THE EFFECT OF EDUCATION POLICY ON CRIME:
AN INTERGENERATIONAL PERSPECTIVE

Costas Meghir
Mårten Palme
Marieke Schnabel

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ABSTRACT

We study the intergenerational effect of education policy on crime. We use Swedish administrative data that links outcomes across generations with crime records and we show that the comprehensive school reform, gradually implemented between 1949 and 1962, reduced conviction rates both for the generation directly affected by the reform and for their sons. The reduction in conviction rates occurred across many types of crime. Key mediators for this reduction in the child generation are an increase in education and a decline in crime amongst their fathers.

Costas Meghir
Department of Economics
Yale University
37 Hillhouse Avenue
New Haven, CT 06511
and IZA
and also NBER
c.meghir@yale.edu

Mårten Palme
Department of Economics
Stockholm University
SE-106 91 Stockholm
SWEDEN
and CESifo, IFS and IZA
Marten.Palme@ne.su.se

Marieke Schnabel
Department of Economics
University College London, Gower Street
London WC1E 6BT, UK
Marieke.Schnabel@ucl.ac.uk

1   Introduction

Policies that increase education can have long lasting impacts on a number of important life outcomes, including earnings and employment. Several studies show that they can also reduce crime (Lochner and Moretti, 2004; Machin, Marie, and Vujić, 2011), consistent with theoretical predictions by Becker (1981), Freeman (1999) and Lochner (2004) amongst others.[1] An outstanding question, however, is the extent to which such policies have intergenerational effects, improving standards of living and other outcomes, including crime, which is the focus of this paper.

Sweden, like many other industrialized countries in the post-war period, introduced a comprehensive school reform that was gradually implemented across its municipalities starting in the late 40s until its complete roll-out in the early 60s. The reform increased compulsory schooling and introduced several other changes, including a uniform curriculum and abolishing selection into academic and vocational tracks at age 12. Meghir and Palme (2005) show that the reform increased schooling and earnings while Hjalmarsson, Holmlund, and Lindquist (2015) show that the reform caused a reduction in convictions, which is our measure of crime. Putting these results together with further evidence we present here, it is clear that the reform led to substantial improvements in the exposed generation.

Our focus in this paper is the effect of the reform on participation in crime amongst the children of those originally exposed. There are several reasons one may expect such an intergenerational impact. The hypothesis builds on Becker and Tomes (1979) who developed the theory of intergenerational transmission of human capital, and on Cunha and Heckman (2007) and Cunha, Heckman, and Schennach (2010) who characterize theoretically and empirically the process of skill formation, which depends on parental skills and investments in their children. Consistent with these ideas, we would expect the improved human capital of

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[1]Examples include Grogger (1998), Gould, Weinberg, and Mustard (2002) Machin and Meghir (2004), Edmark (2006), Williams and Sickles (2002), Freeman (1996), Gallipoli and Fella (2008) and from the criminology and sociology literature Sabates and Feinstein (2008a) and Sabates and Feinstein (2008b).

those directly treated by the reform to lead to improved investments in children (Caucutt and Lochner, 2012; Cunha, 2007) as well as increased productivity of these investments because of a complementarity with parental human capital in the production function for child skills (see Cunha, Heckman, and Schennach, 2010).

Evidence that increased investments, better childhood environments and early education can improve a broad set of outcomes including health and crime can be found both from randomized intervention studies, such as the Perry pre-school experiment and the Abcederian, (Heckman, Moon, Pinto *et al.* (2010), Campbell, Conti, Heckman *et al.* (2014), Schweinhart, Montie, Xiang *et al.* (2005), Gertler, Heckman, Pinto *et al.* (2014)) as well as from observational ones (Cunha and Heckman (2008); Cunha, Heckman, and Schennach (2010), Attanasio, Meghir, and Nix (2020); Currie and Moretti (2003), amongst others). In turn, improved child human capital increases the opportunity cost of crime and may reduce crime participation, as we argue based on a simple model in the Appendix and shown empirically by e.g. Machin and Meghir (2004).

The sociology literature has also emphasized role models as a potential transmission channel (Coleman, 1988; Merton, 1938) and in economics through within-family social interaction (see Dahl, Kostøl, and Mogstad (2014) on dependence on Disability Insurance). The strong intergenerational correlation in criminality (Hjalmarsson and Lindquist, 2012, 2013) and the decline in parental crime caused by the reform (see Hjalmarsson, Holmlund, and Lindquist, 2015, and here) are suggestive of such a channel.

For our empirical analysis we link administrative data on all convictions and prison sentences in Sweden between 1973 to 2010 with educational and demographic information on two generations. Our empirical approach uses difference-in-differences, comparing changes in the crime rate and other outcome variables across cohorts in municipalities that implemented the reforms at different times. Exposure to the reform is based on the municipality of birth of the fathers. We carry out detailed robustness analysis, testing for parallel trends and using placebo contrasts to validate the analysis.

The results show a significant decline of 0.8 percentage points in crime participation by the sons of men exposed to the reform. This corresponds to a 3 percent fall in crime. The decline is across most types of crime, including violence, fraud and a broad category of miscellaneous offences ("other"). There is no effect on participation in crime for daughters, but their crime rates are much lower in the first place with less scope for improvements.[2]

The impact on crime in the child generation is just one facet of the intergenerational effects that we can attribute to the reform. To bring evidence to bear on the mechanisms underlying this decrease we first show that the reform improved key human capital outcomes amongst men in the parental generation, including increases in schooling, earnings, cognitive and social skills, and better marriage market outcomes (measured by the earnings of the spouse).[3] The effects on women are much more limited, most likely because the proportion of women at the compulsory schooling threshold for the 1945-55 cohort that we consider was much lower. Consequently the reform did not have as much of an effect on them, although schooling went up a bit.

We then show that outcomes improved for the children of these fathers, including a significant increase in school GPA, better health, and a rise in employment for sons, and a reduction in welfare dependency for daughters. These results are all consistent with improvements in the parent generation driving growth in the human capital of their children, which in turn led to a reduction in their participation in crime.

