 000 residents.

[1] The time period is chosen due to a lack of income data before year 2004.
[2] In Edmark (2003), Nilsson (2004), and Nilsson and Agell (2003) robbery is included in the category property crimes. However, I follow the definition by FBI and include it in the category violent crimes.
[3] This data is only available at country level.

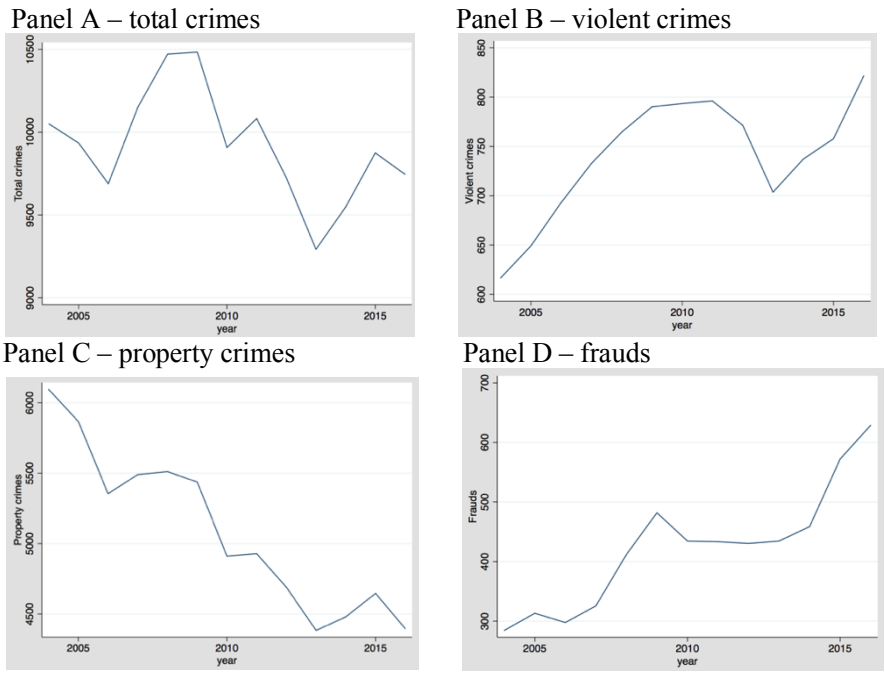
The national trends over time for the mean of total crimes, violent crimes, property crimes and frauds are shown in Figure 2. The national trends over time in a common scale are shown in Panel A-D in Figure A.1 in Appendix A. As shown in this figure, property crimes are more common than violent crimes. Yet, as shown in Figure 2, violent crimes and frauds have slightly increased whilst property crimes have decreased. The fact that frauds have increase whilst overall property crimes have decreased is an interesting finding, due to this I include frauds as a separate crime category in my analysis. National trends for assault, robbery, burglary, auto theft, theft and vandalism are included in Panel E-J in Figure A.1 in Appendix A.

Table 1. Descriptive statistics of crime variables in Sweden

Variable	Observations	Min	Max	Mean	Std. Dev.
Total crimes	3770	2748	24021	9919.781	3009.844
Property crimes	3770	1229	15376	5091.524	1837.544
Violent crimes	3770	105	2942	740.544	284.777
Assault	3770	81	2942	702.445	262.232
Robbery	3770	0	364	38.099	41.274
Burglary	3770	97	4075	959.133	404.799
Auto theft	3770	0	1540	326.904	194.68
Theft	3770	450	7705	2216.516	932.118
Fraud	3770	0	9639	423.682	354.344
Vandalism	3770	111	7392	1165.289	611.308

Note: The crime variables are the total number of crimes reported to the police per 100 000 residents each year in 290 municipalities during the period 2004-2016.

Figure 2. Average number of reported crimes in Sweden



Note: The figure shows the national average number of reported crimes to the police per 100 000 residents of the averages of 290 municipalities during the period 2004-2016.

3.2 Income Inequality Data

To measure income inequality, I use two different ratios of the share of people in top and bottom income brackets[4]. To calculate this, I use data on how many people in each municipality that have annual total earnings in a specific income bracket between 2004 and 2016. The data is available at Statistics Sweden. The annual total earnings in my dataset are ranging from 0 SEK to 1 000 000 SEK, and are divided into 26 different income brackets, all brackets are shown in Table 2.

To obtain measures of the share of people in each income bracket, I divide the number of people in each income bracket by the total number of people above 16 years in each municipality, the measures are shown in Table 2. My first measure is the ratio between the share of people in the top three and bottom three income brackets. It is calculated by dividing the share of people in each municipality who have annual total earnings above 799 000 SEK with the share of people who have annual total earnings below 39 000 SEK. The second measure is the ratio between the share of people in the top five and the bottom five income brackets where I divide the share of people with annual total earnings above 499 000 SEK with the share of people with annual total earnings below 79 000 SEK. The ratio between the share of people in the top five and the bottom five income bracket captures on average 14.2[5] percent of the population in the top brackets and 10.4 percent of the population in the bottom brackets. This measure is chosen since it captures approximately the top ten percent and the bottom ten percent, like the ratio between the 90th and the 10th percentile. The ratio between the share of people in the top three and bottom three income brackets is included since it as a more narrow measure and may be more precise. It captures on average around 2.3 percent of the population in the top brackets and 10.6 percent of the population in the bottom brackets.

I also use a percentile ratio between the 90th and the 10th percentile as an alternative measure of income inequality. I use data on annual total earnings and annual net income per individual on a municipality level, provided by Statistics Sweden[6]. Total earnings include earnings, retirement benefits, sickness benefits and other taxable benefits from the Swedish Social Insurance Agency. Net income is the sum of taxable and non-taxable earnings minus tax and other negative transfers. Individuals in families with zero disposable income are not included in the net income data.

The percentile ratio is a measure of relative income inequality and the income bracket ratio is a measure of absolute income inequality since it measures the share of people in fixed income brackets, instead of percentiles. The 90th percentile measures the income level which 10 percent of the population exceeds and the 10th percentile measures the income level which only 10 percent of the population is below. If the income level in the 90th percentile increases more than the income level for

[4] When there are less than four inhabitants in an income bracket, the number is coded as a missing value by Statistics Sweden. In my dataset, I have changed the missing values into zeros. In order to make sure that the results do not change if it is between one and three persons in each bracket, I include robustness checks where I change the zeros into one, two or three in Section 6.4.

[5] See Table 2 for details about the share of population in each income bracket.

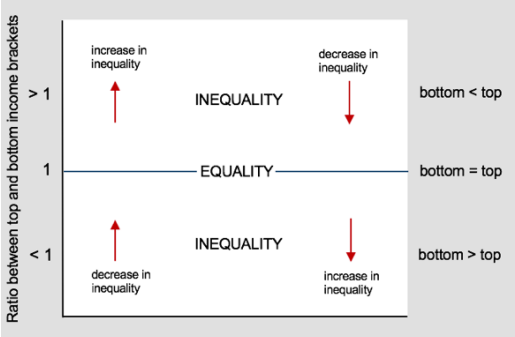
[6] Statistics Sweden provided me with the data after I contacted them.

the 10th percentile, the ratio between the 90th and the 10th percentile increases which implies that the income gap between the richest and the poorest increases.

The income bracket ratio measures the ratio between the share of people with very high earnings and the share of people with very low earnings. The income brackets are fixed and will only capture changes in the share of people in each bracket and not changes in earnings within a bracket. If some individuals in a municipality increase their earnings and move from a bracket in the middle into one of the top brackets, the ratio will increase and the other way around. Since these fixed income bracket ratios measure absolute income, the measure will also capture movements out of lower income brackets and into the higher income brackets as earnings simply increase over time. Additionally, if individuals in any of the top income brackets increase their earnings this will not have an effect on the measure, which is a weakness of this measure. Another weakness with this measure is the fact that it does not contain any information about the rest of the income distribution. It could be a large share of people both in the top and the bottom income brackets compared to the share of people in between and the ratio could still be close to one, this scenario would be considered more equal when interpreting the ratio. If the ratio between the top income brackets and the bottom income brackets is equal to one, it implies that the share of people with the lowest earnings in a municipality is as large as the share with the highest earnings. If the ratio is below one, the share of people with the lowest earnings is larger than the share of people with the highest earnings. Moreover, if the ratio is larger than one, the share of people with the lowest earnings is smaller than the share of people with the highest earnings. A scenario where the income bracket ratio is equal to one is considered to be more equal than if the income bracket ratio is above or below one.

An increase or decrease in the income bracket ratio will imply different things depending on the starting point. If the ratio increases from below one towards one the inequality is decreasing and if the ratio increases from one the inequality is increasing. This is illustrated in Figure 3 below. In order to deal with the opposite effects of an increase in the measure, I estimate my baseline specification both with the full sample and with a restricted sample only including observations with income bracket ratios below one, this is further discussed in the empirical specification.

Figure 3. The income bracket ratio



Note: Illustration of the income bracket ratio measure. Top is the share of people in the top two, three- or five-income brackets. Bottom is the share of people in the bottom two, three- or five-income brackets.

Table 2 shows descriptive statistics for national means of annual total earnings per individual between year 2004 and 2016 in 290 municipalities, and Table 3 shows national means of annual net income per individual between year 2005 and 2016 in 290 municipalities. As shown in Table 2, the mean earnings are about 244 133 SEK and the median is about 227 988 SEK. The average 10th percentile is about 84 958 SEK and the average 90th percentile is about 408 850 SEK. The average Gini coefficient is about 0.32 and the average 90th to 10th percentile ratio is 5.77. The average ratio between the share of people in the top three and the bottom three income brackets is 0.22 and the average ratio between the share of people in the top five and the bottom five income brackets is 0.76. As shown in Table 3, the mean net income is about 210 924 SEK and the median is about 187 864 SEK. The average 10th percentile is about 88 815 SEK and the average 90th percentile is about 330 157 SEK. The average Gini coefficient is about 0.31 and the average 90th to 10th percentile ratio is 3.799.

Table 2. Descriptive statistics of income variables in Sweden (total earnings)

Variable	Observations	Min	Max	Mean	Std. Dev.
Mean earnings	3770	176902.3	544642.1	244133.3	38870.4
Median earnings	3770	166936	370762	227988.5	29974.79
10th percentile	3762	999	125492	84957.96	15864.88
90th percentile	3770	281076	1042987	408849.5	78932.78
Gini coefficient	3770	0.244	0.523	0.317	0.033
90th percentile/10th percentile	3762	3.138	472.327	5.77	12.183
Share of people with earnings 0 tkr	3770	0.008	0.125	0.046	0.014
Share of people with earnings 1-19 tkr	3770	0.017	0.075	0 .04	0.007
Share of people with earnings 20-39 tkr	3770	0.009	0 .056	0.02	0.004
Share of people with earnings 40-59 tkr	3770	0.008	0.039	0.017	0.003
Share of people with earnings 60-79 tkr	3770	0.008	0.05	0.019	0.006
Share of people with earnings 80-99 tkr	3770	0.016	0.108	0.046	0.017
Share of people with earnings 100-119 tkr	3770	0.022	0.089	0.05	0.01
Share of people with earnings 129-139 tkr	3770	0.021	0.089	0.05	0.01
Share of people with earnings 140-159 tkr	3770	0.024	0.1	0.056	0.012
Share of people with earnings 160-179 tkr	3770	0.026	0.103	0.06	0.012
Share of people with earnings 180-199 tkr	3770	0.028	0.099	0.06	0.011
Share of people with earnings 200-219 tkr	3770	0.028	0.096	0.058	0.011
Share of people with earnings 220-239 tkr	3770	0.026	0.097	0.057	0 .01
Share of people with earnings 240-259 tkr	3770	0.027	0.083	0.054	0.009
Share of people with earnings 260-279 tkr	3770	0.022	0 .08	0.051	0.007
Share of people with earnings 280-299 tkr	3770	0.024	0 .075	0.048	0.007
Share of people with earnings 300-319 tkr	3770	0.019	0 .069	0.044	0.007
Share of people with earnings 320-339 tkr	3770	0.011	0.063	0.038	0.009
Share of people with earnings 340-359 tkr	3770	0.007	0.06	0.031	0.009
Share of people with earnings 360-379 tkr	3770	0.004	0.054	0.026	0.009
Share of people with earnings 380-399 tkr	3770	0	0.051	0 .021	0.009
Share of people with earnings 400-499 tkr	3770	0.005	0 .171	0.059	0.03
Share of people with earnings 500-599 tkr	3770	0.002	0.088	0.022	0.015
Share of people with earnings 600-799 tkr	3770	0	0.097	0.015	0.014
Share of people with earnings 800-999 tkr	3770	0	0 .054	0.004	0.005
Share of people with earnings above 1000 tkr	3770	0	0.102	0.004	0.007
Top three/bottom three income brackets	3770	0	1.802	0.22	0.223
Top five/bottom five income brackets	3770	0.061	4.061	0.76	0.519

Note: The income variables are national means of annual total earnings in 290 municipalities during the period 2004-2016. The missing values for the 10th percentile and the 90th percentile to 10th percentile ratio are due to a shortfall in the income data since some inhabitants in municipalities close to Norway are working and paying taxes in Norway.

Table 3. Descriptive statistics of income variables in Sweden (net income)

Variable	Observations	Min	Max	Mean	Std. Dev.
Mean income	3480	141792.9	700850.6	210924.7	41324.9
Median income	3480	130080	333556	187864.3	27515.7
10th percentile	3480	7779	124444	88815.71	11371.97
90th percentile	3480	211450	984427	330157.2	67832.01
Gini coefficient	3480	0.229	0.659	0.312	0.04
90th percentile/10th percentile	3480	2.625	42.604	3.799	1.568

Note: The income variables are national means of annual net income in 290 municipalities during the period 2005-2016.

Figure 4 shows national means of the ratios between the share of people with annual total earnings in the top three and bottom three, and the top five and bottom five, income brackets in all 290 municipalities between 2004 and 2016. Both ratios have increased over time, but the increase in the ratio between the top five and the bottom five income brackets is greater, as shown in Panel C. As shown in Panel A, the ratio between the share of people in the top three and the bottom three income brackets has increased from around 0.1 up to around 0.4 in 12 years. This implies that, on average, the share of people with the lowest earnings is larger than the share of people with the highest earnings, but at a decreasing rate. The ratio between the share of people in the top five and bottom five income brackets, as shown in Panel C, has instead increased from around 0.3 to 1.5 between year 2004 and 2016. The share of people with the lowest earnings is, on average, larger than the share of people with the highest earnings until around year 2013. After 2013, the share of people with the highest earnings is, on average, larger than the share of people with the lowest earnings.

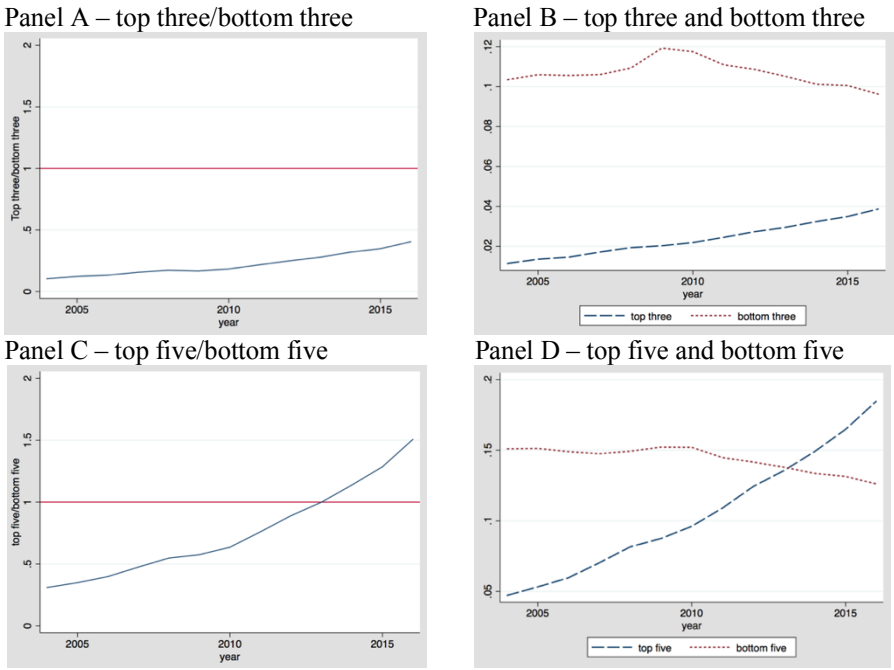
According to Panel A the inequality measured by the income bracket ratio decreased and according to Panel C the inequality decreased and then increased again after 2013. However, as previously discussed, the income bracket ratios will also capture movements due to natural increases in earnings over time. If looking at the growth rates of the share of people in the different income brackets, as shown in Panel B and D, the top income brackets increase at a faster rate compared to the decrease of the bottom income brackets. This implies that more people get richer, but a lot of people also stay in the bottom income brackets. The relative income inequality measured by the Gini coefficient and ratios between the 90^{th} percentile and the 10^{th} percentile have also increased, both using total earnings and net income, this is shown in Figure A.2 in Appendix A.