We do not observe parental investments in children, which would allow us to measure this link directly. Thus, to strengthen the argument linking improvements in parental human capital to crime outcomes in the next generation, we implemented a mediation analysis, similar to Heckman and Pinto (2015). This shows that the most important transmission mechanism is through the increase in fathers' education, followed by a decline in their fathers' participation in crime. The remaining direct effect of the reform on the sons, reflecting other unaccounted channels, accounts for only 12 percent of the total effect.

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[2]The crime rate for women is less than a quarter that of men.

[3]See also Lager, Seblova, Falkstedt *et al.* (2017).

The paper is organized as follows. We first provide a brief description of the reform followed by a section on our administrative data, documenting the crime rates and presenting descriptive evidence on intergenerational associations in crime. After that we present our empirical strategy, and show the main results. We then present evidence supporting the mechanisms we hypothesized and implement a mediation analysis. We close by a discussion of the results and the mechanisms underlying them, followed by a concluding summary. The Appendix includes a simple model, the robustness analysis and supplementary results.

2   The Comprehensive School Reform

Prior to the implementation of the comprehensive school reform, pupils attended a common basic compulsory school (*folkskolan*) until grade six. After the sixth grade pupils were selected to continue one or (mainly in urban areas) two years in the basic compulsory school, or to attend the three year junior secondary school (*realskolan*). Selection of pupils into the two different school tracks was based on their past grades. The pre-reform compulsory school was in most cases administered at the municipality level. The junior secondary school was a prerequisite for the subsequent upper secondary school, which, in turn, was required for higher education.

In 1948 a parliamentary school committee proposed a reform that increased compulsory schooling to nine years, abolished tracking and instituted a new comprehensive school teaching a national curriculum. As a result, compulsory schooling increased by one to two years, depending on the area. The new system only affected schooling following the 6th grade and not before.[4]

The proposed new school system was introduced gradually to the 1,055 Swedish municipalities and parts of city communities from 1949 to 1962 and was implemented either for the cohort of pupils who were in fifth grade at the time or for those who were currently in

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[4]For further details see Meghir and Palme (2003), Meghir and Palme (2005), Holmlund (2007), Marklund (1980) and Marklund (1981) Similar reforms have been adopted in many other countries making the study of their effects of broad interest. England introduced very similar reforms in the mid 60s and in 1973.

Table 1: Timing of implementation and municipality characteristics

Dependent variable: first cohort implemented		
	(1)	(2)
	all municipalities	excluding Stockholm
Municipality Population in 1960	0.036	0.083
	(0.039)	(0.074)
Municipality Income level in 1960	-0.072***	-0.074***
	(0.012)	(0.012)
Municipal Tax rate in 1960	-0.654***	-0.662***
	(0.066)	(0.067)
Observations	984	983

Notes: Significance levels *** p<0.01, The dependent variable is the cohort for which the reform was first implemented in the municipality.

the first grade, effectively delaying the start of the program.[5] In our analysis we include people born between 1945 and 1955 and their children. Appendix Figure 1 shows the number of observations in our sample in each year birth cohort and the proportion of the parent generation assigned to the reform. The roll-out was not random and was decided by the government in consultation with the local authority. Based on a regression of the cohort of implementation for each municipality we find that early implementers were higher income and had a higher local tax rate. The municipality population size had no effect (Table 1).[6]

3 Data

Our data is drawn from Sweden's population census. Using the multi generation register from Statistics Sweden (2003) we link two generations: the *parent generation* consisting of all those individuals born in Sweden between 1945 and 1955 and who as a result attended school during the gradual implementation of the new education system; and their children referred to as the *children generation*. Information on educational achievement is obtained by linking this data to the education register.

To obtain convictions, which is our measure of crime, we link the data above to the records

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[5]The purpose of gradual implementation was evaluation of the reforms from an administrative perspective (Marklund, 1981; National School Board, 1959).

[6]We do not have crime rates by municipality early enough to check whether implementation was correlated with the crime rate.

from the Swedish National Council for Crime Prevention. This provides all convictions at individual level as well as the type of crime and the date it was committed.[7] The crime records start in 1973 and the gradual transition to the new system covers the cohorts born between 1945-1955. However, when estimating effects of the reform on crime for the parent generation we use data for the 1952-55 cohort who were 18-21 years old in 1973 when records begin. They are followed up until 2010 when they are 55-58.

For the child generation we observe the conviction history from age 15, when legal criminal responsibility begins and convictions start being recorded. We follow them until the age of 29, estimating the effects on the most important part of the criminal life cycle. Their fathers may have been born any time in the 1945-55 period of gradual reform implementation since we only need information on the type of school system attended by the parent (and not their crime history).[8]

Table 2 shows the conviction rates overall and by type of crime, conditional on conviction. We categorize crimes into seven types: violent crimes, property crimes, fraud and tax evasion, traffic crimes, drug and trafficking violations, sex crimes and others, which do not fit the above definitions.[9] Since individuals can have multiple convictions these columns add up to more than 100.

Over the observation period, 34 percent of men in the parent generation have been convicted at some point. Of those, 21 percent have a conviction for a property crime, 18 percent for fraud (including tax evasion) and 33 percent for "other" crimes (defined in the appendix and below). One in five convictions led to a prison sentence. Finally, 58 percent of convictions relate to serious traffic offenses leading to a court appearance, including drunk driving, causing a serious accident *et cetera*. Minor offenses leading to a direct fine without a court appearance are *not* included.

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[7]There are five types of punishments in the Swedish judicial system: fines, prisons, parole, probation and special medical treatment. The fines that are decided in courts and included in our data are related to the convicted person's income and in most cases paid during a period of time.

[8]For this sample of sons we are able to match education information of paternal grandfathers, used in the X-vector of controls in the regressions, from the education census for 61.5 percent of cases.

[9]Table 8 in the Appendix provides a detailed description of each category.

The children generation, shown in the lower two panels have a lower, but still substantial, conviction rate of 24 percent (by the age of 29). The distribution changed somewhat with an increased relative importance of property crime. The child generation has half the incarceration rate (conditional on a conviction) over the age range we observe them. Finally, women in both generations have about a third of the conviction rate than men with some small changes in the distribution by types of crime.

As we show in Appendix Figure 2 crime declines drastically with age, with the most relevant window being from the teenage years to about 30. Moreover, crime has declined quite substantially across cohorts in the child generation.[10]

Table 2: Conviction rates for men in the parent generation and sons in the child generation by type of crime

| | Total | Percent convicted by crime type conditional on being convicted | | | | | | |
		Violent	Property	Fraud	Traffic	Drugs	Other	Prison
		Men in Parent Generation: at least one conviction						
All	33.94	14.97	21.02	18.16	57.96	17.04	33.23	19.65
		Women in Parent Generation: at least one conviction						
All	9.08	5.71	26.94	17.81	45.34	13.71	15.77	5.77
		Sons in Child Generation: at least one conviction						
All (15-29)	23.69	19.23	33.07	12.28	46.03	13.63	31.18	10.26
		Daughters in Child Generation: at least one conviction						
All (15-29)	7.92	8.64	53.17	18.49	17.60	18.49	18.49	1.40

Notes: Table shows proportion ever convicted over the observed age range. Convictions by type are proportions of that type conditional on having been convicted at least once. For the parent generation "All" includes the whole sample of men born 1945-55 (N=447,382). For the child generation: "All (15-29)" includes the whole sample of sons born on or before 1993 (N=426,721). **"Other"** crimes includes defamation, family law, vandalism, hazardous general crimes, crimes against public order, violation of general business, Crimes against national security, misconduct, Environmental law, Alcohol law, Weapon and knife law, Immigration law, Copyright law, Working environment law, visiting rights law - harassment of ex-spouse etc., privacy and data protection. See Appendix for all crime definitions.

We assign people in the 1945-55 cohort to the reform depending on whether their birth municipality implemented the new system for their cohort, avoiding the potential bias induced by parents moving municipalities as a result of the reform.[11]. We then assign people

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[10]Additional support of such high conviction rates in Sweden is provided by Hjalmarsson and Lindquist (2012, 2013), Grönqvist (2011) and von Hofer (2014).

[11]We thank Helena Holmlund who provided the matching algorithm - see Holmlund (2007). Based on survey data where we observe both the municipality of birth and of schooling, the discrepancy is only 9.9%. 5.3 percent moved to a non-reform municipality and 4.6 percent moved in the other direction. This leads to a potential attenuation factor of 0.901.

in the child generation to the reform depending on whether their father was assigned.

Table 3: Education, Crime and Intergenerational Persistence

	Panel A: Association between Crime and Education							
	Parent Generation				Child Generation			
	Men, $N = 725,723$		Women, $N = 698,029$		Sons. $N = 460,770$		Daughters. $N = 436,004$	
	Convicted	Prison	Convicted	Prison	Convicted	Prison	Convicted	Prison
Own education	-2.181	-0.976	-0.554	-0.092	-	-	-	-
	(0.018)	(0.009)	(0.012)	(0.003)				
Fathers' education	-	-	-	-	-0.944	-0.186	-0.209	-0.012
					(0.024)	(0.008)	(0.015)	(0.002)
Mothers' education	-	-	-	-	-0.837	-0.205	-0.282	-0.012
					(0.026)	(0.010)	(0.017)	(0.002)
$\overline{y}$	33.1%	7.2%	9.7%	0.6%	27.1%	3.4%	8.7%	0.2%

	Panel B: Intergenerational Persistence in Crime			
	Sons. $N = 488,194$		Daughters. $N = 461,461$	
	Conviction	Prison	Conviction	Prison
Father conviction/prison	0.133	0.116	0.046	0.024
	(0.002)	(0.007)	(0.001)	(0.003)
Mother conviction/prison	0.126	0.070	0.075	0.006
	(0.001)	(0.002)	(0.002)	(0.001)
$\overline{y}$	27.1%	3.4%	8.7%	0.2%

Notes: Significance levels *** p<0.01, ** p<0.05,* p<0.1. Effects scaled by 100. Dependent variables for men born 45-55: indicator variables for having ever been convicted or having received a prison sentence between 1973-2010. Dependent variables for sons/daughters: indicator variables for having ever been convicted or having received a prison sentence between the ages 15-29. Robust standard errors in parentheses clustered by own birth municipality or by father's birth municipality. Includes own birth cohort and birth municipality indicator variables, or father's cohort and father's birth municipality indicator variables.

We complete our description by showing the association between schooling and crime as well as the intergenerational association of crime rates in Table 3. All regressions include dummies for the municipality of birth of the father and cohort effects. One year of own schooling for men in the parent generation is associated with a decrease of the probability of a conviction of 2.2 percentage points (pp). In the child generation one extra year of education for the father is associated with 0.9pp reduction in crime for sons and 0.21pp for daughters. A similar association is true with respect to mother's education. The strong association with education is also true for prison sentences.

There is also a very strong intergenerational correlation in crime as illustrated in the lower panel of the same table, although less so for daughters.[12]

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[12]See Haider and Solon (2006) on the importance of aligning ages when carrying out intergenerational regressions. In our cases aligning ages only mattered when looking at prison sentences, where the alignment increased the coefficient from 6.2 to 9.1.

4 Intergenerational Transmission of the Reform

The reform may affect participation in crime through the transmission of human capital across generations as in Becker and Tomes (1979) as well as through a role model or norm defining channel.

The Human Capital Channel

Exposure to the reform improved human capital and earnings in the parental generation, as we discuss below. The resulting increase in parental wealth will imply a rise in the demand for child utility by altruistic parents, leading to increased cash transfers and investments in their children's development. This is particularly so if parental human capital is complementary to investments in the production function of child human capital, which also provides a direct route for transmission of intergenerational skills. This channel, should manifest itself through an improvement in overall human capital of the child, which is what we document in Section 6.3.