3.3 Control Variables

As control variables I include time-varying socioeconomic factors such as the proportion of males aged 15-24 since they tend to be overrepresented in crime statistics and have lower income (Machin & Meghir, 2004), and the proportion of residents not born in Sweden since they also tend to be overrepresented in crime statistics (National Council for Crime Prevention, 2005). Moreover, single parent households have been shown to have a significant impact since it works as a measure for an

unstable family situation for young people. Single parent households are also likely to have lower incomes so if not controlled for the results may be biased (Nilsson, 2004). However, data on single parent households is not available for the time period of the study, instead I include the share of divorced individuals to control for this.

Figure 4. Ratios between the share of people in top and bottom income brackets in Sweden



Note: The figure shows the national mean of the measures in 290 municipalities each year during the period 2004-2016. Panel A shows the ratio between the share of people with annual total earnings in the top three and the bottom three income brackets, and Panel B shows the share of people in the top three income brackets and the share of people in the bottom three income brackets. Panel C shows the ratio between the share of people with annual total earnings in the top five and bottom five income brackets and panel D shows the share of people in the top five income brackets and the share of people in the bottom five income brackets.

As discussed in Section 3.1, I include municipality fixed effects to control for unobserved factors varying across municipalities but are constant over time, and year fixed effects to control for unobserved factors varying over time in all municipalities. The year fixed effects remove national trends and captures for example differences in income inequality and unemployment due to the financial crisis in 2008. However, the fixed effects do not control for unobserved factors varying both across municipalities and over time, to reduce the omitted variable bias from this I include the time-varying control variables discussed above. Apart from the control variables included in my baseline specification, I also include robustness checks where I control for variation in local education levels, unemployment and lagged crime rates, among other things.

Table 4 shows descriptive statistics for the control variables. The average share of foreign-born individuals is about 11 percent, the average share of males aged 15-24 is about 6 percent and the average share of divorced individuals is about 9 percent.

Table 4. Descriptive statistics of control variables in Sweden

Variable	Observations	Min	Max	Mean	Std. Dev.
Share of foreign born individuals	3770	0.025	0.410	0.111	0.057
Share of males aged 15-24	3770	0.045	0.094	0.064	0.006
Share of divorced individuals	3770	0.053	0.396	0.092	0.02

Note: The control variables are national means of the control variables in 290 municipalities during the period 2004-2016.

A measure of the probability of conviction, such as number of police officers which has been used in previous studies, will not be included since there is a possible reverse causality between measures of the probability of conviction and crime rates. Hence, the quality of the police likely varies between municipalities but not across municipalities and over the time period studied and could to some extent be controlled for by using fixed effects.

4 Instrumental Variable

To test the hypothesis outlined in section 2, the OLS approach would be to estimate the following equation:

$$Crime_{it} = \alpha + \beta_1 I_{it} + \beta_2 X_{it} + \lambda_t + \gamma_i + \varepsilon_{it} \quad (4)$$

where i indicates municipality and t year, with the specific crime rate per 100 000 residents, $Crime_{it}$, as dependent variable. The independent variable, I_{it}, is the different measures of income inequality. X_{it} is a vector of control variables including the proportion of males 15-24 years old, the proportion of foreign-born individuals and the share of divorced individuals. λ_t and γ_i are year and municipality fixed effects, respectively. All standard errors are robust to heteroskedasticity.

There is likely a problem of reverse causality between income inequality and crime rates due to for example richer individuals moving out of areas with high rates of crime, causing bias in the OLS estimates. To control for this, I use predicted ratios between the share of people in the top and the bottom income brackets in each municipality as an instrument for the actual ratios, following Boustan, Ferreira, Winkler and Zolt (2013). The instrument has also been used in previous studies by for example Enamorado, López-Calva, Rodríguez-Castelán and Winkler (2016), and Hearey (2016). I start with the initial share of people in the top and the bottom income brackets in each municipality in year 2004 and then predict the share in each bracket based on the national growth rate of the share of people in the corresponding income bracket. Additionally, I calculate predicted percentile ratios between the 90th percentile and the 10th percentile, using both total earnings and net income. It is calculated in the same way as the predicted income bracket ratios.

To calculate a national growth rate for each municipality where the growth in the municipality itself is excluded, I start by taking the sum of the shares of people in the bottom income bracket in all m municipalities, $S_{b,t}$.

$$S_{b,t} = \sum_{i=1}^{m} W_{bi,t} \quad (5)$$

Then, I calculate the average share of people in the bottom income bracket for each municipality. I take $S_{b,t}$, minus the share of people in the bottom income bracket in municipality *i* and year *t,* $W_{bi,t}$, divided by *m-1* municipalities

$$\bar{W}_{bi,t} = \frac{S_{b,t} - W_{bi,t}}{m-1} \tag{6}$$

The growth rate in municipality *i* and year *t*, $g_{bi,t}$, is calculated by dividing the average share of people in the bottom income bracket in municipality *i* and year *t,* $\bar{W}_{bi,t}$, with the average share of people in the bottom income bracket in municipality *i* and year *t-1*, $\bar{W}_{bi,t-1}$.

$$g_{bi,t} = \frac{\bar{W}_{bi,t}}{\bar{W}_{bi,t-1}} \tag{7}$$

For *t=1,* the predicted share of people in the bottom income bracket in municipality *i* and year *t=1,* $\widehat{W}_{bi,t=1}$, is the share of people in the bottom income bracket, municipality *i* and year *t=0*, $W_{bi,t=0}$ times the national growth rate in the bottom income bracket year *t=1*, $g_{b,t=1}$.

$$\widehat{W}_{bi,t=1} = W_{bi,t=0} * g_{bi,t=1} \tag{8}$$

For *t=2,…,10,* the predicted share of people in the bottom income bracket in municipality *i* and year *t*, $\widehat{W}_{bit}$, is calculated by taking the predicted share of people in the bottom income bracket, municipality *i* and year *t-1*, $\widehat{W}_{bi,t-1}$, times the national growth rate in the bottom income bracket municipality *i* and year *t*, $g_{bi,t}$.

$$\widehat{W}_{bit} = \widehat{W}_{bi,t-1} * g_{bi,t} \tag{9}$$

The predicted ratio between the share of people in the top income bracket and the bottom income bracket in municipality *i* and year *t* is the predicted W_t in municipality *i* and year *t* divided by the predicted W_b in municipality *i* and year *t*.

$$Predicted\ ratio_{i,t} = \frac{\widehat{W}_{ti,t}}{\widehat{W}_{bi,t}} \tag{10}$$

Table 5 shows descriptive statistics for the different predicted measures calculated using total earnings and Table 6 shows descriptive statistics for the measures calculated using net income. As shown in Table 5, the average predicted 10th percentile is about 85 939 SEK and the average predicted 90th percentile is about 413 163 SEK. The average predicted ratio between the 90th and the 10th percentile is 4.923. The average predicted share of people in the bottom three income brackets is 0.107, and in the top three it is 0.022. The average ratio between the share of people in the top three and bottom three income brackets is 0.202. The average predicted share of people in the bottom five income brackets is 0.143 and in the top five it is 0.104. The average predicted ratio between the share of people in the top five and bottom five income brackets is 0.733. For net income, as shown in Table 6,

the average predicted 10th percentile is about 89 864 SEK. The average predicted 90th percentile is about 332 601 SEK and the average predicted ratio between the 90th and the 10th percentile is 3.702.

Table 5. Descriptive statistics of instrument in Sweden (total earnings)

Variable	Observations	Min	Max	Mean	Std. Dev.
Predicted 10th percentile	3416	35047.73	108045.3	85939.42	10277.81
Predicted 90th percentile	3416	289766.8	863119	413163	72124.87
Predicted 90th percentile/10th percentile	3416	3.19	13.819	4.923	1.369
Predicted bottom three	3442	0.07	0.234	0.107	0.017
Predicted top three	3442	0	0.187	0.022	0.023
Predicted top three/bottom three	3442	0	1.391	0.202	0.199
Predicted bottom five	3426	0.093	0.271	0.143	0.02
Predicted top five	3426	0.009	0.637	0.104	0.081
Predicted top five/bottom five	3426	0.069	3.71	0.733	0.574

Note: The income variables are national means of annual total earnings in 290 municipalities during the period 2005-2016. Year 2004 is dropped when the instrument is calculated. There are missing values for the 10th percentile and the 90th percentile to 10th percentile ratio due to a shortfall in the income data since some inhabitants in municipalities close to Norway are working and paying taxes in Norway. Top one percent outliers removed.

Table 6. Descriptive statistics of instrument in Sweden (net income)

Variable	Observations	Min	Max	Mean	Std. Dev.
Predicted 10th percentile	3083	59535.4	118497.6	89864.22	8393.938
Predicted 90th percentile	3083	224932.1	532244.8	332601.3	48144.65
Predicted 90th percentile/10th percentile	3083	2.67	5.257	3.702	0.421

Note: The income variables are national means of annual net income in 290 municipalities during the period 2006-2016. Year 2005 is dropped when the instrument is calculated. Top one percent outliers removed.

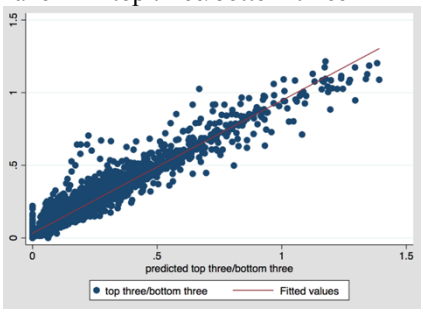
For the instrument to be valid it must be relevant and exogenous (in other words, correlated with the endogenous variable but uncorrelated with the error term). Since the predicted ratios in each municipality are calculated by excluding the municipality itself from the growth rate, the instrument should not be influenced by local factors such as crime rates or migration from municipalities with more crime. Therefore, the instrument should only capture the changes driven by national trends and is likely exogenous (Enamorado et al., 2016). However, one possible violation is that the initial income distribution may not be exogenous to local factors since some municipalities may have initially lower or higher income bracket ratios due to differences in crime rates. To reduce the risk of this, I drop the start year for each predicted income inequality measure. The predicted measure should also be correlated with the actual measure in the way it is constructed and therefore, be relevant.

The relationships between the actual and predicted income bracket ratios are shown in Figure 5, Panel A shows the ratio between the share of people in the top three and the bottom three income brackets and Panel B shows the ratio between the share of people in the top five and bottom five income brackets. The relationships between the actual and predicted top, and bottom income brackets and the relationship between the actual and predicted income bracket ratios with outliers included are shown in Figure A.3 in Appendix A. The relationships between the actual and the predicted 90th and

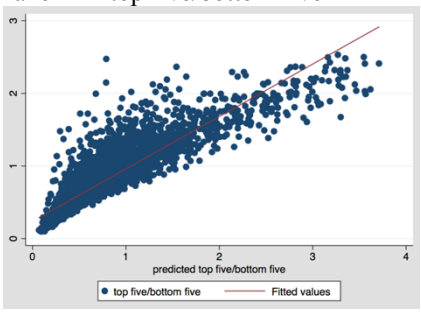
10th percentiles and the actual and the predicted ratio between the 90th and the 10th percentile are shown in Figure A.4 in Appendix A. As shown in the figures, there is both a strong correlation between the actual and the predicted ratios, and variation in the measures, which is necessary for a suitable instrument.

Figure 5. Relationship between actual and predicted income bracket ratios in Sweden

Panel A – top three/bottom three



Panel B – top five/bottom five



Note: The figure shows the relationships between the actual and the predicted income bracket ratios. Calculations are based on annual total earnings in 290 municipalities during the period 2005-2016. The top one percent outliers are removed.

5 Empirical Specification

To test my hypothesis using a two-stage least squares model with the predicted income inequality ratios as instruments for the actual ratios, I start by estimating the first stage using the following equation

$$I_{it} = \pi_0 + \pi_1 Predicted\, ratio_{it} + \pi_2 X_{it} + \lambda_t + \gamma_i + u_{it} \quad (11)$$

where I_{it} is the actual income inequality measures, $Predicted\, ratio_{it}$ is the predicted income inequality measures and X_{it} is a vector of control variables including the share of males 15-24 years old, the share of foreign-born individuals and the share of divorced individuals, and u_{it} is the error term. λ_t and γ_i are year and municipality fixed effects, respectively. The reduced form estimates the relationship between the predicted income inequality measure and different crime rates. It is estimated by the following equation

$$Crime_{it} = \gamma_0 + \gamma_1 Predicted\, ratio_{it} + \gamma_2 X_{it} + \lambda_t + \gamma_i + u_{it} \quad (12)$$

where $Crime_{it}$ is different crime rates per 100 000 residents or the logarithm of different crime rates, $Predicted\, ratio_{it}$ is the predicted ratios using different measures of income inequality, X_{it} is a vector of control variables including the proportion of males 15-24 years old, the share of foreign-born individuals and the share of divorced individuals, and u_{it} is the error term. λ_t and γ_i are year and municipality fixed effects. The second stage of the two-stage least squares model is estimated by the following equation

$$Crime_{it} = \beta_0 + \beta_1 \hat{I}_{it} + \beta_2 X_{it} + \lambda_t + \gamma_i + u_{it} \quad (13)$$

this specification is similar to equation 12, but the independent variable is the predicted measures of income inequality, $\hat{I}_{it}$.

How do we interpret β_1? I estimate the second stage of the two-stage least squares model with the full sample, and also with a restricted sample where all observations with predicted income bracket ratios above one are removed. I split the sample due to the fact that an increase in the income bracket ratios has different interpretations if it increases towards one or from one, which is discussed in section 3.3 and illustrated in Figure 3. I do not estimate the model with a restricted sample including observations where the predicted ratio is above one since there are very few observations in this group[7]. When the sample is restricted to predicted income bracket ratios below one, an increase in the income bracket ratio implies a decrease in inequality since the ratio increases towards one. As mentioned previously, when the income bracket ratio is equal to one, the share of people in the top of the income distribution is as large as the share in the bottom of the income distribution and it is considered as more equal than if the ratio was above or below one. When the income bracket ratio is above one an increase in the measure would imply an increase in inequality. Since this reverse effect from the income bracket ratios above one is removed from this estimation, if indeed inequality increases crime, I expect stronger effects of my income bracket ratios on criminal activity when estimating the second stage with a restricted sample.

6 Results

6.1 First Stage Results

In this section, I present the results from the first stage of the two-stage least squares model. As shown in Table 7, there are significant positive relationships between the actual and the predicted ratios, which supports the relevance assumption. Moreover, the F-statistics on the relationship between the actual and the predicted ratios are all above 10 which indicates a sufficiently strong instrument. As shown in Panel A, the coefficient on the predicted ratio between the share of people in the top three and bottom three income brackets in the equation with municipality and year fixed effects is 0.678. This implies that a one unit increase in the predicted ratio is associated with a 0.678 unit increase in the actual ratio. When using the ratio between the share of people in the top five and the bottom five income brackets in Panel B, with year and municipality fixed effects, the coefficient is 0.227. This implies that a one unit increase in the predicted ratio is associated with a 0.227 unit increase in the actual ratio.

[7] For the top three/bottom three ratio, there are 43 observations with a predicted ratio above one and 3399 observations with a predicted value below one. For the top five/bottom five ratio, there are 730 observations with a predicted ratio above one and 2696 observations with a predicted ratio below one.

Table 7. First stage results for income bracket ratios in Sweden

	(1)	(2)	(3)	(4)
Y =	Top three/ bottom three	Top three/ bottom three	Top five/ bottom five	Top five/ bottom five
	Panel A: Predicted ratio between the top three and bottom three income brackets			
Predicted Top three/bottom three	0.914*** (0.008)	0.678*** (0.017)		
	Panel B: Predicted ratio between the top five and bottom five income brackets			
Predicted Top five/bottom five			0.313*** (0.004)	0.227** (0.011)
Year fixed effects	no	yes	no	yes
District fixed effects	no	yes	no	yes
Control variables	no	yes	no	yes
Sample size	3442	3442	3426	3426
F-statistic	13519.29	1580.92	5713.21	396.95

Note: Calculations are based on total earnings during the period 2005-2016. Control variables included are the share of foreign-born individuals, the share of males aged 15-24 years and the share of divorced individuals. Top one percent outliers removed. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

The output from the first stage when using the ratio between the 90th and the 10th percentile for total earnings and net income is included in Table A.1, in Appendix A. As shown in Panel A, the relationship between the predicted and the actual 90th to 10th percentile ratio (total earnings) is positive and significant, but when fixed effects are included in Column 2, the relationship is negative and insignificant. When using the 90th to 10th percentile ratio for net income, shown in Panel B, the relationship is only significant when no fixed effects are included. Moreover, the F-statistics for both specifications are all below 10 when fixed effects are included, which indicates a weak instrument. The measures are highly correlated so the weak relationship between the actual and predicted percentile ratios is likely due to little variation in the measures. As previously discussed, the percentile ratios are measures of relative income inequality whilst the income bracket ratios are measures of absolute income levels, since they measure different things there are different amounts of variation in the measures. As shown in the first stage output, there is more variation in the absolute income measures. Due to this, my main measure of income inequality will be the two income bracket ratios.