Improved skills can increase the opportunity cost of crime as the return to lawful work becomes relatively more attractive, leading to a decline in crime participation as shown empirically by Machin and Meghir (2004). This will be particularly so if the expected marginal utility of income from crime is lower than the marginal utility of income when in work. In the online Appendix Section A.1 we provide a simple model illustrating the intergenerational channel through human capital.

The Father as a Role Model

A second channel through which impacts on crime participation can be transmitted to the child generation is through the change in the behavior of the father himself. There is no direct evidence on this because it is hard to disentangle it from the human capital channel. However, there are theories on peer transmission of crime (see for example Glaeser, Sacerdote,

and Scheinkman, 1996) and recent empirical evidence by Dustmann and Landersø (2021) who show that reducing the criminal behavior of a focal person in a community lowers crime participation; the father is likely to be such a focal person for their child. Finally, broader evidence of direct transmission of behavior across generations is provided by Dahl, Kostøl, and Mogstad (2014), where welfare participation in the parent generation increases the chance of welfare receipt in the child generation, given income.

Similar arguments are made in early work in sociology by Merton (1949) on the importance of role models for career development and human behavior in general and by Coleman (1988), who discusses the relation between the formation of social and human capital.

5   Empirical Strategy

Our main outcome variables is the overall conviction rate, which we also breakdown by type of crime. For the parent generation individuals are aged 18-65 and for the child generation 15-29. Since we do not observe offending but only convictions, a key assumption for the interpretation of our results is that the reform did not affect the relationship between the two.

The reform was not randomized, so we control for potential differences across treatment and comparison groups using difference in differences. We compare the change in convictions across cohorts in municipalities that implemented the reform for the younger cohort but not the older one to the change in convictions across the same cohorts living in municipalities where they were unaffected by the change in policy.

There are over 1,000 municipalities and 11 cohorts making a probit or a logit with fixed effects impractical. We thus estimate the impacts using OLS on the linear probability model (LPM).[13] For all results we present below we use the regression

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[13]To check whether using an LPM biases the results we ran a Monte Carlo experiment replicating the crime rates across municipalities and imposing an average effect of the reform equal to what we obtain. Assuming the data was generated by a normal probability model (probit) and then using an LPM only biased the results upwards by 5 percent with respect to the true average effect - a difference that is statistically

$$y_{i,m,t} = \alpha + \beta_1 R_{i,m,t} + \gamma_1' t_i + \gamma_2' m_i + \gamma_3' X_{it} + \epsilon_{i,m,t}, \tag{1}$$

where i denotes individual, m municipality and t cohort; $y_{i,m,t}$ is one if a conviction is observed and zero otherwise; $R_{i,m,t}$ is the reform indicator, which equals one if the individual belongs to a municipality and cohort that has been assigned to the new school system; t_i and m_i are indicators denoting the cohort and the birth municipality of the individual; X_{it} is grandfather's education, which we include to improve precision, since there is such a strong intergenerational association between education and crime. Finally, $\epsilon_{i,m,t}$ is assumed conditionally independent of $R_{i,m,t}$.[14] All standard errors are clustered at the level of the municipality of the parent generation. Following the discussion of our main results we present a set of robustness checks, with details in the appendix.

5.1 Definition of Treatment

For the parent generation being treated is defined as having been born in a municipality where the birth cohort of the individual concerned attended the reformed school system. Hence the impacts are interpreted as intention to treat, because some people may have moved to a different municipality at the time of their secondary schooling, although mobility was limited.[15]

For the child generation the definition of treatment is potentially more complex because either parent could have been treated. Moreover, whether both or only one parent is treated (or indeed none) is endogenous because marital sorting can be affected by the reform (as indeed is the case). Since, the reform affected mainly men, we assign treatment status to the children based on their father only. We explore assignment based on the mother in the appendix.

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indistinguishable in our data.

[14]The general assumptions underlying the method of Difference in Differences are discussed in Heckman and Robb (1985), Heckman, Ichimura, Smith *et al.* (1999) and Athey and Imbens (2006).

[15]see Meghir and Palme (2005).

6 Results

6.1 The Reform and Crime in the Child Generation

In Table 4 we show the impact of the reform on convictions overall and by type of crime.[16] The reduction in conviction rates is about 0.79 percentage points (p-value<0.002), which represents a reduction of 3.4 percent.[17] In terms of percentage reduction this is a similar magnitude as the decline in crime attributed to the reform for the fathers. There was also a large reduction of 0.43pp (p-value 0.03) in the incidence of multiple convictions, representing a reduction of 5.8 percent.

Table 4: Impact of the Reform on crime in the child generation

	Convictions		Breakdown by type of crime					
	Any[+]	Multiple[++]	Violent	Property	Drugs	Traffic	Fraud	Other
Men, Obs. 410,476								
Reform	-0.791[†††]	-0.428[††]	-0.265*	-0.026	0.102	-0.446*	-0.223*	-0.408**
	(0.253)	(0.196)	(0.117) [0.09]	(0.154) [>0.5]	(0.109) [>0.5]	(0.173) [0.057]	(0.096) [0.090]	(0.152) [0.047]
Mean of dep var %	23.54	7.34	4.49	7.74	3.18	10.8	7.024	7.32
Women, Obs 388,135								
Reform	0.156	0.004	0.091	0.111	0.004	0.108	-0.049	-0.129*
	(0.158)	(0.072)	(0.049) [0.36]	(0.119) [>0.5]	(0.044) [>0.5]	(0.075) [0.40]	(0.073)	(0.047) [0.052]
Mean of dep var, %	7.92	1.51	0.68	4.21	0.77	1.39	1.46	0.83

Notes: [+]Any convictions: having ever been convicted. [++]Multiple Convictions: two or more convictions at different times. Results are percentage points. Robust standard errors, clustered by birth municipality, in parentheses; Romano-Wolf step down p-values in square brackets for the six different types of crime. The sample are sons and daughters of men born 1945-55 who are fully observed from age 15-29. All regressions include a full set of father's birth municipality, father's birth cohort indicator variables, and grandfather's education levels. For the types of crime the counterfactual is "not that crime", whether that is no conviction or some other conviction. * and **: RW stepdown p-value <0.1 and <0.05 respectively allowing for 6 hypotheses in columns 3-8. [††] and [†††] p-value<0.05 and p-value<0.01 respectively on a single hypothesis test basis

We next break down the overall conviction rate to the six types of crime reported in Table 2. To adjust for multiple testing, we report stepdown p-values as proposed by Romano and Wolf (2005) (RW). The declines are across the board and significant with the exception of "Property" and "Drug" related crimes. Specifically, "Violent" crime declined by 0.27pp (RW

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[16]Detailed results on the parents are presented in the Appendix and discussed below.

[17]The reduction is equally significant if we exclude traffic crimes.

p-value 0.09), "Traffic" related crimes by 0.45pp (RW p-value < 0.06) "Fraud" by 0.22pp (p-value < 0.09) and "Other" by 0.41pp (p-value< 0.05). The percentage reductions with respect to the mean incidence for these four types of crime are similar and lie between 3 and 6 percent. The 95% confidence intervals for "Property" and "Drugs" do not exclude an equivalent drop.

For women the impacts are much smaller, which is not surprising, given their baseline crime rates are almost a quarter of those for men. However, even here we see a reduction in the "other crime" category by 0.129pp representing a 15.5 percent reduction, which has a stepdown p-value of 0.052.

Thus overall, exposure of the father to the educational reform has caused large and significant reductions in the crime rates of the children. We now discuss the robustness of the results and then present evidence on the mechanisms that have led to these improvements.

6.2 Robustness Checks

The key assumption underlying our empirical approach is that growth in crime rates between cohorts would have been the same across all municipalities in the absence of the reform. In Appendix section A.4 we present in detail three alternative tests that provide strong support for this parallel trends assumption. We summarize the conclusions here. First, including municipality specific linear trends does not change the impacts (p-value 0.85) and the linear trends themselves are not significant (p-value 0.23). This is also true for the parent generation that was directly exposed to the reform. Second, we carry out Placebo tests and show that the impacts are all indistinguishable from zero unless we use the correct date of the reform in each municipality. Finally, we show graphically that the residuals from the crime regressions are uncorrelated to municipality specific trends. All approaches lead to the same conclusion and provide strong support for our empirical approach.

6.3 Discussion

Appendix Table 9 shows that the reform reduced crime for fathers in the parent generation by 1.5 percentage point (pp) (see also Hjalmarsson, Holmlund, and Lindquist, 2015). Table 10 then shows that a number of human capital indicators for the father also improved including earnings by 1 percent (std error 0.403 percent), cognition 0.14 of st Dev (std error 0.054),[18] social skills by 0.17 st Dev (st error 0.08), schooling by 0.32 years (st error 0.024). This is strong evidence of an increase in human capital in the parent generation as a consequence of the reform.

Interestingly, the reform also improved the marriage market outcomes for men, reflected in the earnings of the spouses of men by 1,022 SEK in 1968 prices at age 40 (std error 402).[19] This is consistent with positive assortative matching and an improvement in marriage market prospects of men exposed to the reform resulting from improved human capital (Chiappori, Costa-Dias, and Meghir, 2018). This could also reflect in part a mechanical effect, since the reform reduced the number of low educated persons, although many still exist in the earlier cohorts.

This result raises the question as to whether there is a spillover of the effect of the reform on the comparison group (untreated individuals) who now face a worse marriage market. However, the comparison group are people living in a different municipality, and so long as the marriage market is mainly within a municipality, there will be no bias in the estimates from a spillover to the control group.[20] Thus, our estimates measure the impact in a municipality with the reform to one without, correctly accounting for changes in the local equilibrium. However, there is a limitation to external validity: Once the reform was rolled out nationally, at the end of our study period, there may have been further general

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[18]On reform effect on cognitive and non-cognitive skills, see also Lager, Seblova, Falkstedt *et al.* (2017).

[19]Corresponding to approximately \$945 in 2023 prices and exchange rates.

[20]Reform status is assigned based on the municipality of birth and thus some people assigned to the reform may have moved. As is reported in Meghir and Palme (2005) only 9.9% of people moved to a municipality of different reform status than the municipality of birth. This is too small a number to affect the argument above.

equilibrium effects both from the changes in educational composition among men and women and from changes in skill prices.

The impact of the reform on women in the parent generation was lower. Schooling increased by 0.2 years (st. error 0.022) compared to 0.32 for men. We also find little impact on other human capital indicators and there is no effect on crime participation (which is very low in the first place, with little possibility of improvement). However, this is not surprising because the proportion of women directly affected by the reform was much lower. For the 1945-55 cohorts there were an average of 20 percent of men and only 13 percent of women at or below the compulsory schooling threshold that would therefore be affected by the reform. The overall average level of education for women was 0.34 years higher than that of men and it was also an a steeper trend: the growth of education for women for these birth cohorts was 0.56 years, compared to 0.36 years for men (in the untreated municipalities). Moreover the growth stalled to zero for men born after 1949, while rapid growth continued for women for at least another 2 cohorts.

We do, however, observe an increase in spousal earnings for women (SEK 1,449 st err 599)[21] and spousal education (0.093 st err 0.035), indicating better marriage market outcomes. Like for men this is consistent with positive assortative matching as well as a mechanical effect induced by the decline in the numbers of lower educated men as a result of the reform (although there were still some to be found amongst the earlier cohorts in the gradual roll-out period). In sum, the reform mainly affected men, because of their lower initial education level and their lower rate of education growth in the untreated state. This explains our focus on the intergenerational impacts of men in the parent generation being exposed to the comprehensive school reform. For a full set of results for women see Appendix Tables 9 and 10.