6.2 Reduced Form Results

The results from the reduced form are shown in Table 8. As shown in Panel C and D, the reduced form estimation yields positive and significant coefficients on both predicted income bracket ratios for property crimes when using the logarithm of crime rates as dependent variable. Additionally, it yields negative and significant coefficients on both predicted income bracket ratios for violent crimes, when using the crime rate per 100 000 residents and when using the logarithm of crime rates as dependent

variable. When using the logarithm of crime rates as dependent variable, as shown in Panel C, a one unit increase in the predicted ratio between the share of people in the top three and the bottom three income brackets is associated with a 12.3 percent increase in property crimes and a 49.4 percent decrease in violent crimes. As shown in Panel D, a one unit increase in the predicted ratio between the share of people in the top five and the bottom five income brackets is associated with a 2.7 percent increase in property crimes, and a 17.1 percent decrease in violent crimes.

Table 8. Reduced form results for income bracket ratios in Sweden

		(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) OLS	(6) OLS	(7) OLS	(8) OLS
Panel A: Top three/Bottom three	Y =	Total crimes	Total crimes	Property crimes	Property crimes	Violent crimes	Violent crimes	Frauds	Frauds
Predicted		1,779.034***	-376.916	1,320.710***	41.279	0.014	-326.027***	302.192***	108.745
Top three/Bottom three		(312.585)	(334.708)	(190.148)	(256.925)	(25.653)	(43.311)	(32.969)	(86.251)
Panel B: Top five/Bottom five	Y =	Total crimes	Total crimes	Property crimes	Property crimes	Violent crimes	Violent crimes	Frauds	Frauds
Predited		525.402***	-171.874	253.287***	-36.458	14.404	-114.607***	124.502***	32.168
Top five/Bottom five		(102.804)	(109.907)	(63.576)	(84.060)	(8.879)	(13.559)	(10.337)	(27.476)
Panel C: Top three/Bottom three	Y =	ln(Total crimes)	ln(Total crimes)	ln(Property crimes)	ln(Property crimes)	ln(Violent crimes)	ln(Violent crimes)	ln(Frauds)	ln(Frauds)
Predicted		0.165***	-0.041	0.236***	0.123***	-0.009	-0.494***	0.741***	-0.022
Top three/Bottom three		(0.029)	(0.036)	(0.032)	(0.047)	(0.038)	(0.067)	(0.049)	(0.112)
Panel D: Top five/Bottom five	Y =	ln(Total crimes)	ln(Total crimes)	ln(Property crimes)	ln(Property crimes)	ln(Violent crimes)	ln(Violent crimes)	ln(Frauds)	ln(Frauds)
Predicted		0.049***	-0.018	0.041***	0.027*	0.018	-0.171***	0.308***	0.009
Top five/Bottom five		(0.010)	(0.011)	(0.011)	(0.015)	(0.013)	(0.021)	(0.016)	(0.036)
Year fixed effects		no	yes	no	yes	no	yes	no	yes
Municipality fixed effects		no	yes	no	yes	no	yes	no	yes
Control variables		no	yes	no	yes	no	yes	no	yes
Sample size A		3442	3442	3442	3442	3442	3442	3442	3442
Sample size B		3442	3442	3442	3442	3442	3442	3441	3441
Sample size C		3426	3426	3426	3426	3426	3426	3426	3426
Sample size D		3426	3426	3426	3426	3426	3426	3425	3425

Note: Calculations are based on total earnings during the period 2005-2016. Control variables included are the share of foreign-born individuals, the share of males aged 15-24 years and the share of divorced individuals. Top one percent outliers removed. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

6.3 IV Results

In this section I present the results from the second stage of the two-stage least squares model. The results from the reduced form shown in the previous section are not rescaled by the first stage, the main results from the IV estimation are presented in this section and shown in Table 9. As shown in Panel A and Panel C, the 2SLS estimation with the ratio between the share of people in the top three and the bottom three income brackets yields negative significant coefficients for violent crimes. Both when using the crime rate per 100 000 residents and the logarithm of crime rates as dependent variable. In Panel C, when using the logarithm as dependent variable, the 2SLS estimation also yields a positive significant coefficient on property crimes. As shown in Panel B, when using the ratio

between the share of people in the top five and the bottom five income brackets as independent variable and the crime rate per 100 000 residents as dependent variable, the 2SLS estimation yields a negative significant coefficient on violent crimes. Additionally, as shown in Panel D, when using the logarithm of crime rates as dependent variable, it yields a positive significant coefficient on property crimes and negative significant coefficients on total crimes and violent crimes.

A one unit increase in the ratio between the share of people in the top three and the bottom three income brackets is associated with a decrease of 481 violent crimes per 100 000 residents. When using the logarithm of the crimes rates as dependent variable a one unit increase in the ratio is associated with an 18.1 percent increase in property crimes and a 72.9 percent decrease in violent crimes. For the ratio between the share of people in the top five and the bottom five income brackets, a one unit increase is associated with a decrease of 504 violent crimes per 100 000 residents. When using the logarithm as dependent variable, a one unit increase is associated with a 11.9 percent increase in property crimes, a 8.1 percent decrease in total crimes and a 75.4 percent decrease in violent crimes.

However, a one unit increase in the ratios between the share of people in the top and bottom income brackets may not be reasonable. If instead interpreting the change in the coefficients as standard deviations the magnitudes decrease. A one standard deviation increase in the ratio between the share of people in the top three and the bottom three income brackets is associated with a 3.61 percent increase in property crimes and a 14.52 percent decrease in violent crimes. For the ratio between the share of people in the top five and the bottom five income brackets, a one standard deviation increase is associated with a 6.85 percent increase in property crimes, a 4.63 percent decrease in total crimes and a 43.28 percent decrease in violent crimes.

The different results from the two income bracket ratios may be due to the fact that the measures capture different shares of the population. As previously mentioned, the ratio between the share of people in the top three and bottom three income brackets is a very narrow measure and captures a small share of the population, whilst the ratio between the share of people in the top five and bottom five income brackets captures a larger share which could be more reasonable.

I also estimate the relationship between the actual income bracket ratios and crime rates using OLS[8]. As previously discussed, there is a possible reverse causality between income inequality and crime rates. In this case, the OLS estimates should be larger than the IV estimates. According to the OLS estimation, this assumption seems to hold. To mention one finding from the OLS estimation, when using the ratio between the share of people in the top three and the bottom three income brackets as independent variable the OLS estimation yields a coefficient of 138.87 for total crimes and of 579.81 for property crimes. These coefficients are larger compared to the IV estimation which yields a coefficient of -555.86 for total crimes and 60.88 for property crimes as shown in Table 9, Panel A.

[8] The results are available but not included.

Table 9. Second stage results for income bracket ratios in Sweden

	(1) 2SLS	(2) 2SLS	(3) 2SLS	(4) 2SLS	(5) 2SLS	(6) 2SLS	(7) 2SLS	(8) 2SLS
Panel A: Top three/Bottom three Y =	Total crimes	Total crimes	Property crimes	Property crimes	Violent crimes	Violent crimes	Frauds	Frauds
Top three/Bottom three	1,946.582***	-555.857	1,445.093***	60.877	0.015	-480.809***	330.652***	160.372
	(342.225)	(471.331)	(208.635)	(361.780)	(28.061)	(62.735)	(35.901)	(121.352)
Share of foreign born individuals		380.151		-4,681.306**		1,542.404***		1,166.085
		(3,076.761)		(2,120.324)		(387.283)		(730.437)
Share of males aged 15-24		16,866.904*		11,960.543**		3,082.935**		4,152.903*
		(9,909.624)		(5,965.145)		(1,291.744)		(2,460.192)
Share of divorced individuals		39,888.526***		23,708.793***		1,658.274		1,888.257
		(9,755.103)		(6,191.487)		(1,260.487)		(1,794.197)
Panel B: Top five/Bottom five Y =	Total crimes	Total crimes	Property crimes	Property crimes	Violent crimes	Violent crimes	Frauds	Frauds
Top five/Bottom five	728.142***	-756.181	351.024***	-160.401	19.962	-504.230***	172.544***	141.529
	(143.766)	(460.194)	(89.360)	(351.994)	(12.297)	(63.150)	(14.185)	(115.413)
Share of foreign born individuals		-2,931.885		-5,574.445*		-539.599		1,660.993
		(4,371.315)		(3,159.554)		(571.897)		(1,079.452)
Share of males aged 15-24		13,690.000		10,992.398*		1,511.219		4,581.951*
		(9,904.564)		(6,004.011)		(1,368.205)		(2,536.857)
Share of divorced individuals		37,731.026***		22,560.397***		1,041.267		1,824.406
		(9,916.786)		(6,267.280)		(1,328.088)		(1,838.955)
Panel C: Top three/Bottom three Y =	ln(Total crimes)	ln(Total crimes)	ln(Property crimes)	ln(Property crimes)	ln(Violent crimes)	ln(Violent crimes)	ln(Frauds)	ln(Frauds)
Top three/Bottom three	0.181***	-0.060	0.258***	0.181***	-0.010	-0.729***	0.811***	-0.033
	(0.032)	(0.050)	(0.036)	(0.066)	(0.041)	(0.096)	(0.053)	(0.158)
Share of foreign born individuals		0.272		0.519		1.432***		-0.498
		(0.316)		(0.400)		(0.533)		(0.885)
Share of males aged 15-24		1.318		2.341*		1.879		8.582***
		(1.135)		(1.344)		(2.063)		(3.128)
Share of divorced individuals		4.429***		5.083***		1.959		6.015**
		(1.088)		(1.360)		(1.850)		(2.894)
Panel D: Top five/Bottom five Y =	ln(Total crimes)	ln(Total crimes)	ln(Property crimes)	ln(Property crimes)	ln(Violent crimes)	ln(Violent crimes)	ln(Frauds)	ln(Frauds)
Top five/Bottom five	0.068***	-0.081*	0.057***	0.119*	0.025	-0.754***	0.426***	0.041
	(0.013)	(0.048)	(0.015)	(0.064)	(0.018)	(0.096)	(0.021)	(0.151)
Share of foreign born individuals		-0.088		0.888		-1.693**		-0.105
		(0.448)		(0.585)		(0.816)		(1.328)
Share of males aged 15-24		0.998		2.628*		-0.450		8.658***
		(1.141)		(1.362)		(2.176)		(3.193)
Share of divorced individuals		4.188***		4.767***		1.118		6.306**
		(1.107)		(1.400)		(1.967)		(2.973)
Year fixed effects	no	yes	no	yes	no	yes	no	yes
Municipality fixed effects	no	yes	no	yes	no	yes	no	yes
Control variables	no	yes	no	yes	no	yes	no	yes
Sample size A	3442	3442	3442	3442	3442	3442	3442	3442
Sample size B	3442	3442	3442	3442	3442	3442	3441	3441
Sample size C	3426	3426	3426	3426	3426	3426	3426	3426
Sample size D	3426	3426	3426	3426	3426	3426	3425	3425

Note: Calculations are based on total earnings during the period 2005-2016. Control variables included are the share of foreign-born individuals, the share of males aged 15-24 years and the share of divorced individuals. Top one percent outliers removed. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

According to the findings from the second stage, there is a positive relationship between an increase in the income bracket ratios and property crimes, and a negative relationship between an increase in the income bracket ratios and violent crimes. How does a change in the income bracket ratios translate into a change in income inequality? To be able to say more about this, I estimate a restricted sample

only including observations where the predicted ratios are below one[9]. The results from the second stage with the restricted sample are shown in Table 10.

As shown in Panel A, the restricted sample estimation yields negative significant coefficients on total crimes and violent crimes when using the ratio between the share of people in the top three and bottom three income brackets as independent variable and the crime rate as dependent variable. When using the logarithm of crime rates as dependent variable, as shown in Panel C, the coefficient on property crimes is also significant, however it is positive. When using the ratio between the share of people in the top five and bottom five income brackets as independent variable, the restricted sample estimation yields negative significant coefficients on total crimes, property crimes and violent crimes, as shown in both Panel B and D. As seen in the output, when using the logarithm of crime rates as dependent variable, a one unit increase in the ratio is associated with a 10.7 percent decrease in total crimes, a 13.6 percent increase in property crimes and a 95.4 percent decrease in violent crimes. A one unit increase in the ratio between the share of people in the top five and the bottom five income brackets, with the logarithm of crime rates as dependent variable, a one unit increase in the income bracket ratios is associated with a 43.8 percent decrease in total crimes, a 31.7 percent decrease in property crimes and a 137.7 percent increase in violent crimes.

When instead interpreting the increase in the income bracket ratios using standard deviations, a one standard deviation increase is the ratio between the share of people in the top three and the bottom three income brackets is associated with a 2.13 percent decrease in total crimes, a 2.71 percent increase in property crimes and a 19 percent decrease in violent crimes. A one standard deviation increase in the ratio between the share of people in the top five and the bottom five income brackets is associated with a 25.14 percent decrease in total crimes, an 18.19 percent decrease in property crimes and a 79.03 percent decrease in violent crimes.

When restricting the sample, the coefficients for total crimes and violent crimes increase, in absolute terms, compared to the coefficients in the full sample, as expected. The coefficient for property crimes is still positive when using the ratio between the share of people in the top three and bottom three income brackets which implies than a decrease in income inequality is associated with an increase in property crimes. The coefficient for property crimes turns negative when using the wider ratio between the share of people in the bottom five income brackets and the top five income brackets. This implies that a decrease in income inequality is associated with a decrease in property crimes, and the other way around.

6.4 Robustness Checks

To check the robustness of the main results shown in section 6.3, some alternative specifications are presented in this section[10].

[9] See discussion in Section 3.3 about the different directions of the income bracket ratios.

Table 10. Second stage results for income bracket ratios in Sweden (restricted sample)

	(1) 2SLS	(2) 2SLS	(3) 2SLS	(4) 2SLS	(5) 2SLS	(6) 2SLS	(7) 2SLS	(8) 2SLS
Panel A: Top three/Bottom three Y =	Total crimes	Total crimes	Property crimes	Property crimes	Violent crimes	Violent crimes	Frauds	Frauds
Top three/Bottom three	2,844.152***	-1,244.297**	1,816.562***	-608.108	74.579**	-625.778***	394.967***	139.298
	(385.096)	(554.879)	(230.020)	(412.707)	(33.654)	(75.699)	(37.855)	(145.700)
Share of foreign born individuals		-731.025		-5,734.964***		1,295.111***		1,101.945
		(3,176.349)		(2,215.000)		(400.625)		(764.378)
Share of males aged 15-24		15,530.282		10,599.138*		2,659.623**		4,215.229*
		(9,969.526)		(5,984.890)		(1,303.511)		(2,495.057)
Share of divorced individuals		37,558.460***		21,529.161***		924.427		1,913.345
		(9,817.803)		(6,199.505)		(1,282.408)		(1,865.106)
Panel B: Top five/Bottom five Y =	Total crimes	Total crimes	Property crimes	Property crimes	Violent crimes	Violent crimes	Frauds	Frauds
Top five/Bottom five	1,560.643***	-4,136.472***	72.469	-2,989.880***	230.829***	-726.705***	231.567***	453.644
	(233.405)	(1,236.780)	(137.101)	(789.308)	(22.961)	(168.680)	(22.881)	(353.378)
Share of foreign born individuals		-16,999.209**		-16,871.975***		-512.905		3,626.290**
		(7,104.650)		(4,454.366)		(961.994)		(1,734.673)
Share of males aged 15-24		4,271.648		2,836.725		924.107		6,731.154*
		(12,986.420)		(7,926.178)		(1,774.479)		(3,659.794)
Share of divorced individuals		20,743.623*		11,979.856*		-1,450.854		4,099.797
		(11,151.286)		(7,002.096)		(1,536.585)		(2,618.905)
Panel C: Top three/Bottom three Y =	ln(Total crimes)	ln(Total crimes)	ln(Property crimes)	ln(Property crimes)	ln(Violent crimes)	ln(Violent crimes)	ln(Frauds)	ln(Frauds)
Top three/Bottom three	0.269***	-0.107*	0.327***	0.136*	0.097**	-0.954***	0.989***	-0.092
	(0.037)	(0.058)	(0.041)	(0.074)	(0.048)	(0.114)	(0.061)	(0.185)
Share of foreign born individuals		0.200		0.469		1.033*		-0.680
		(0.323)		(0.409)		(0.548)		(0.914)
Share of males aged 15-24		1.256		2.324*		1.255		8.641***
		(1.144)		(1.350)		(2.082)		(3.166)
Share of divorced individuals		4.280***		4.981***		0.872		5.776*
		(1.100)		(1.375)		(1.876)		(2.973)
Panel D: Top five/Bottom five Y =	ln(Total crimes)	ln(Total crimes)	ln(Property crimes)	ln(Property crimes)	ln(Violent crimes)	ln(Violent crimes)	ln(Frauds)	ln(Frauds)
Top five/Bottom five	0.156***	-0.438***	0.002	-0.317**	0.332***	-1.377***	0.667***	0.105
	(0.024)	(0.136)	(0.027)	(0.156)	(0.033)	(0.275)	(0.041)	(0.423)
Share of foreign born individuals		-1.700**		-1.296		-3.322**		1.140
		(0.754)		(0.869)		(1.437)		(2.163)
Share of males aged 15-24		0.122		1.797		-2.686		9.374**
		(1.473)		(1.679)		(2.928)		(4.135)
Share of divorced individuals		2.564**		3.331**		-2.626		7.821**
		(1.257)		(1.578)		(2.356)		(3.634)
Year fixed effects	no	yes	no	yes	no	yes	no	yes
Municipality fixed effects	no	yes	no	yes	no	yes	no	yes
Control variables	no	yes	no	yes	no	yes	no	yes
Sample size A	3399	3399	3399	3399	3399	3399	3399	3399
Sample size B	2696	2696	2696	2696	2696	2696	2696	2696
Sample size C	3399	3399	3399	3399	3399	3399	3398	3398
Sample size D	2696	2696	2696	2696	2696	2696	2695	2695

Note: Calculations are based on annual total earnings during the period 2005-2016. All observations with a predicted ratio between the share of people in the top and the bottom income brackets above one are removed. Control variables included are the share of foreign-born individuals, the share of males aged 15-24 years and the share of divorced individuals. Top one percent outliers removed. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

[10] The robustness checks in this section are based on the full sample used in Table 9. Results from robustness checks based on the restricted sample in Table 10 are also available, these results are similarly robust to the alternative specifications.

6.4.1 Population weighted

In the first robustness check I estimate a weighted model where all municipalities are weighted by the number of inhabitants, this will increase the influence from the bigger cities and reduce the influence from small municipalities. The results are presented in Panel I, Table A.2 in Appendix A. In the weighted 2SLS estimation, the coefficient on the ratio between the share of people in the bottom three and the top three income brackets turns significant for total crimes, with a magnitude of 0.362. When using the ratio between the share of people in the bottom five and the top five income brackets as independent variable, the coefficient for total crimes turns positive and the magnitude changes from -0.081 to 0.320. There are also changes in the magnitudes for the other coefficients, for the ratio between the top three and the bottom three income brackets, the coefficient for violent crimes increases from -0.729 to -0.258, for property crimes it increases from 0.181 to 0.808. For the ratio between the top five and the bottom five income brackets the coefficient for violent crimes increases from -0.754 to -0.305, for property crimes it increases from 0.119 to 0.735.

6.4.2 Education

I also estimate a specification including different measures of education as additional control variables. Education may affect criminal activity in different ways, one way is through increased economic opportunity and therefore increased opportunity costs of crime which could make people less likely to engage in criminal activity (Lochner & Moretti, 2004). Another way is through increased patience and risk aversion which also could make people less likely to engage in criminal activity. If education is not included, the results may suffer from omitted variable bias. To control for this, I estimate my baseline specification including different measures of education, the output is shown in Table A.2 in Appendix A. In Panel D, I include the share of people with less than 10 years of education, in Panel E the share of people with 10-13 years of education and in Panel F, I include the share of people with 13-16 years of education.

The share of people with 10-13 years of education has the largest effect on the income inequality measures. When it is included, the coefficient on the ratio between top three and bottom three for violent crimes increases from -0.729 to -0.44 and the coefficient for property crimes turns insignificant. The coefficient on the ratio between the top five and bottom five income brackets for violent crimes also increases from -0.754 to -0.359 and the coefficients for property crimes and total crimes turns insignificant. When including the share of people with less than 10 years of education, only the coefficient on the ratio between top five and bottom five income brackets for total crimes turns insignificant. Additionally, when including the share of people with 13-16 years of education the coefficient on the ratio between the top five and bottom five income brackets for property crimes turns insignificant. All other results remain robust. Yet, one problem with including measures of education is that unobserved characteristics affecting education also likely affect the decision to commit crimes and there might not be a direct effect from education on criminal activity.

6.4.3 Unemployment

Another factor that might affect the decision to engage in criminal activity is unemployment. Previous studies in Sweden have found significant positive relationships between unemployment and crime rates, mainly property crimes[11]. The unemployment measure will likely capture a part of the income effect due to decreased economic opportunities when unemployed, but also a social effect in terms of inactivity (Nilsson, 2004). To control for this, I include the proportion of unemployed of the municipality labour supply[12] as an additional regressor. The output from the 2SLS estimation including unemployment is shown in Panel G, Table A.2 in Appendix A. Most of the results remain robust, except for the coefficient on the income bracket ratio between the top five and bottom five income brackets for property crimes, it turns insignificant when including unemployment. However, unemployment is also a problematic regressor to include since the relationship between crime rates and unemployment may suffer from reverse causality. Firms and jobs may move out of areas with high crime rates and this would further increase unemployment. The estimated model is also likely over specified since I include both municipality fixed effects, year fixed, municipality-specific time trends in terms of unemployment, control variables which vary at the year and municipality level and my instrument which is calculated using the national growth rate. Including all these factors may lead to collinearity and imprecise estimates.

6.4.4 Lagged crime variables

Another factor which may cause bias to the results is the fact that crime rates in a specific area may persist over time. The decision to engage in criminal activity may also be affected by the decision of other people in the surrounding environment, so called peer effects (Nilsson, 2004). To control for this, I include lagged dependent variables in the 2SLS estimation in Panel H, Table A.2 in Appendix A. Both Nilsson (2004) and Machin and Meghir (2004) include lagged dependent variables as control variables in their specifications and find significant persistence in crime rates due to peer effects and neighbourhood effects. However, their main results remain robust. As shown in Panel G, the lagged dependent variables are positive and significant in all specifications, which could imply that Swedish crime rates are persistent, as also found by Nilsson (2004). In the specification with the ratio between the share of people in the top three and the bottom three income brackets as independent variable, the coefficients remain significant, but there are some changes in the magnitudes. The coefficient for property crimes decreases from 0.181 to 0.123 and the coefficient for violent crimes changes from -0.729 to -0.592. When using the ratio between the share of people in the top five and the bottom five

[11] See Edmark (2005), Nilsson (2004) and Nilsson and Agell (2003)

[12] I calculate an annual average unemployment rate from monthly unemployment data from the Swedish Public Employment Service, data on the municipality labour force is available at Statistics Sweden.

income brackets as independent variable, the coefficients for total crimes and property crimes turns insignificant, and the coefficient for violent crimes increases from -0.754 to -0.611[13].

6.4.5 Disaggregated violent crime rates

My main crime variables are total crimes, violent crimes, property crimes and frauds. In my violent crime category, I include both assaults and robberies according to the definition by FBI (U.S Department of Justice, 2017). However, some previous studies from Sweden[14] include robberies as a property crime and assaults as the only crime rate in the violent crime category. None of these previous studies find a significant correlation between their violent crime assaults and income inequality, whilst I find significant results for violent crimes in all specifications. To be able to compare our results for the violent crime category assaults, I estimate my baseline specification using disaggregated violent crime rates as dependent variables. In Column 1 and 2 in Table A.3, in Appendix A, I use assaults as dependent variable and in Column 3 and 4 I use robberies as dependent variable. As shown in the output, I find significant negative coefficients on the income bracket ratios for both crime rates included in my violent crime category, assaults and robberies, as I also find when using violent crimes as dependent variable in my baseline specification.

6.4.6 Clustered standard errors

Additionally, I estimate the second stage of the two-stage least squares model with standard errors clustered at the municipality level to allow for heteroskedasticity and serial correlation. The results are shown in Panel J, Table A.2. The clustered standard errors are larger than the heteroskedasticity robust standard errors and due to this, there are some changes to the results. The coefficients on total crimes and property crimes in the specification with the ratio between the share of people in the top five and bottom five income brackets turns insignificant when using clustered standard errors. All other results remain robust.

6.4.7 Top-coded data

As previously mentioned, my data contains missing values in some income brackets when there are less than four persons in each income bracket. In my baseline specification I coded these as zeros. To check the robustness of my results if there were one, two or three persons instead of zero in these brackets, I change the missing values into one, two or three. The results are shown in Panel A, B and C in Table A.2 in Appendix A. When coding the missing value as two or three, the coefficient on the ratio between the share of people in the top five and bottom five income brackets for total crimes turns insignificant. The other results remain robust.

---

[13] These changes in the results could imply that crime rates in Sweden are persistent, but the changes in the magnitudes and significance of the coefficients could also to some extent be due to bias in dynamic models with fixed effects, the Nickell bias (Nickell, 1981).

[14] See Edmark (2005), Nilsson (2004) and Nilsson and Agell (2004).

6.4.8 Outliers

As mentioned in section 5.1, the top one percent observations in the ratios between the share of people in the top and bottom income brackets are removed in all output to reduce the influence from outliers. When the outliers are included, there are some changes to the results. The results are shown in Table A.4 in Appendix A. When using the crime rate per 100 000 residents as dependent variable, the coefficients on property crimes turns significant for both income bracket ratios. When instead using the logarithm of crime rates as dependent variable, the coefficient on total crimes turns insignificant for the ratio between the share of people in the top five and bottom five income brackets. There are also some changes in the magnitudes for the other coefficients.

6.5 Discussion

According to the results shown in section 6.3, there is a robust inverse relationship between the income bracket ratios and violent crimes, and a fairly robust inverse relationship between the income bracket ratios and total crimes. Additionally, there is a positive relationship between the income bracket ratios and property crimes, but the results are not robust when including specific measures of education and when controlling for lagged crime rates. When using the full sample, the coefficients are difficult to interpret in terms of income inequality since an increase in the income bracket ratio has different meanings in terms of inequality depending on if the ratio increases towards one or from one, as discussed previously. However, when removing observations with predicted income bracket ratios above one, an increase in the income bracket ratios is always an increase towards one which implies a decrease in income inequality[15].

There is a robust inverse relationship between the income bracket ratios and violent crimes both when using the full sample and when using the restricted sample. This implies that an increase in income inequality is associated with an increase in violent crimes. My findings for violent crimes differ from the previous findings by Nilsson (2004). She found no significant relationship between income inequality, relative poverty or unemployment and violent crimes. However, we do not use the same definition of the crime rates. I include robberies and assaults in my category for violent crimes whilst Nilsson includes robberies in property crimes and assaults as the only violent crime. My findings show a robust inverse relationship between the income bracket ratios and violent crimes, in all specifications, both when using all violent crimes and when using the specific categories assaults and robberies as dependent variables. My findings for robberies imply that a decrease in the ratios between the share of people in the top and bottom income brackets is associated with an increase in violent crimes. The income bracket ratios are decreasing when the share of people in the bottom income brackets increases relative to the share of people in the top income brackets. This corresponds to the findings by Nilsson (2004), who found that if the proportion of the population with earnings

[15] See Figure 3 for illustration.

below 10 percent of the median increases with one percentage point, robberies would increase with 9.1 percent. On the other hand, my findings for assaults differ from the previous findings by both Nilsson (2004) and Edmark (2005), who found the share of males aged 15-24 to be the only variable significantly correlated with assaults.

The findings for the relationship between income inequality and property crimes is instead more unclear. In the full sample estimation, the coefficients for property crimes on both income bracket ratios are positive. When using the restricted sample, the coefficient on the ratio between the share of people in the top five and the bottom five income brackets turns negative. The results from the restricted sample imply that an increase in income inequality when using the ratio between the share of people in the top three and the bottom three income brackets is associated with a reduction in property crimes, but an increase in income inequality when using the ratio between the share of people in the top five and the bottom five income brackets is associated with an increase in property crimes. As previously discussed in section 6.4, the ratio between the share of people in the top three and bottom three income brackets is a very narrow measure and only includes a small share of high-income people. Due to this, the wider measure, the ratio between the share of people in the top five and bottom five income brackets, may give more reasonable results. One possible reason for these ambiguous results may be spillover effects due to the mobility of criminals. Property crimes are, to a greater extent than violent crimes, likely planned, and the offenders may travel from one area to another to commit crimes.

These latter findings from the restricted sample which implies an increase in property crimes due to an increase in income inequality, are in line with the findings by Nilsson (2004). Nilsson finds a positive relationship between the proportion of the population with an income below 10 percent of the median and property crimes. The property crime rates included by Nilsson (2004), except from robbery, are burglary and auto theft where a one percentage point increase in the proportion of the population with an income below 10 percent of median income is associated with a 5.9 percent increase in burglaries and a 22.1 percent increase in auto thefts.

Additionally, Nilsson finds a significant positive impact of the proportion of the population with an income below 10 percent of the median on total crimes, where a one percentage point increase in the proportion of the population with an income below 10 percent of the median income is associated with a 2.9 percent increase in the overall crime rate. According to Nilsson's results, an increase in the 90^{th} percentile is also associated with an increase in the overall crime rate, however the effect is very small. I also find significant positive relationships between total crimes and income inequality, both in the full sample and in the restricted sample. However, these findings are not robust to all alternative specifications. The reason why some of my results show insignificant coefficients on the income bracket ratios for total crimes is likely due to different directions of the correlation with property and violent crimes. Property crimes are mainly positively correlated with an increase in the income bracket ratio and violent crimes are negatively correlated.

In conclusion, my findings show that income inequality is correlated with both violent crimes, property crimes and total crimes. An increase in income inequality, due to a larger share of people with very low earnings is associated with an increase in violent crimes. These findings are in line with the theoretical predictions since violent crimes are expected to increase with increased income inequality due to the fact that some individuals might feel anger or dissatisfaction when they do not succeed to reach the socially desirable goals or when resources in the society are allocated in an unfair way. If this occurs, some individuals may engage in criminal activities to increase their outcome or to decrease the outcomes of others, as previously discussed in Section 2.

My findings for property crimes are more ambiguous and the relationship between property crimes and income inequality changes depending on the specification. However, the findings from the restricted sample when using the ratio between the share of people in the top five and the bottom five income brackets are in line with the theoretical predictions. These findings imply that an increase in income inequality due to an increase in the share of people in the bottom income brackets is associated with an increase in property crimes. According to the theory presented in Section 2, property crimes are expected to increase when income inequality increases since there are more low-income individuals present who could gain more from criminal activity than from legal work. Additionally, as shown in Panel I, Figure A.2, the results change when estimating the population weighted model, these results imply that the relationship between income inequality and crime looks different when the influence from bigger cities increase. Due to this, I further examine this relationship in Sweden's biggest city, Stockholm.

7 Stockholm

Stockholm is the largest city in Sweden with around 1 million inhabitants, and it accounts for a lot of the reported crimes in Sweden. The Stockholm municipality has a mean of about 22 222 total crimes per 100 000 residents, whilst the mean of total crimes in Sweden is about 9920 per 100 000 residents. Compared to the second and third biggest cities in Sweden the mean in Stockholm is still slightly higher, Gothenburg has a mean of about 18 000 total crimes and Malmö has a mean of about 20 184 total crimes per 100 000 residents. To further extend my analysis of the relationship between income inequality and criminal activity, I compare the 14 districts of Stockholm to investigate if the relationship looks different within the biggest city of Sweden than in the Swedish municipalities.

Section 7.1 reviews the data for the dependent variable (crime rates), the independent variable (income inequality) and the control variables. Section 7.2 presents the instrumental variable and the empirical specification. Section 7.3 presents the output from the first stage and the reduced form and the output from the second stage is presented in section 7.4. The results are discussed in Section 7.5.

7.1 Data

The crime data I use is a panel of the total number of crimes reported to the police per 100 000 residents on a yearly basis, from 2004 to 2016 for 14 districts in Stockholm. The crime data is available at the National Council for Crime Prevention. My main crime categories are total crimes, property crimes, violent crimes and frauds[16]. Table 11 shows descriptive statistics for the crime variables. The average number of total crimes is about 20 885, the average number of property crimes is about 12 403 and the average number of violent crimes is about 1517. The average number of assaults is about 1290, the average number of robberies is about 227, the average number of burglaries is 1202, the average number of auto thefts is about 584, the average number of thefts is about 5801, the average number of frauds is about 974 and the average number of vandalisms is about 3842.