Given the increase in men's human capital we now explore the impact on their children for a broad set of outcomes based on the same difference-in-differences approach used for

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[21]$1340 in 2023 prices and exchange rates.

the effects of the reform on crime. In Panel A of Table 5 we present results on cognitive and non-cognitive skills, which are available only for men.[22] Cognitive skills improve by about 14 percent of a standard deviation with a p-value for a single hypothesis test of 0.067, although based on Romano-Wolf stepdown p-values for the entire Panel A, the impact is not significant.[23]

Turning to Panel B we find a 1.2 percentile increase in school GPA (RW p-value 0.05). Schooling itself does not increase and there is no impact on women. Finally, Panel C shows significant impacts on men's health with a reduction in hospitalization by 2.4 days (RW p-value 0.02), representing a 17 percent reduction and in prescribed drugs by 31 doses (RW p-value 0.09) representing 2.8 percent decline. These substantial improvements are consistent with findings in Campbell, Conti, Heckman *et al.* (2014) showing that the Abcedarian Early Childhood development intervention improved adult health.

In Appendix Table 12 we break down the prescription drugs to various categories and find that for men the overall reduction is driven by a decline in the use of nervous system drugs (RW p-value 0.055) and specifically painkillers (RW p-value 0.014), pointing to a possible improvement in mental health. For women we also find a reduction in prescribed drugs driven by a decline in drugs for the respiratory system (p-value 0.012, which could be pointing to a decline in smoking) and to drugs that have a "calming effect" (RW p-value 0.038), again pointing to improved mental health.

We now turn to longer term labor market outcomes measured at age 40 and presented in Table 6.[24] We find that men's employment, defined as positive labor income, increased by 2.3 percentage points (RW stepdown p-value 0.04) and unemployment, measured as receipt of unemployment benefits, declined by approximately the same amount (RW p-value 0.04). In the same direction is an increase in annual post-tax earnings by SEK 11,500 and a decline

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[22]The IQ and non-cognitive tests are available for men only, because they are collected when enrolling for military service, which is not compulsory for women over the relevant time period. See e.g. Lindqvist and Westman (2011) for a detailed description of these scores.

[23]Lundborg, Nilsson, and Rooth (2014) presents similar evidence for children of cohorts of parents different than ours, including early cohorts, hardly affected by the reform.

[24]See Haider and Solon (2006) for a motivation of choice of age group for evaluating labor market outcomes.

Table 5: Skills, Education and Health for the Child Generation

	Sons	
Panel A: *Cognitive and non-cognitive skills*‡		
IQ, verbal test	0.139†	
	(0.076), [0.396]	
IQ, number series test	0.020	
	(0.066), [>0.5]	
IQ, spatial	0.141	
	(0.105), [0.446]	
IQ, mechanical	-0.001	
	(0.083), [>0.5]	
Non-cognitive test	0.0065	
	(0.018), [>0.5]	
	Sons	Daughters
Panel B: *Education*		
GPA‡‡ last year of compulsory schooling (percentile)	0.012**	0.002
	(0.0055), [0.050]	(0.0058), [>0.5]
Years of schooling	0.015	0.019
	(0.012), [0.198]	(0.013), [0.178]
Panel C: *Health*		
Hospitalization, days over 1987-2015	-2.40**	-0.21
	(0.81), [0.02]	(0.78), [>0.5]
Average hospitalization days	14.22	24.04
All prescribed drugs total daily doses over 2006-2015	-30.711*	-7.623
	(14.417), [0.089]	(20.31), [>0.5]
Average doses over the period	1,079.9	2,581.3

Notes: Standard errors clustered at the municipality level in round brackets. Romano Wolf step down *p*-values adjusting for multiple testing, separately for men and women and for each group (Cognitive and non-cognitive skills (5), Education (2), Health (2)) in square brackets. *** significance at 1% ** Significance at 5% and * Significance at 10% all based on the RW *p*-values. †Significant at 10% with single hypothesis test but not with multiple testing. ‡Cognitive and non-cognitive tests are administered to conscripts, who are all male. Here they are measured in standard deviation units. The cognitive tests are IQ type tests and the non-cognitive ones are scores from a psychological assessments. No such tests are available for women ‡‡GPA: grade point average awarded centrally.

in welfare dependency. Both are individually significant at the 10% and at the 5% level respectively, but not when we adjust for multiple testing. For women only the decline in welfare dependency is significant.

These results offer a consistent picture: the educational reform improved fathers' human capital, earnings and marriage outcomes. It also reduced fathers' participation in crime. In turn the sons' and to some extent the daughters' outcomes improved in many dimensions, including labor market and health. As suggested in the simple model in the Appendix,

Table 6: Labor Market outcomes of the child generation

	Sons	Daughters
Annual Earnings, SEK	11,494	5,240
	(6,554), [0.287]	(4,769), [0.495]
Employment	2.28**	1,22
	(0.89), [0.040]	(1.37), [0.960]
Unemployment	-1.87**	0.01
	(0.72), [0.040]	(0.83), [0.980]
Welfare receipt	-2.22	-2.57**
	(1.10), [0.190]	(1.01), [0.050]

Notes: Data for the period 2000-2010 used. Fixed effects for *Year*, *Year of birth* and *Municipality* included in the specification. SEK measured in 2000 prices. SEK 11,494 and SEK 5,240 corresponds to 1,546 and 705 2023 US $, respectively. Standard errors clustered at the municipality level in round brackets. Romano Wolf step down *p*-values for four hypotheses for Sons and Daughters separately in square brackets. ** Significance at 5% and based on the RW stepdown *p*-values.

this improvement in human capital provides the mechanism for a reduction in crime among the child generation, particularly amongst sons. But equally important, it highlights the potential of educational policy to improve intergenerational outcomes.

Finally, for completeness, in Appendix Table 11 we consider the impact of maternal exposure on their sons and daughters but find no impact on their children.