Table 11. Descriptive statistics of crime variables in Stockholm

Variable	Observations	Min	Max	Mean	Std. Dev.
Total crime	182	10996	55460	20884.51	9425.348
Property crime	182	6284	37045	12403.43	6235.678
Violent crimes	182	484	4457	1516.967	813.2516
Assault	182	386	3826	1289.907	697.9452
Robbery	182	59	730	227.060	125.8083
Burglary	182	647	2313	1202.341	285.478
Auto theft	182	218	1365	583.5549	232.4236
Theft	182	1896	27116	5801.253	5140.323
Fraud	182	307	4364	973.8571	656.9023
Vandalism	182	1507	11348	3842.429	1743.737

Note: The crime variables are the total number of crimes reported to the police per 100 000 residents each year in 14 districts of Stockholm during the period 2004-2016.

Table 12 shows descriptive statistics for means of annual total earnings[17] per individual in 14 districts of Stockholm. The sample includes data on median earnings and percentiles between year 2004 and 2016, and the share of people in different income brackets between year 2006 and 2016. The data is provided by Statistik Stockholm/SWECO and Statistics Sweden.

The main measure of income inequality is the ratio between the share of people in the top two and the bottom two income brackets[18]. It is calculated by dividing the share of people with annual total earnings above 400 000 SEK with the share of people with annual total earnings below 159 900 SEK in each municipality. I will also use the ratio between the 90th percentile and the 10th percentile, and the ratio between the 75th percentile and the 25th percentile as measures of income inequality. As shown in Table 12, the average median earnings are about 245 440 SEK, the average 10th percentile is

[16] Explanations and details about the crime categories are included in Section 3.1

[17] Detailed description of total earnings is included in Section 3.2.

[18] Due to data shortage I cannot use ratios of the same income brackets as in the Sweden specification. The Stockholm sample only includes the share of people in five different income brackets, since the bottom income bracket consists of people with earnings of 0 tkr, I choose to look at the top two and the bottom two brackets.

about 20 795, the average 25th percentile is about 122 343, the average 75th percentile is 368 652 and the average 90th percentile is about 522 652. The average ratio between the 90th and the 10th percentile is 68.527, the average ratio between the 75th and the 25th percentile is 3.138 and the average ratio between the share of people in the bottom two and the top two income brackets is 1.161.

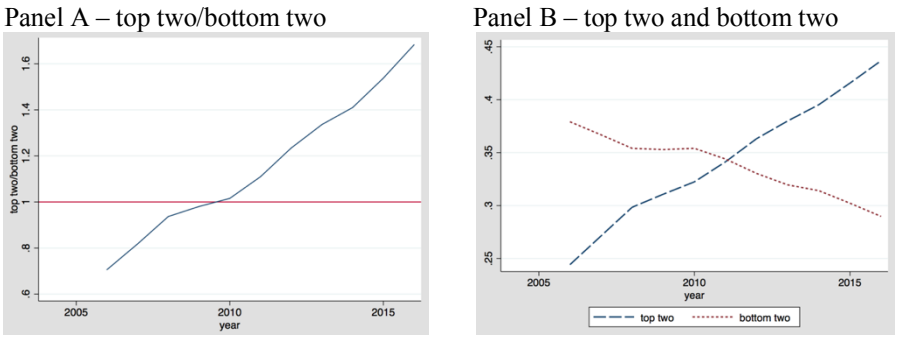
Table 12. Descriptive statistics of income variables in Stockholm

Variable	Observations	Min	Max	Mean	Std. Dev.
Median earnings	182	153101	367635	245439.5	51342.55
10th percentile	182	0	69997	20794.77	15753.29
25th percentile	182	53420	200342	122342.7	33354.39
75th percentile	182	234810	551629	368652	72967.33
90th percentile	182	321125	830164	522652.1	119798.6
90th percentile/10th percentile	168	10.616	1151.273	68.527	158.759
75th percentile/25th percentile	182	2.465	5.052	3.138	0.635
Share of people with earnings 0 tkr	154	0.045	0.190	0.082	0.034
Share of people with earnings 0.1-159.9 tkr	154	0.152	0 .385	0.255	0.055
Share of people with earnings 160-319.9 tkr	154	0.21	0.443	0.319	0.052
Share of people with earnings 320-499.9 tkr	154	0.081	0.328	0.219	0.056
Share of people with earnings above 500 tkr	154	0.021	0.300	0.124	0.070
Top two/bottom two	154	0.180	2.905	1.161	0.616

Note: The median earnings and the percentiles are means of annual total earnings in 14 districts in Stockholm during the period 2004-2016. The measures of share of people in different income brackets are calculated using data on annual total earnings in 14 districts in Stockholm during the period 2006-2016.

Figure 6 shows the means in the 14 districts of Stockholm between 2006 and 2016 for the ratio between the share of people in the top two income brackets and the bottom two income brackets. The ratio increased from around 0.7 to 1.7 between 2006 and 2016. Before 2010, the share of people with the lowest earnings is, on average, larger than the share of people with the highest earnings, but the difference decreased as the measure moved towards 1. After 2010, the share of people with the highest earnings is, on average, larger than the share of people with the lowest earnings, which implies an increased inequality. As previously discussed, the ratio measures absolute income inequality between the top and the bottom income brackets, and people will move out of the lower brackets and into the higher brackets as earnings increase over time. However, as shown in Panel B, the share of people in the top income brackets increase at a faster rate compared to the rate of people leaving the bottom income brackets. The means for the ratio between the 90th percentile and the 10th percentile, and the ratio between the 75th percentile and the 25th percentile are shown in Figure B.1 in Appendix B. These figures show volatility in the ratios over the years with increases and decreases in relative income inequality, but an overall increase in the inequality when comparing year 2016 to year 2004.

Figure 6. Ratio between the share of people in the top and bottom income brackets in Stockholm



Note: The figure shows the city-level mean of the measures in 14 districts of Stockholm during the period 2006-2016. Panel A shows the ratio between the share of people with annual total earnings in the top two and the bottom two income brackets, and Panel B shows the share of people in the top two income brackets and the share of people in the bottom two income brackets.

The control variables included are the share of foreign-born individuals and the share of males aged 15-24 years for 14 districts in Stockholm between year 2004 and 2016[19] as shown in Table 13. The data is provided by SWECO/Statistik Stockholm. The average share of foreign-born individuals is about 24 percent and the average share of males aged 15-24 years is about 12 percent.

Table 13. Descriptive statistics of control variables in Stockholm

Variable	Observations	Min	Max	Mean	Std. Dev.
Share of foreign born individuals	182	0.121	0.575	0.241	0.128
Share of males aged 15-24	182	0.071	0.16	0.118	0.022

Note: The control variables are city-level means of the control variables in 14 districts in Stockholm during the period 2004-2016.

7.2 Instrumental Variable and Empirical Specification

The predicted income inequality measures are calculated in the same way as in section 3.4. However, since I do not have data on the corresponding income brackets in Sweden as in Stockholm, I calculate the predicted measures using a Stockholm growth rate instead of a national growth rate. Descriptive statistics for the instruments are shown in Table 14. The average predicted ratio between the 90th and the 10th percentile is 27.276, the average predicted ratio between the 75th and the 25th percentile is 3.069 and the average predicted ratio between the share of people in the top two and the bottom two income brackets is 1.162.

Figure 7 shows the relationship between the actual and the predicted ratio between the share of people in the top two and the bottom two income brackets. As shown in Panel A and B, there is a high correlation between the actual and the predicted ratios, and variation in the measures. The relationships between the actual and predicted top and bottom income brackets are shown in Figure

[19] The share of divorced inhabitants is not included as a control variable in the Stockholm specification due to a lack of data.

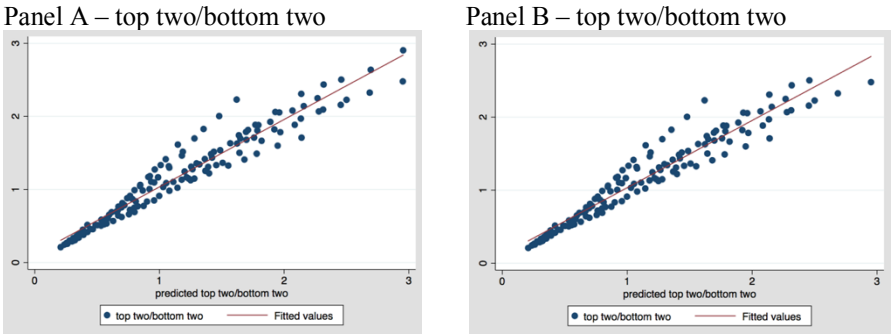
B.2, and the relationship between the actual and predicted ratio between the 90th and 10th percentile, and between the 75th and the 25th percentile, are shown in Figure B.3 in Appendix B.

Table 14. Descriptive statistics of instrument in Stockholm

Variable	Observations	Min	Max	Mean	Std. Dev.
Predicted 10th percentile	143	5019.427	63262.07	24572.07	24631.15
Predicted 25th percentile	165	59389.33	180694.7	124612.6	63638.31
Predicted 75th percentile	165	241201.5	530106.9	375598.4	65223.67
Predicted 90th percentile	143	333413.1	796039.3	545166.5	105441.5
Predicted 90th percentile/10th percentile	143	11.202	78.028	27.276	14.358
Predicted 75th percentile/25th percentile	165	2.497	4.371	3.069	0.468
Predicted bottom two	138	0.233	0.545	0.334	0.071
Predicted top two	138	0.113	0.686	0.35	0.135
Predicted top two/bottom two	138	0.207	2.952	1.162	0.621

Note: The income variables are city-level means of annual total earnings in 14 districts in Stockholm. The income percentiles based on annual total earnings in all districts between 2005-2016. Year 2004 is dropped when the instrument is calculated. The income brackets and income bracket ratios are based on annual total earnings between 2007-2016. Year 2006 is dropped when the instrument is calculated. Top one percent outliers removed.

Figure 7. Relationship between actual and predicted income bracket ratios in Stockholm



Note: The figure shows the relationship between the actual and the predicted income bracket ratios. Panel B shows the same ratio as in Panel A, but, with the top one percent outliers removed. Calculations are based on annual total earnings in 14 districts of Stockholm during the period 2007-2016.

To test my hypothesis using the district-level data from Stockholm, I estimate a two-stage least squares model with the same equations as in the analysis with the municipality-level data from Sweden. The first stage for the Stockholm analysis is estimated using equation 11, the reduced form is estimated using equation 12 and the second stage of the two-stage least squares model is estimated using equation 13. However, I include district fixed effects instead of municipality fixed effects in this estimation, and the vector of time-varying control variables, X_{it}, only includes the proportion of foreign-born individuals and the proportion of males aged 15-24 years old[20].

[20] The share of divorced individuals is not included as a control variable due to a lack of data as previously mentioned.

7.3 First Stage and Reduced Form Results

The output from the first stage is shown in Table 15. As shown in the table, there is a significant positive relationship between the actual and the predicted ratios, and the F-statistics in all specifications are above 10, which indicates a sufficiently strong instrument. A one unit increase in the predicted ratio between the share of people in the top two and the bottom two income brackets is associated with an increase in the actual ratio of 0.531.

The output from the first stage when using the ratio between the 90th and the 10th percentile, and the 75th and the 25th percentile are shown in Table B.1 in Appendix B. For the 90th to 10th percentile ratio there are significant positive relationships between the actual and the predicted ratios, and the F-statistics are above 10 in all specifications. For the ratio between the 75th and the 25th percentile, the relationships are also significant. However, the F-statistic is below 10 when including fixed effects, which indicates a weak instrument.

The output from the reduced form is shown in Figure B.2 in Appendix B. When using the crime rate as dependent variable, there are significant coefficients for total crimes, property crimes and violent crimes. When instead using the logarithm of crime rates as dependent variable, there are significant coefficients on total crimes, property crimes, violent crimes and frauds. The coefficients on total crimes and property crimes are positive, whilst the coefficients on violent crimes and frauds are negative. Output from the reduced form when using the ratio between the 90th and the 10th percentile as independent variable is included in Table B.3 in Appendix B.

Table 15. First stage results for the income bracket ratio in Stockholm[21]

	(1)	(2)	(3)	(4)	(5)
Y =	Top two/ bottom two	Top two/ bottom two	Top two/ bottom two	Top two/ bottom two	Top two/ bottom two
Predicted Top two/bottom two	0.920*** (0.024)	0.951*** (0.044)	0.587*** (0.067)	0.767*** (0.048)	0.531*** (0.059)
Year fixed effects	no	no	yes	no	yes
District fixed effects	no	yes	yes	yes	yes
Control variables	no	no	no	yes	yes
Sample size	138	138	138	138	138
F-statistic	1519.80	471.70	77.27	258.29	79.80

Note: Calculations are based on total earnings during the period 2007-2016. Control variables included are the share of foreign-born individuals and the share of males aged 15-24 years. Top one percent outliers removed.
Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

7.4 IV Results

The main results from the analysis in Stockholm, the IV results, are presented in this section and shown in Table 16[22]. The output when using the crime rates per 100 000 residents as dependent

[21] The top one percent outliers are removed in all output.

variable, is shown in Panel A, and when using the logarithm of the crime rates as dependent variable it is shown in Panel B. As shown in Panel A, the 2SLS estimation yields positive significant coefficients on total crimes and property crimes, and a negative significant coefficient on violent crimes. When using the logarithm of crime rates as dependent variable, as shown in Panel B, the 2SLS estimation yields positive significant coefficients on total crimes and property crimes, and negative significant coefficients on violent crimes and frauds.

As shown in Panel A, a one unit increase in the ratio between the top two and the bottom two income brackets is associated with an increase of about 4485 total crimes, 7605 property crimes and a decrease of about 1111 violent crimes. When using the logarithm as dependent variable, shown in Panel B, a one unit increase in the ratio is associated with a 15.2 percent increase in total crimes, a 40.9 percent increase in property crimes, a 49.3 percent decrease in violent crimes and a 38.7 percent decrease in frauds. If interpreted as standard deviations, a one standard deviation increase in the ratio between the share of people in the top two and the bottom two income brackets when using the logarithm of crime rates as dependent variable, is associated with a 9.42 percent increase in total crimes, a 25.36 percent increase in property crimes, a 30.57 percent decrease in violent crimes and a 24.01 percent decrease in frauds.

The output from the second stage of the 2SLS estimation when using the ratio between the 90th and the 10th percentile as independent variable is included in Table B.4 in Appendix B. The 2SLS estimation yields positive significant coefficients on total crimes and property crimes when using the crime rate per 100 000 residents as dependent variable. A one standard deviation increase in the ratio between the 90th percentile and the 10th percentile is associated with an increase of 334 total crimes and 337 property crimes per 100 000 residents. No significant relationship is found when using the logarithm of crime rates as dependent variable.

7.5 Discussion

Compared to the results from the Sweden specification, the changes in crimes rates associated with a one standard deviation change in the income bracket ratios are much larger in Stockholm. A possible reason for this difference is that the income brackets used in Stockholm are wider than the ones used in Sweden. The income distribution in Sweden is divided into 26 income brackets whilst the distribution in Stockholm is divided into five brackets. Additionally, the standard deviation of the income bracket ratio in Stockholm is much larger than the standard deviation of the ratio between the share of people in the top three and bottom three income brackets in Sweden, it is 0.621 in Stockholm compared to 0.199 in Sweden. When instead using the wider income bracket ratio in Sweden, the standard deviation increases to 0.574 and the magnitudes also increase.

[22] The output from the second-stage when all outliers are included is shown in Table B.5 in Appendix B. There are no changes in the sign or significance of the coefficients and only minor changes in the magnitudes when all outliers are included.

Table 16. Second stage results for the income bracket ratio in Stockholm

	(1) 2SLS	(2) 2SLS	(3) 2SLS	(4) 2SLS	(5) 2SLS	(6) 2SLS	(7) 2SLS	(8) 2SLS
Panel A: Top two/Bottom two Y =	Total crimes	Total crimes	Property crimes	Property crimes	Violent crimes	Violent crimes	Frauds	Frauds
Top two/Bottom two	5,823.259***	4,485.247***	4,772.010***	7,604.863***	131.551	-1,110.676***	449.242***	-153.372
	(1,995.151)	(1,694.171)	(1,354.705)	(1,619.101)	(154.646)	(295.478)	(140.957)	(396.922)
Share of foreign born individuals		56,722.581***		67,738.759***		-6,097.473*		2,407.062
		(21,840.560)		(20,709.232)		(3,131.803)		(4,375.849)
Share of males aged 15-24		63,342.950**		72,870.410**		-9,285.546*		1,514.819
		(30,937.214)		(29,923.224)		(5,396.140)		(7,320.413)
Panel B: Top two/Bottom two Y =	ln(Total crimes)	ln(Total crimes)	ln(Property crimes)	ln(Property crimes)	ln(Violent crimes)	ln(Violent crimes)	ln(Frauds)	ln(Frauds)
Top two/Bottom two	0.150**	0.152**	0.232***	0.409***	-0.066	-0.493***	0.262***	-0.387*
	(0.068)	(0.074)	(0.073)	(0.104)	(0.084)	(0.096)	(0.089)	(0.210)
Share of foreign born individuals		2.518**		4.541***		-1.277		1.033
		(1.076)		(1.553)		(1.391)		(3.027)
Share of males aged 15-24		2.365		1.916		0.987		-1.445
		(1.507)		(2.118)		(1.884)		(4.086)
Year fixed effects	no	yes	no	yes	no	yes	no	yes
District fixed effects	no	yes	no	yes	no	yes	no	yes
Sample size	138	138	138	138	138	138	138	138

Note: Calculations are based on total earnings during the period 2007-2016. Control variables included are the share of foreign-born individuals and the share of males aged 15-24 years. Top one percent outliers removed. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Moreover, the coefficient on the income bracket ratio for frauds is significant in Stockholm, but not significant in any specification in the analysis in Sweden. The reason may be the same as discussed above, that the income brackets used in Stockholm are much wider. Fraud is also a difficult crime to examine since a lot of the reported frauds in this time period are committed on the internet (National Council for Crime Prevention, 2018), and the offender and the victim may live in different areas. Due to this, it may be difficult to identify a relationship between local income inequality and reported frauds. Additionally, the coefficient for total crimes is negative in the Sweden specification but positive in the Stockholm specification. This can be explained by the different directions of the coefficients on property and violent crimes, as previously mentioned, since total crimes capture both of them. In Stockholm, the coefficient on property crimes is 0.409[23], the coefficient on violent crimes is -0.493 and the total effect becomes positive. In Sweden, the coefficient on property crimes is much smaller, only 0.119[24], the coefficient on violent crimes is -0.754, which is much larger in absolute value than in Stockholm, and the total effect becomes negative.

As previously discussed in the Sweden specification, it is difficult to interpret the income bracket ratios since an increase in the measure means different things when increasing towards one or from one[25]. To deal with this issue, I estimate the second stage using a restricted sample only including observations where the predicted ratio is below one. However, there are only 65 observations with a

[23] See Table 16, Panel B.
[24] See Table 9, Panel D.
[25] See Figure 3 for illustration.

predicted ratio below one and the coefficient on the income bracket ratio for violent crimes is the only significant coefficient. This coefficient is negative which implies that an increase in income inequality is associated with an increase in violent crimes. For the other crime rates, I cannot say anything about statistical significance, yet the coefficients on total crimes and property crimes are also negative. This finding is supported by the results from the second stage estimation when using the ratio between the 90^{th} and the 10^{th} percentile ratio as a measure of income inequality. According to these results, an increase in income inequality is associated with an increase in total crimes and property crimes.

One shortcoming when using district-level data is the fact that spillover effects due to the mobility of criminals is likely a bigger issue than when using municipality-level data. Criminals travelling from their district of residence to another district to commit crimes is a likely scenario within Stockholm and may be a reason for the weaker results for property crimes.

8 Conclusion

In this study, I investigate the relationship between income inequality and crime rates in Sweden between year 2004 and 2016, by using panel data for 290 Swedish municipalities. My theoretical predictions are based on the models by Becker (1968) and Ehrlich (1973), where criminal activity is expressed as a rational choice made by a utility maximizing individual. Since these theories are mainly applicable to property crimes, I base my predictions for violent crimes on the strain theory by Merton (1938), and on the general strain theory by Agnew (1992). Based on these theoretical models, I expect positive relationships between income inequality and crime rates.

I use an instrumental variable approach where I include predicted income inequality measures, calculated by using the national income growth rate, as instruments for the actual measures. My main measure of income inequality is two different ratios between the share of people in different fixed income brackets where I compare the share of people with the highest and the lowest earnings. As dependent variables I use different crime rates per 100 000 residents and the logarithm of crime rates, I also control for different time-varying socioeconomic variables such as the share of young males and foreign-born individuals in the population and include year and municipality fixed effects.

My results suggest that there is a robust positive relationship between income inequality and violent crimes, and some of my specifications suggest a positive relationship between income inequality and property crimes, and income inequality and total crimes. However, these latter findings are somewhat ambiguous. My findings are in line with the theoretical predictions since crimes rates are expected to increase with increased income inequalities. In addition to this, I estimate a similar specification using district-level data from Sweden's biggest city, Stockholm, between year 2006 and 2016. I find, to some extent, similar results in Stockholm as in Sweden, but since I am using a slightly

different measure of income inequality[26] the magnitudes differ. I also find a significant positive relationship between the 90th to 10th percentile ratio, total crimes and property crimes which further suggests that an increase in income inequality as associated with an increase in criminal activity.

Turning to the shortcomings of this study. First, I rely on the assumption that my instrument only captures changes driven by national trends, and not changes in local factors. However, a possible violation is that differences in the initial income distribution could be influenced by local factors. In this case, my instrument would not be exogenous, and the estimates would be inconsistent. Second, I do not take possible spillover effects into consideration. Property crimes are likely planned, to a greater extent than violent crimes, and there is a possibility that the offender and victim lives in different areas. This is not taken into account in my analysis and might be a reason to my more ambiguous findings for property crimes compared to violent crimes. In addition to this, I do not include any measure of the probability of conviction or arrest since there is a possible reverse causality between factors like the number of police officers in an area and crime rates. As previously discussed, my main measure of income inequality also has some weaknesses. The income bracket ratios only contain information about the share of people with very high and very low earnings, but it does not contain any information about the rest of the income distribution. Additonally, the study is restricted by the fact that I only have access to aggregate panel data at the municipality-level. Access to individual-level data would allow me to do a more thorough analysis and for example construct several measures of income inequality. For future research, including factors like spillover effects and the probability of conviction, and use individual-level data, could improve the results and give more insights about the relationship between income inequality and crime.

[26] Due to different data I do not include the same income brackets when I calculate my income inequality measure in Stockholm as in Sweden.

References

Agnew, R. (1992). Foundation for a general strain theory of crime and delinquency. *Criminology, 30*(1), 47-88.

Becker, G. S. (1968), Crime and Punishment: A n Economic Approach, *Journal of Political Economy 78*, 526-5

Boustan, L., Ferreira, F., Winkler, H., & Zolt, E. M. (2013). The effect of rising income inequality on taxation and public expenditures: Evidence from US municipalities and school districts, 1970–2000. *Review of Economics and Statistics*, *95*(4), 1291-1302.

Buonanno, P. (2003). The socioeconomic determinants of crime. A review of the literature. *Working Paper Dipartimento di Economia Politica, Università di Milano Bicocca; 63*.

Choe, J. (2008). Income inequality and crime in the United States. *Economics Letters*, *101*(1), 31-33.

Edmark, K. (2005). Unemployment and crime: Is there a connection? *Scandinavian Journal of Economics*, *107*(2), 353-373.

Ehrlich, I., (1973). "Participation in Illegitimate Activities: A Theoretical and Empirical Investigation", *Journal of Political Economy*, 81(3), pp. 521-565.

Enamorado, T., López-Calva, L. F., Rodríguez-Castelán, C., & Winkler, H. (2016). Income inequality and violent crime: Evidence from Mexico's drug war. *Journal of Development Economics*, *120*, 128-143.

Eurostat (2019). "Gini coefficient of equivalised disposable income – EU-SILC survey" Accessed 21 April 2019. http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=ilc_di12

Fleisher, B. M. (1966). The effect of income on delinquency. *The American Economic Review*, *56*(1/2), 118-137.

Hearey, O. (2016). The Effect of Rising Income Inequality Across Neighborhoods on Local School Funding and Enrollment (Job Market Paper). Accessed 19 Mars 2019. https://www.semanticscholar.org/paper/The-Effect-of-Rising-Income-Inequality-Across-on-(-Hearey/f2ef05590b37adb0952ac1bcff87e34c676fd4b3

Kelly, M., (2000). "Inequality and Crime", *The Review of Economics and Statistics*, 82 (4), pp. 530-539.

Machin, S., & Meghir, C. (2004). Crime and economic incentives. *Journal of Human Resources*, *39*(4), 958-979.

Merton, R. K. (1938). Social structure and anomie. *American Sociological Review*, *3*(5), 672-682.

National Council for Crime Prevention. (2005). Brottslighet bland personer födda i Sverige och i utlandet, BRÅ rapport 2005:17, Stockholm.

National Council for Crime Prevention. (2017). Brottsutvecklingen i Sverige fram till år 2015, BRÅ rapport 2017:5, Stockholm.

National Council for Crime Prevention. (2018). Kortanalys om brottsutvecklingen, BRÅ kortanalys 5/2018, Stockholm.

Nickell, S. (1981). Biases in dynamic models with fixed effects. *Econometrica: Journal of the Econometric Society*, 1417-1426.

Nilsson, A. (2004). *Income inequality and crime: The case of Sweden* (No. 2004: 6). Working Paper, IFAU-Institute for Labour Market Policy Evaluation.

Nilsson, A., & Agell, J. (2003). *Crime, unemployment and labor market programs in turbulent times* (No. 2003: 14). Working Paper, IFAU-Institute for Labour Market Policy Evaluation.

Nilsson, I. & Wadeskog, A. (2012). *Gatuvåldets ekonomi. Ett kommunalt perspektiv.* Stockholm: Skandia Försäkringsaktiebolag. Accessed 29 November 2018. https://www.ideerforlivet.se/globalassets/pdf/rapporter/gatuvaldsrapporten-130123.pdf

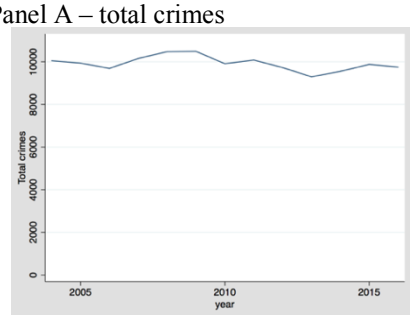
Statistics Sweden (2018). "At risk of poverty rate 1991–2016". Accessed 13 November 2018. https://www.scb.se/en/finding-statistics/statistics-by-subject-area/household-finances/income-and-income-distribution/income-and-tax-statistics/pong/tables-and-graphs/income--consumption-unit-the-entire-country/at-risk-of-poverty-rate/

U.S. Department of Justice, Federal Bureau of Investigation (2017). Crime in the United States 2016. Accessed 2 December 2018. https://ucr.fbi.gov/crime-in-the-u.s/2016/crime-in-the-u.s.-2016/topic-pages/violent-crime.pdf

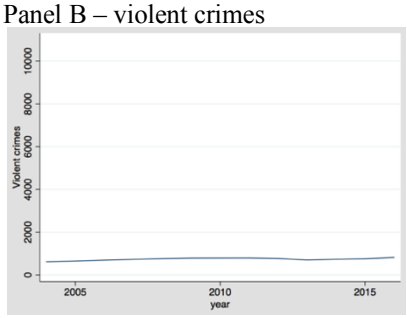
Appendix A. Results from the Sweden Specification

Figure A.1. Average number of reported crimes in Sweden

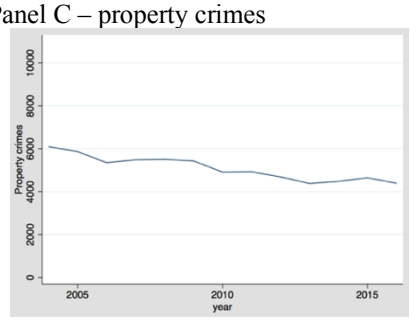
Panel A – total crimes



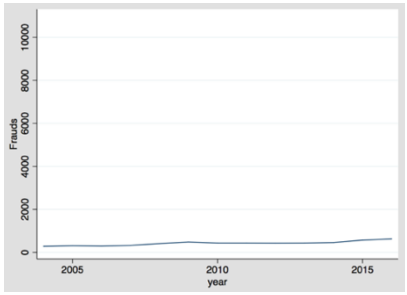
Panel B – violent crimes



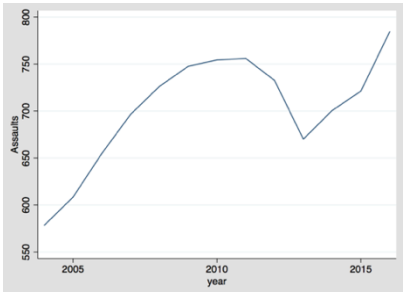
Panel C – property crimes



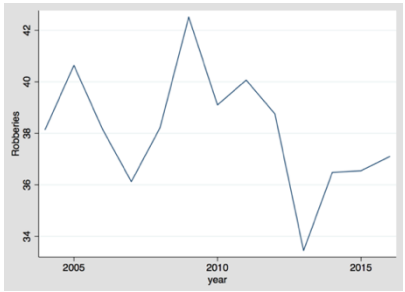
Panel D – frauds



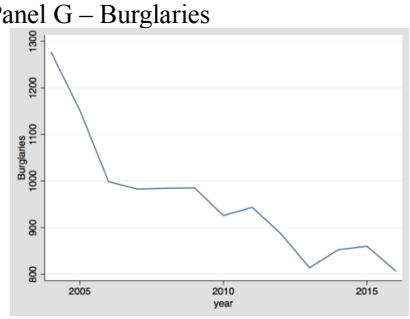
Panel E – Assaults



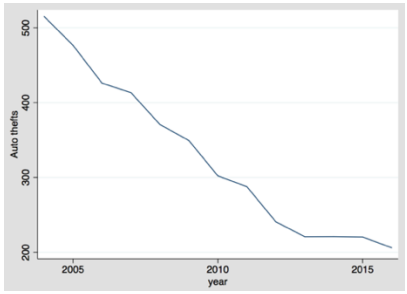
Panel F – Robberies



Panel G – Burglaries



Panel H – Auto thefts



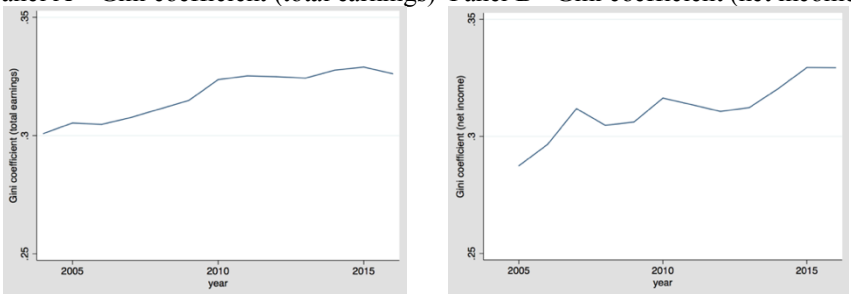
Panel I – Thefts

Panel J – Vandalism

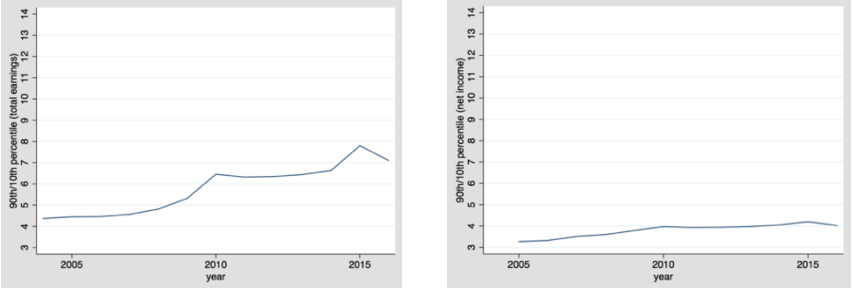
Note: The figure shows the national average number of reported crimes to the police per 100 000 residents, of the averages of 290 municipalities during the period 2004-2016.