6.3.1 Mediation Analysis

We conclude with a simple mediation analysis (Heckman and Pinto, 2015) intended to quantify the channels for the intergenerational links that drive the overall effect. Specifically, we consider two mediators: fathers participation in crime and father's education, both of which we have argued are key factors driving the impacts we have discussed. We use a restricted sample of men born between 1952-55 so that we can observe the entire age range over which fathers may have participated in crime. And to preserve consistency across generations for this mediation exercise, we also restrict the sample to those with children, who then constitute the sample for the child generation. We thus start by reporting the impact of the reform on the two mediators for this subsample based on the following regression and using our difference in differences strategy:

$$M_i^k = \beta^k R_{i,t,m} + \beta_k' X_i + \gamma_1' t_i + \gamma_2' m_i + u_i^k, \quad k = \{crime,\ education\}, \tag{2}$$

where $R_{i,t,m}$ again is an indicator taking the value 1 when the father was exposed to the reform and X includes grand parents education; $y_{i,m,t}$ is one if a conviction is observed and zero otherwise. We then estimate the crime outcome equation:

$$y_i = \delta_0 + \delta_1 R_{i,t,m} + \delta_2 M_i^{crime} + \delta_3 M_i^{education} + \gamma' X_i + \gamma_1' t_i + \gamma_2' m_i + v_i. \tag{3}$$

Table 7: Mediation Analysis

| | Parental Generation | | Child Generation | | |
| | Education | Crime | Crime | | |
	(1)	(2)	(3)	(4)	(5)
Father's Exposure to School Reform	0.316***	-1.269	-1.090**	-0.433	-0.406
	(0.046)	(0.783)	(0.522)	(0.527)	(0.530)
Father's years of schooling			-	-2.019***	-1.670***
				(0.052)	(0.0044)
Father's crime			-	-	10.6***
					(0.236)
N	152,662	153,311	153,311	152,622	152,622

Notes: Impacts measured in percentage points. Sample: Men from the 1952-55 cohorts and their children. Those of the parent generation with no children are excluded. All regressions include controls for grandfather's education, cohort fixed effects and municipality fixed effects. Standard errors clustered at the municipality level in parentheses.

In Table 7 we present the results. The first column shows that the reform increased fathers' years of schooling by about 0.3 years, which is very similar to the results in Appendix Table 10, which uses a broader range of cohorts. Column 2 shows that the reform led to

a -1.3pp decline in crime (p-value 0.105) again very similar to that obtained on the whole sample (Table 9), where it is highly significant. In column 3 we present the impact of the reform for the children of the fathers included in column 2 and obtain an estimate similar to that of Table 4.

When we include fathers' education the direct impact of the reform declines from -1.1pp to -0.43pp (column 4). One year of parental schooling is associated with a 2pp decline in child crime. Moving to column 5, Father's participation in crime is associated with a 10pp increase in child participation but it's inclusion only reduces the direct impact to -0.406. Nevertheless, it is worth noting that the impact of the reform is no longer significant in columns 4 and 5.

A simple decomposition, based on the point estimates, implies that the direct effect of the reform (reflecting channels that are not explicitly considered) accounts for 37.2 percent of the total impact; the effect attributed to an improvement in parental education accounts for 48 percent of the total. Finally, the decline in parental crime participation and its resulting effect on child crime accounts for the remaining 12.3 percent of the effect.[25] Overall, the mediation analysis is consistent with the mechanisms discussed earlier and highlights the importance of the human capital channel, proxied here by education, with some role operating directly from a reduction in father's crime participation.[26]

7 Conclusions

The comprehensive school reform of the 50s and 60s in Sweden, increased schooling and led to improvements in a broad set of human capital indicators as well as reducing the participation in crime for those exposed to the reform, particularly for men. In this paper we explore the effects that this had on the children of those exposed. We find that particularly for boys this also led to broad improvements in their outcomes, including school performance, health

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[25]The total effect of the reform implied by column 5 is calculated as -0.406 - 1.670×0.316-1.269×10.6/100.

[26]The interpretation of these results rely on assuming that we can take parental education and crime as conditionally exogenous for child crime.

and employment. It also reduced their participation in crime. This paper thus shows the potential of well-designed education policy to improve a wide set of outcomes, having far-reaching consequences down the generations, very much as expected from the seminal work of Becker and Tomes (1979).

References

Athey, S. and Imbens, G. W. (2006). 'Identification and Inference in Nonlinear Difference-In-Differences Models.' *Econometrica*, vol. 74(2):pages 431–497.

Attanasio, O., Cattan, S., Fitzsimons, E., Meghir, C., and Rubio-Codina, M. (2020). 'Estimating the Production Function for Human Capital: Results from a Randomized Controlled Trial in Colombia.' *American Economic Review*, vol. 110(1):pages 48–85.

Attanasio, O., Meghir, C., and Nix, E. (2020). 'Human Capital Development and Parental Investments in India.' *Review of Economic Studies*, vol. 87:pages 2511–2541.

Becker, G. S. (1981). *A Treatise on the Family*. Harvard University Press, New York.

Becker, G. S. and Tomes, N. (1979). 'An Equilibrium Theory of the Distribution of Income and Intergenerational Mobility.' *Journal of Political Economy*, vol. 87(6):pages 1153–1189.

Brå Kodning av brott (2010). 'Kodning av brott.' Anvisningar och regler Version 8.0, Brottsförebyggande rådet.

Brå Variabelbeskrivning Lagföringsregistret (2009). 'Variabelbeskrivning Lagföringsregistret 2.0.' Variabelinnehåll register över lagförda personer, Brottsförebyggande rådet.

Campbell, F., Conti, G., Heckman, J. J., Moon, S. H., Pinto3, R., Pungello, E., and Pan, Y. (2014). 'Early Childhood Investments Substantially Boost Adult Health.' *Science*, vol. 343:pages 1478–1485.

Caucutt, E. and Lochner, L. (2012). 'Early and Late Human Capital Investments, Borrowing Constraints, and the Family.' Working paper no. 18493, NBER.

Chiappori, P.-A., Costa-Dias, M., and Meghir, C. (2018). 'The Marriage Market, Labor Supply, and Education Choice.' *Journal of Political Economy*, pages S26–S72.

Coleman, J. S. (1988). 'Social Capital in the Creation of Human Capital.' *American Journal of Sociology*, vol. 94:pages pp. S95–S120. ISSN 00029602.