Figure A.2. Income inequality measures in Sweden

Panel A – Gini coefficient (total earnings) Panel B - Gini coefficient (net income)



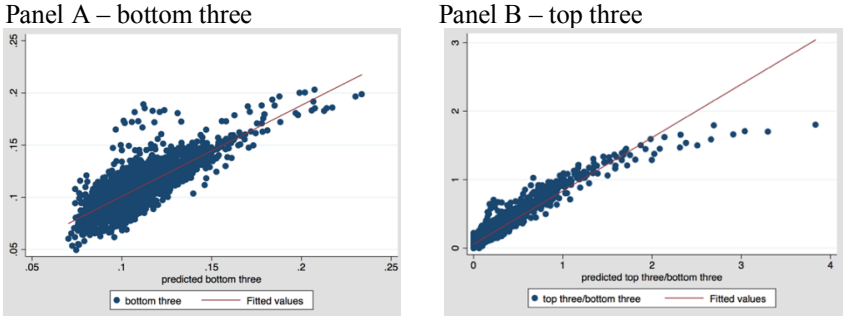
Panel C – $90^{th}/10^{th}$ percentile (total earnings) Panel D – $90^{th}/10^{th}$ percentile (net income)



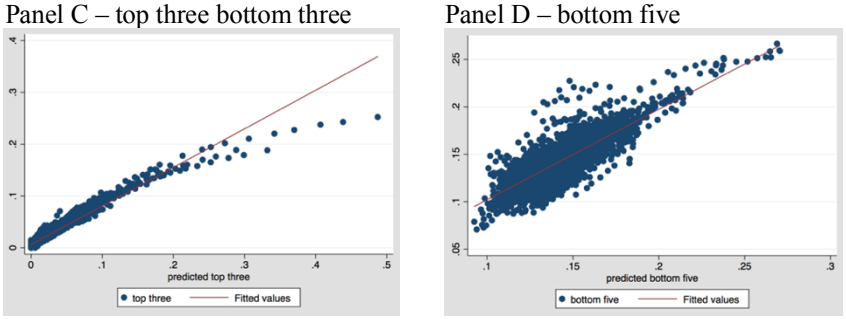
Note: The income inequality measures are the national means of the corresponding measures in 290 municipalities. The measures in Panel A and Panel C are based on total earnings between 2004 and 2016, and the measures in Panel B and Panel D are based on net income during the period 2005-2016.

Figure A.3. Relationship between actual and predicted income bracket ratios in Sweden

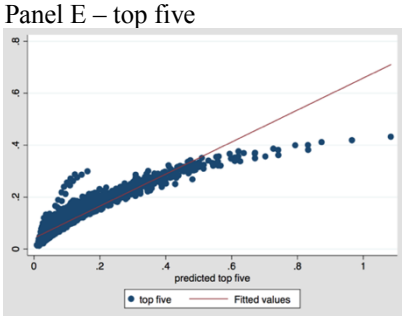
Panel A – bottom three Panel B – top three



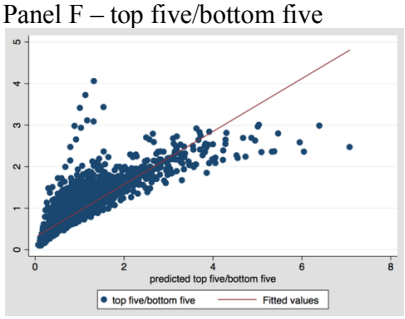
Panel C – top three bottom three Panel D – bottom five



Panel E – top five



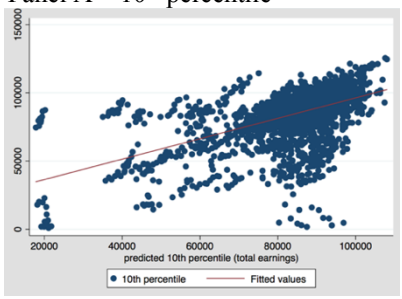
Panel F – top five/bottom five



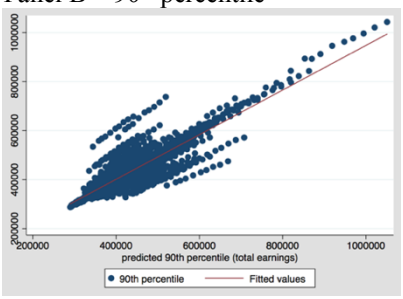
Note: The figure shows the relationships between the actual and the predicted top and bottom income brackets, and the relationship between the actual and predicted ratios between the share of people in top and bottom income brackets. Calculations are based on annual total earnings in 290 municipalities during the period 2005-2016.

Figure A.4. Relationship between actual and predicted percentile ratios in Sweden

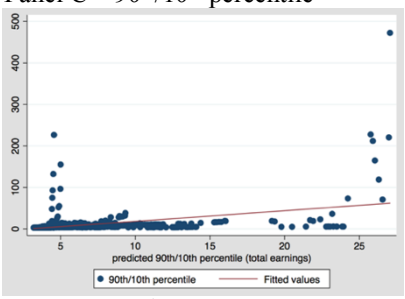
Panel A – 10th percentile



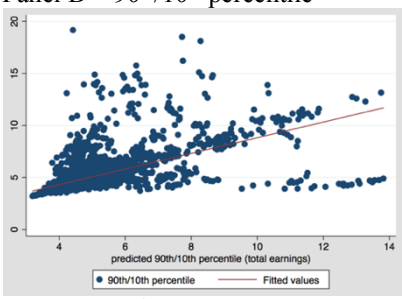
Panel B – 90th percentile



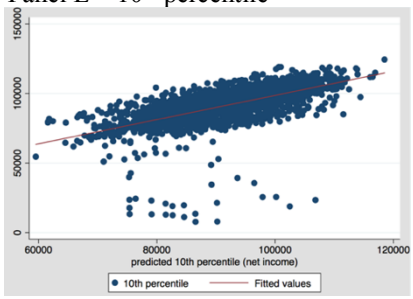
Panel C – 90th/10th percentile



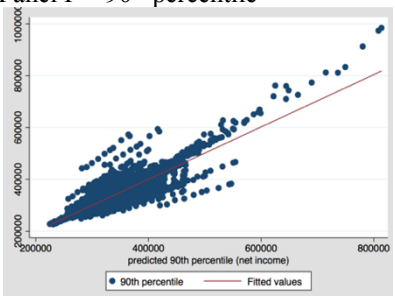
Panel D – 90th/10th percentile



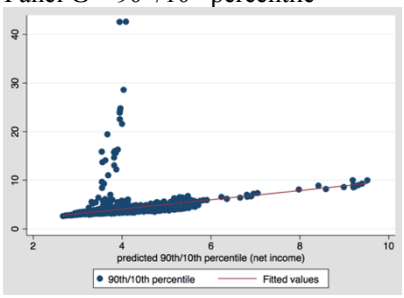
Panel E – 10th percentile



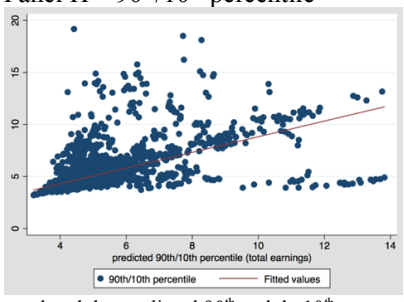
Panel F – 90th percentile



Panel G – $90^{th}/10^{th}$ percentile



Panel H – $90^{th}/10^{th}$ percentile



Note: The figure shows the relationships between the actual and the predicted 90^{th} and the10^{th} percentile, and the relationship between the actual and the predicted ratio between the 90^{th} and the 10^{th} percentile. Panel D and H show the same ratios as in Panel C and G, respectively, but, with the top one percent outliers removed. Calculations in Panel A – Panel D are based on annual total earnings in 290 municipalities during the period 2005-2016, and calculations in Panel E – H are based on annual net income in 290 municipalities during the period 2006-2016.

Table A.1. First stage results for the percentile ratio in Sweden

	(1)	(2)	(3)	(4)
Y =	90th/10th percentile (total earnings)	90th/10th percentile (total earnings)	90th/10th percentile (net income)	90th/10th percentile (net income)
	Panel A: Predicted ratio between the 90th and the 10th percentile (total earnings)			
Predicted 90th/10th percentile (total earnings)	0.751***	-0.308		
	(0.04)	(0.375)		
	Panel B: Predicted ratio between the 90th and the 10th percentile (net income)			
Predicted 90th/10th percentile (net income)			0.847***	0.07
			(0.016)	(0.269)
Year fixed effects	no	yes	no	yes
District fixed effects	no	yes	no	yes
Control variables	no	yes	no	yes
Sample size	3416	3416	3083	3083
F-statistic	319.38	0.67	2967.63	0.07

Note: Calculations are based on annual total earnings during the period 2005-2016 in Panel A, and on net income between 2006-2016 in Panel B. Control variables included are the share of foreign-born individuals, the share of males aged 15-24 years and the share of divorced individuals. Top one percent outliers removed. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A.2. Robustness checks for income bracket ratios in Sweden

	(1) 2SLS	(2) 2SLS	(3) 2SLS	(4) 2SLS		(5) 2SLS	(6) 2SLS	(7) 2SLS	(8) 2SLS
Panel A. Missing values coded as 1	Y= ln(Total crimes)	ln(Property crimes)	ln(Violent crimes)	ln(Frauds)		Y= ln(Total crimes)	ln(Property crimes)	ln(Violent crimes)	ln(Frauds)
Top three/ Bottom three	-0.054	0.187***	-0.712***	-0.021	Top five/ Bottom five	-0.079*	0.121*	-0.747***	0.044
	(0.049)	(0.066)	(0.094)	(0.154)		(0.047)	(0.063)	(0.095)	(0.150)
Panel B: Missing values coded as 2	Y= ln(Total crimes)	ln(Property crimes)	ln(Violent crimes)	ln(Frauds)		Y= ln(Total crimes)	ln(Property crimes)	ln(Violent crimes)	ln(Frauds)
Top three/ Bottom three	-0.047	0.193***	-0.695***	-0.009	Top five/ Bottom five	-0.077	0.122*	-0.740***	0.047
	(0.049)	(0.065)	(0.092)	(0.151)		(0.047)	(0.063)	(0.094)	(0.149)
Panel C: Missing values coded as 3	Y= ln(Total crimes)	ln(Property crimes)	ln(Violent crimes)	ln(Frauds)		Y= ln(Total crimes)	ln(Property crimes)	ln(Violent crimes)	ln(Frauds)
Top three/ Bottom three	-0.040	0.199***	-0.678***	0.003	Top five/ Bottom five	-0.075	0.123*	-0.733***	0.050
	(0.048)	(0.065)	(0.090)	(0.149)		(0.047)	(0.063)	(0.093)	(0.148)
Panel D: Education controls	Y= ln(Total crimes)	ln(Property crimes)	ln(Violent crimes)	ln(Frauds)		Y= ln(Total crimes)	ln(Property crimes)	ln(Violent crimes)	ln(Frauds)
Top three/ Bottom three	-0.022	0.237***	-0.755***	-0.044	Top five/ Bottom five	-0.051	0.169**	-0.806***	0.043
	(0.054)	(0.071)	(0.105)	(0.172)		(0.053)	(0.070)	(0.107)	(0.169)
Share with >10 years	1.816**	2.651***	-1.239	-0.506	Share with >10 years	1.722**	2.933***	-3.064**	0.124
	(0.736)	(0.898)	(1.365)	(2.200)		(0.780)	(0.959)	(1.531)	(2.341)
Panel E: Education controls	Y= ln(Total crimes)	ln(Property crimes)	ln(Violent crimes)	ln(Frauds)		Y= ln(Total crimes)	ln(Property crimes)	ln(Violent crimes)	ln(Frauds)
Top three/ Bottom three	-0.031	0.083	-0.440***	0.091	Top five/ Bottom five	-0.036	0.004	-0.359***	0.106
	(0.058)	(0.077)	(0.112)	(0.171)		(0.040)	(0.051)	(0.078)	(0.119)
Share with 10-13 years	0.313	-1.055*	3.097***	1.337	Share with 10-13 years	0.516	-1.316***	4.525***	0.755
	(0.434)	(0.547)	(0.824)	(1.512)		(0.377)	(0.476)	(0.721)	(1.351)
Panel F: Education controls	Y= ln(Total crimes)	ln(Property crimes)	ln(Violent crimes)	ln(Frauds)		Y= ln(Total crimes)	ln(Property crimes)	ln(Violent crimes)	ln(Frauds)
Top three/ Bottom three	-0.073	0.168**	-0.745***	-0.033	Top five/ Bottom five	-0.094*	0.104	-0.770***	0.038
	(0.051)	(0.068)	(0.097)	(0.161)		(0.048)	(0.065)	(0.097)	(0.154)
Share with 13-16 years	-1.685*	-1.693	-2.136	-0.003	Share with 13-16 years	-1.635*	-1.806	-1.969	-0.293
	(0.925)	(1.159)	(1.660)	(2.668)		(0.928)	(1.158)	(1.783)	(2.650)
Panel G: Unemployment controls	Y= ln(Total crimes)	ln(Property crimes)	ln(Violent crimes)	ln(Frauds)		Y= ln(Total crimes)	ln(Property crimes)	ln(Violent crimes)	ln(Frauds)
Top three/ Bottom three	-0.065	0.185***	-0.757***	0.006	Top five/ Bottom five	-0.097**	0.098	-0.734***	0.082
	(0.051)	(0.067)	(0.095)	(0.160)		(0.047)	(0.061)	(0.096)	(0.150)
Share of people unemployed	0.176	0.449*	-0.385	-0.104		0.018	0.489*	-1.252***	-0.012
	(0.201)	(0.253)	(0.375)	(0.609)		(0.218)	(0.273)	(0.442)	(0.659)
Panel H: Lagged dependent variable	Y= ln(Total crimes)	ln(Property crimes)	ln(Violent crimes)	ln(Frauds)		Y= ln(Total crimes)	ln(Property crimes)	ln(Violent crimes)	ln(Frauds)
Top three/ Bottom three	-0.061	0.123*	-0.592***	-0.095	Top five/ Bottom five	-0.068	0.083	-0.611***	-0.029
	(0.047)	(0.063)	(0.090)	(0.154)		(0.044)	(0.058)	(0.089)	(0.148)
Lagged dependent	0.329***	0.289***	0.209***	0.118***	Lagged dependent	0.328***	0.293***	0.215***	0.118***
	(0.019)	(0.020)	(0.024)	(0.025)		(0.019)	(0.021)	(0.025)	(0.025)
Panel I: Population weighted	Y= ln(Total crimes)	ln(Property crimes)	ln(Violent crimes)	ln(Frauds)		Y= ln(Total crimes)	ln(Property crimes)	ln(Violent crimes)	ln(Frauds)
Top three/ Bottom three	0.362***	0.808***	-0.258***	0.015	Top five/ Bottom five	0.320***	0.735***	-0.305***	0.107
	(0.076)	(0.148)	(0.070)	(0.173)		(0.093)	(0.194)	(0.081)	(0.176)
Panel J: Clustered standard errors	Y= ln(Total crimes)	ln(Property crimes)	ln(Violent crimes)	ln(Frauds)		Y= ln(Total crimes)	ln(Property crimes)	ln(Violent crimes)	ln(Frauds)
Top three/ Bottom three	-0.060	0.181*	-0.729***	-0.033	Top five/ Bottom five	-0.081	0.119	-0.754***	0.041
	(0.079)	(0.101)	(0.151)	(0.216)		(0.079)	(0.104)	(0.154)	(0.216)
Year fixed effects	yes	yes	yes	yes		yes	yes	yes	yes
Municipality fixed effects	yes	yes	yes	yes		yes	yes	yes	yes
Control variables	yes	yes	yes	yes		yes	yes	yes	yes
Sample size	3442	3442	3442	3441		3426	3426	3426	3425

Note: Calculations are based on total earnings during the period 2005-2016. Control variables included are the share of foreign-born individuals, the share of males aged 15-24 years and the share of divorced individuals. Top one percent outliers removed. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A.3. Robustness checks for income bracket ratios with disaggregated crime rates in Sweden

		(1) 2SLS	(2) 2SLS	(3) 2SLS	(4) 2SLS
Panel A: Top three/Bottom three	Y =	ln(Assault)	ln(Assault)	ln(Robbery)	ln(Robbery)
Top three/Bottom three		-0.084**	-0.695***	0.825***	-0.540**
		(0.040)	(0.098)	(0.079)	(0.214)
Share of foreign born individuals			1.591***		-0.188
			(0.542)		(1.259)
Share of males aged 15-24			1.855		6.801
			(2.101)		(4.478)
Share of divorced individuals			1.954		1.501
			(1.860)		(4.752)
Panel B: Top five/Bottom five	Y =	ln(Assault)	ln(Assault)	ln(Robbery)	ln(Robbery)
Top five/Bottom five		-0.003	-0.710***	0.337***	-0.603***
		(0.017)	(0.097)	(0.035)	(0.187)
Share of foreign born individuals			-1.347		-2.478
			(0.824)		(1.711)
Share of males aged 15-24			-0.279		4.240
			(2.204)		(4.565)
Share of divorced individuals			1.163		1.325
			(1.969)		(4.741)
Year fixed effects		no	yes	no	yes
Municipality fixed effects		no	yes	no	yes
Control variables		no	yes	no	yes
Sample size A		3442	3442	2927	2927
Sample size B		3426	3426	2914	2914

Note: Calculations are based on total earnings during the period 2005-2016. Control variables included are the share of foreign-born individuals, the share of males aged 15-24 years and the share of divorced individuals.
Top one percent outliers removed. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A.4. Second stage results for income bracket ratios in Sweden (full sample)

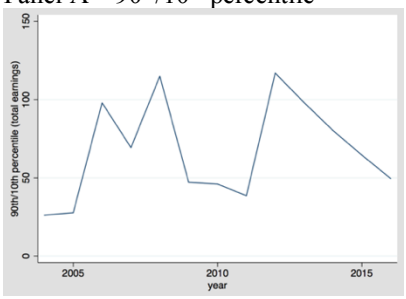
	(1) 2SLS	(2) 2SLS	(3) 2SLS	(4) 2SLS	(5) 2SLS	(6) 2SLS	(7) 2SLS	(8) 2SLS
Panel A: Top three/Bottom three Y =	Total crimes	Total crimes	Property crimes	Property crimes	Violent crimes	Violent crimes	Frauds	Frauds
Top three/Bottom three	1,006.799***	667.998	1,063.469***	1,159.164***	-90.558***	-348.128***	249.819***	134.912
	(234.929)	(496.865)	(145.607)	(387.060)	(19.355)	(49.882)	(24.043)	(92.826)
Share of foreign born individuals		3,839.579		-1,654.224		1,848.900***		1,204.010*
		(3,153.331)		(2,183.907)		(379.985)		(703.940)
Share of males aged 15-24		20,147.721**		14,856.572**		3,363.946***		3,935.957
		(9,859.084)		(5,975.303)		(1,268.800)		(2,409.586)
Share of divorced individuals		48,821.960***		31,692.497***		2,447.201**		1,732.393
		(10,206.283)		(6,723.414)		(1,236.318)		(1,727.815)
Panel B: Top five/Bottom five Y =	Total crimes	Total crimes	Property crimes	Property crimes	Violent crimes	Violent crimes	Frauds	Frauds
Top five/Bottom five	437.215***	338.756	293.446***	1,011.098**	-20.878**	-543.802***	152.221***	155.983
	(118.398)	(590.390)	(74.601)	(476.638)	(10.549)	(80.060)	(11.486)	(128.175)
Share of foreign born individuals		4,185.596		2,311.394		-1,251.348*		1,970.094
		(5,525.158)		(4,202.675)		(739.732)		(1,271.635)
Share of males aged 15-24		22,380.158**		19,998.095***		1,100.612		4,649.081*
		(9,763.910)		(6,361.064)		(1,361.292)		(2,427.456)
Share of divorced individuals		46,993.457***		32,916.608***		-415.152		2,272.782
		(11,363.942)		(7,789.460)		(1,555.568)		(2,055.271)
Panel C: Top three/Bottom three Y =	ln(Total crimes)	ln(Total crimes)	ln(Property crimes)	ln(Property crimes)	ln(Violent crimes)	ln(Violent crimes)	ln(Frauds)	ln(Frauds)
Top three/Bottom three	0.099***	0.058	0.200***	0.331***	-0.143***	-0.562***	0.626***	-0.020
	(0.022)	(0.051)	(0.025)	(0.067)	(0.030)	(0.085)	(0.037)	(0.129)
Share of foreign born individuals		0.612*		0.949**		1.852***		-0.378
		(0.323)		(0.411)		(0.535)		(0.867)
Share of males aged 15-24		1.632		2.748**		2.185		8.471***
		(1.126)		(1.334)		(2.030)		(3.076)
Share of divorced individuals		5.293***		6.208***		2.965		5.969**
		(1.116)		(1.406)		(1.836)		(2.816)
Panel D: Top five/Bottom five Y =	ln(Total crimes)	ln(Total crimes)	ln(Property crimes)	ln(Property crimes)	ln(Violent crimes)	ln(Violent crimes)	ln(Frauds)	ln(Frauds)
Top five/Bottom five	0.0417***	0.0215	0.0506***	0.3592***	-0.0353**	-0.8631***	0.3796***	-0.0096
	(0.0114)	(0.0617)	(0.0133)	(0.0950)	(0.0162)	(0.1290)	(0.0176)	(0.1752)
Share of foreign born individuals		0.5782		2.6432***		-3.0363***		-0.3844
		(0.5738)		(0.8401)		(1.1286)		(1.6097)
Share of males aged 15-24		1.8019		4.4262***		-1.4246		8.4053***
		(1.1137)		(1.4393)		(2.1932)		(3.0747)
Share of divorced individuals		5.0498***		7.2927***		-1.5037		6.0288*
		(1.2568)		(1.7707)		(2.3620)		(3.3036)
Year fixed effects	no	yes	no	yes	no	yes	no	yes
Municipality fixed effects	no	yes	no	yes	no	yes	no	yes
Control variables	no	yes	no	yes	no	yes	no	yes
Sample size A	3480	3480	3480	3480	3480	3480	3480	3480
Sample size B	3480	3480	3480	3480	3480	3480	3480	3480
Sample size C	3480	3480	3480	3480	3480	3480	3479	3479
Sample size D	3480	3480	3480	3480	3480	3480	3479	3479

Note: Calculations are based on total earnings during the period 2005-2016. Control variables included are the share of foreign-born individuals, the share of males aged 15-24 years and the share of divorced individuals. Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

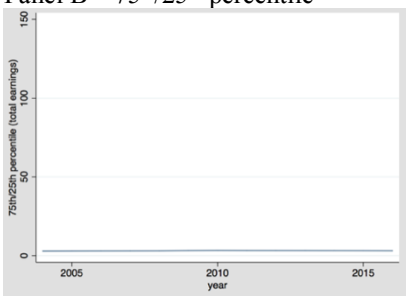
Appendix B. Results from the Stockholm Specification

Figure B.1. Income inequality measures in Stockholm

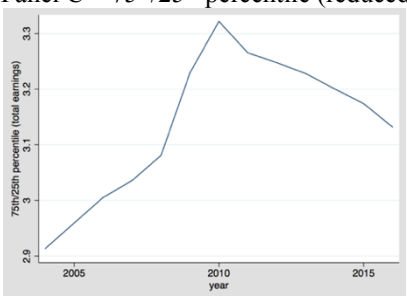
Panel A – 90th/10th percentile



Panel B – 75th/25th percentile



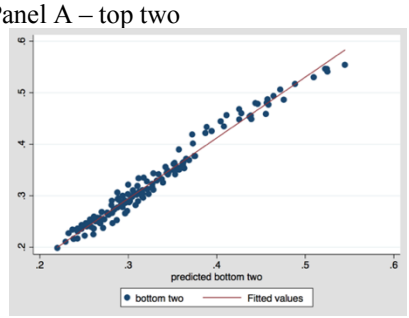
Panel C – 75th/25th percentile (reduced scale)



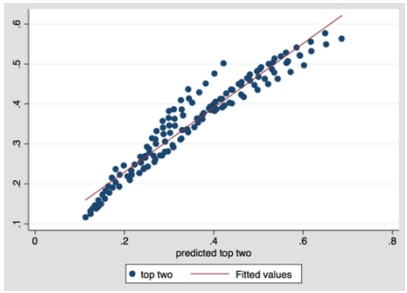
Note: The ratios are the city-level means of the ratios of 14 districts of Stockholm during the period 2004-2016. The calculations are based on annual total earnings.

Figure B.2. Relationship between actual and predicted income bracket ratios in Stockholm

Panel A – top two



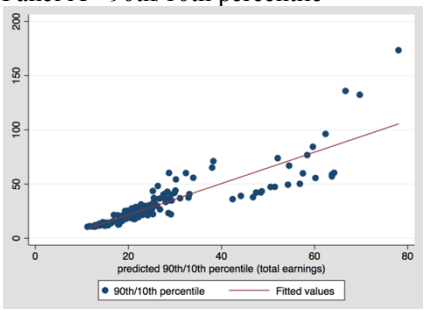
Panel B – bottom two



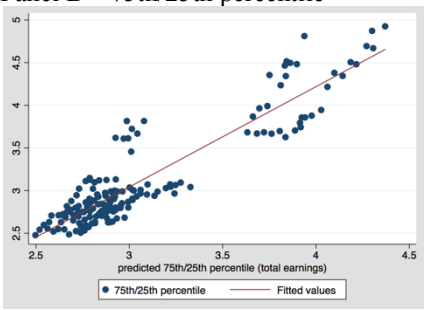
Note: The figure shows the relationship between the actual and the predicted top and bottom income brackets. Calculations are based on annual total earnings in 14 districts of Stockholm during the period 2006-2016.

Figure B.3. Relationship between actual and predicted percentile ratios in Stockholm

Panel A - 90th/10th percentile



Panel B – 75th/25th percentile



Note: The figure shows the relationships between the actual and the predicted percentiles ratios. Panel A shows the relationship between the actual and the predicted ratio between the 90th and the 10th percentile. Panel B shows the relationship between the actual and the predicted ratio between the 75th and the 25th percentile. Calculations are based on annual total earnings in 14 districts during the period 2005-2016. Top one percent outliers are removed.

Table B.1. First stage results for percentile ratios in Stockholm

	(1)	(2)	(3)	(4)
Y =	90th/10th percentile	90th/10th percentile	75th/25th percentile	75th/25th percentile
	Panel A: Predicted ratio between the 90th and the 10th percentile			
Predicted 90th/10th percentile	1.416***	3.661***		
	(0.169)	(1.042)		
	Panel B: Predicted ratio between the 75th and the 25th percentile			
Predicted 75th/25th percentile			1.176***	1.622**
			(0.043)	(0.954)
Year fixed effects	no	yes	no	yes
District fixed effects	no	yes	no	yes
Control variables	no	yes	no	yes
Sample size	143	143	165	165
F-statistic	77.82	12.35	759.48	2.89

Note: Calculations are based on total earnings during the period 2005-2016. Control variables included are the share of foreign-born individuals and the share of males aged 15-24 years. Top one percent outliers removed. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table B.2. Reduced form results for the income bracket ratio in Stockholm

		(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) OLS	(6) OLS	(7) OLS	(8) OLS
Panel A: Top two/Bottom two	Y =	Total crimes	Total crimes	Property crimes	Property crimes	Violent crimes	Violent crimes	Frauds	Frauds
Predicted Top two/Bottom two		5,355.456***	2,381.560**	4,388.658***	4,038.003***	120.983	-589.743***	413.152***	-81.437
		(1,776.133)	(1,030.660)	(1,192.916)	(903.527)	(141.855)	(140.021)	(125.811)	(234.080)
Panel B: Top two/Bottom two	Y =	ln(Total crimes)	ln(Total crimes)	ln(Property crimes)	ln(Property crimes)	ln(Violent crimes)	ln(Violent crimes)	ln(Frauds)	ln(Frauds)
Predicted Top two/Bottom two		0.138**	0.081*	0.213***	0.217***	-0.061	-0.262***	0.241***	-0.205*
		(0.061)	(0.045)	(0.065)	(0.066)	(0.079)	(0.049)	(0.080)	(0.122)
Year fixed effects		no	yes	no	yes	no	yes	no	yes
Municipality fixed effects		no	yes	no	yes	no	yes	no	yes
Control variables		no	yes	no	yes	no	yes	no	yes
Sample size		138	138	138	138	138	138	138	138

Note: Calculations are based on annual total earnings during the period 2007-2016. Control variables included are the share of foreign-born individuals and the share of males aged 15-24 years. Top one percent outliers removed. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table B.3. Reduced form results for the percentile ratio in Stockholm

		(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) OLS	(6) OLS	(7) OLS	(8) OLS
Panel A: 90th/10th percentile	Y =	Total crimes	Total crimes	Property crimes	Property crimes	Violent crimes	Violent crimes	Frauds	Frauds
Predicted		-24.345	85.169	-23.014	85.896*	4.428*	-11.949	-1.482	-5.776
90th/10th percentile		(25.060)	(56.269)	(17.718)	(50.572)	(2.532)	(7.480)	(2.137)	(11.317)
Panel B: 90th/10th percentile	Y =	ln(Total crimes)	ln(Total crimes)	ln(Property crimes)	ln(Property crimes)	ln(Violent crimes)	ln(Violent crimes)	ln(Frauds)	ln(Frauds)
Predicted		0.000	0.004	-0.000	0.007	0.005***	-0.009**	0.001	-0.003
90th/10th percentile		(0.001)	(0.003)	(0.001)	(0.004)	(0.001)	(0.004)	(0.002)	(0.009)
Year fixed effects		no	yes	no	yes	no	yes	no	yes
Municipality fixed effects		no	yes	no	yes	no	yes	no	yes
Control variables		no	yes	no	yes	no	yes	no	yes
Sample size		143	143	143	143	143	143	143	143

Note: Calculations are based on annual total earnings during the period 2005-2016. Control variables included are the share of foreign-born individuals and the share of males aged 15-24 years. Top one percent outliers removed. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table B.4. Second stage results for the percentile ratio in Stockholm

		(1) 2SLS	(2) 2SLS	(3) 2SLS	(4) 2SLS	(5) 2SLS	(6) 2SLS	(7) 2SLS	(8) 2SLS
Panel A: 90th/10th percentile	Y =	Total crimes	Total crimes	Property crimes	Property crimes	Violent crimes	Violent crimes	Frauds	Frauds
90th/10th percentile		-14.066	18.115*	-13.974	18.552*	3.179**	-1.875	-0.962	-2.726
		(15.606)	(10.283)	(10.758)	(9.477)	(1.441)	(1.739)	(1.302)	(2.602)
Share of foreign born individuals			1,143.306		-31,243.885***		8,250.079***		1,722.543
			(11,517.350)		(10,647.419)		(1,851.627)		(2,361.489)
Share of males aged 15-24			20,881.377		44,683.038		-9,136.443*		2,100.635
			(37,767.026)		(32,605.443)		(4,854.973)		(7,086.811)
Panel B: 90th/10th percentile	Y =	ln(Total crimes)	ln(Total crimes)	ln(Property crimes)	ln(Property crimes)	ln(Violent crimes)	ln(Violent crimes)	ln(Frauds)	ln(Frauds)
90th/10th percentile		0.000	0.001	0.000	0.001*	0.004***	-0.002	0.001	-0.002
		(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Share of foreign born individuals			0.361		-1.590*		4.392***		3.984*
			(0.568)		(0.877)		(0.917)		(2.094)
Share of males aged 15-24			0.294		-0.203		2.122		-5.787
			(1.960)		(2.677)		(2.072)		(5.778)
Year fixed effects		no	yes	no	yes	no	yes	no	yes
Municipality fixed effects		no	yes	no	yes	no	yes	no	yes
Sample size		144	144	144	144	144	144	144	144

Note: Calculations are based on total earnings during the period 2005-2016. Control variables included are the share of foreign-born individuals and the share of males aged 15-24 years. Top one percent outliers removed. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table B.5. Second stage results for the income bracket ratio in Stockholm (full sample)

	(1) 2SLS	(2) 2SLS	(3) 2SLS	(4) 2SLS	(5) 2SLS	(6) 2SLS	(7) 2SLS	(8) 2SLS
Panel A: Top two/Bottom two Y =	Total crimes	Total crimes	Property crimes	Property crimes	Violent crimes	Violent crimes	Frauds	Frauds
Top two/Bottom two	5,152.632***	3,945.528***	4,304.764***	6,761.078***	86.422	-979.444***	404.322***	-324.659
	(1,831.680)	(1,482.087)	(1,246.935)	(1,411.893)	(140.691)	(248.462)	(129.169)	(375.655)
Share of foreign born individuals		49,326.532**		56,633.209***		-4,447.038*		228.652
		(20,020.153)		(18,433.000)		(2,615.306)		(4,328.440)
Share of males aged 15-24		56,266.272*		62,420.875**		-7,763.452		-504.381
		(29,718.837)		(28,063.448)		(4,801.339)		(7,020.134)
Panel B: Top two/Bottom two Y =	ln(Total crimes)	ln(Total crimes)	ln(Property crimes)	ln(Property crimes)	ln(Violent crimes)	ln(Violent crimes)	ln(Frauds)	ln(Frauds)
Top two/Bottom two	0.135**	0.141**	0.213***	0.392***	-0.080	-0.489***	0.244***	-0.468**
	(0.061)	(0.068)	(0.066)	(0.096)	(0.075)	(0.085)	(0.080)	(0.218)
Share of foreign born individuals		2.348**		4.286***		-1.205		-0.011
		(1.025)		(1.479)		(1.316)		(3.135)
Share of males aged 15-24		2.193		1.658		1.061		-2.420
		(1.494)		(2.101)		(1.815)		(4.260)
Year fixed effects	no	yes	no	yes	no	yes	no	yes
Municipality fixed effects	no	yes	no	yes	no	yes	no	yes
Sample size	140	140	140	140	140	140	140	140

Note: Calculations are based on total earnings during the period 2007-2016. Control variables included are the share of foreign-born individuals and the share of males aged 15-24 years. Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1