Cunha, F. (2007). *An Essay on Skill Formation*. Ph.D. Thesis, University of Chicago.

Cunha, F. and Heckman, J. (2007). 'The Technology of Skill Formation.' *The American Economic Review*, vol. 97(2):pages pp. 31–47. ISSN 00028282.

Cunha, F. and Heckman, J. (2008). 'Formulating, Identifying and Estimating the Technology of Cognitive and Noncognitive Skill Formation.' *Journal of Human Resources*, vol. 43(4):pages 738–782.

Cunha, F., Heckman, J. J., and Schennach, S. M. (2010). 'Estimating the Technology of Cognitive and Noncognitive Skill Formation.' *Econometrica*, vol. 78(3):pages 883–931. ISSN 1468-0262.

Currie, J. and Moretti, E. (2003). 'Mother's Education and the Intergenerational Transmission of Human Capital: Evidence from College Openings.' *Quarterly Journal of Economics*, vol. 118:pages 1495–1532.

Dahl, G. B., Kostøl, A. R., and Mogstad, M. (2014). 'Family welfare cultures.' *The Quarterly Journal of Economics*, vol. 129(4):pages 1711–1752.

Dahl, G. B., Kostøl, A. R., and Mogstad, M. (2014). 'Family Welfare Cultures.' *The Quarterly Journal of Economics*, vol. 129(4):pages 1711–1752. ISSN 0033-5533.

Dustmann, C. and Landersø, R. (2021). 'Child's Gender, Young Fathers' Crime, and Spillover Effects in Criminal Behavior.' *Journal of Political Economy*, vol. 129(12):pages 3261–3301.

Edmark, K. (2006). 'Unemployment and Crime: Is There a Connection?' *Scandinavian Journal of Economics*, vol. 107(2):pages 353–373.

Freeman, R. B. (1996). 'Why Do So Many Young American Men Commit Crimes and What Might We Do About It?' *The Journal of Economic Perspectives*, vol. 10(1):pages pp. 25–42. ISSN 08953309.

Freeman, R. B. (1999). 'The Economics of Crime.' vol. 3, Part 3, Chapter 52 of *Handbook of Labor Economics*. Elsevier.

Gallipoli, G. and Fella, G. (2008). 'Education and Crime over the Life Cycle.' *Working Papers 630, Queen Mary, University of London, School of Economics and Finance*.

Gertler, P., Heckman, J. J., Pinto, R., Zanolini, A., Vermeersch, C., Walker, S., Chang, S. M., and Grantham-McGregor, S. (2014). 'Labor market returns to an early childhood stimulation intervention in Jamaica.' *Science*, vol. 344(6187):pages 998–1001.

Glaeser, E. L., Sacerdote, B., and Scheinkman, J. A. (1996). *The Quarterly Journal of Economics*, vol. 111(2):pages 507–548.

Gould, E. D., Weinberg, B. A., and Mustard, D. B. (2002). 'Crime Rates and Local Labor Market Opportunities in the United States: 1979-1997.' *Review of Economics and Statistics*, vol. 84(1):pages 45–61.

Grogger, J. (1998). 'Market Wages and Youth Crime.' *Journal of Labor Economics*, vol. 16(4):pages pp. 756–791. ISSN 0734306X.

Grönqvist, H. (2011). 'Youth Unemployment and Crime: New Lessons Exploring Longitudinal Register Data.' *SOFI Working-paper 07/2011*.

Haider, S. and Solon, G. (2006). 'Life-Cycle Variation in the Association between Current and Lifetime Earnings.' *The American Economic Review*, vol. 96(4):pages pp. 1308–1320. ISSN 00028282.

Heckman, J., Moon, S. H., Pinto, R., Savelyev, P., and Yavitz, A. (2010). 'Analyzing social experiments as implemented: A reexamination of the evidence from the HighScope Perry Preschool Program.' *Quantitative Economics*, vol. 1:pages 1–46.

Heckman, J. and Robb, R. (1985). 'Alternative Methods for Evaluating the Impact of Interventions.' In J. Heckman and B. Singer, eds., *Longitudinal analysis of labor market data*. Econometric Society monograph series (Cambridge University Press, New York.

Heckman, J. J., Ichimura, H., Smith, J., and Todd, P. (1999). 'Characterizing Selection Bias Using Experimental Data.' *Econometrica*, vol. 66(5):pages 1017–1098.

Heckman, J. J. and Pinto, R. (2015). 'Econometric Mediation Analyses: Identifying the Sources of Treatment Effects from Experimentally Estimated Production Technologies with Unmeasured and Mismeasured Inputs.' *Econometric Reviews*, vol. 34:pages 6–31.

Hjalmarsson, R., Holmlund, H., and Lindquist, M. (2015). 'The Effect of Education on Criminal Convictions and Incarceration: Causal Evidence from Micro-data.' *The Economic Journal*, vol. 125:pages 1290–1326.

Hjalmarsson, R. and Lindquist, M. J. (2012). 'Like Godfather, Like Son: Exploring the Intergenerational Nature of Crime.' *Journal of Human Resources*, vol. 47(2):pages 550–582.

Hjalmarsson, R. and Lindquist, M. J. (2013). 'The Origins of Intergenerational Associations in Crime: Lessons from Swedish Adoption Data.' *Labour Economics*, vol. 20:pages 68–81.

von Hofer, H. (2014). 'Crime and reactions to crime in 34 Swedish birth cohorts: from historical descriptions to forecasting the future.' *Journal of Scandinavian Studies in Criminology and Crime Prevention, forthcoming.*

Holmlund, H. (2007). 'A Researcher's Guide to the Swedish Compulsory School Reform.' *SOFI Working Paper 9/2007*.

Lager, A., Seblova, D., Falkstedt, D., and Martin, L. (2017). 'Cognitive and emotional outcomes after prolonged education: a quasi-experiment on 320 182 Swedish boys.' *International Journal of Epidemiology*, vol. 46:pages 303–311.

Lochner, L. (2004). 'Education, Work, and Crime: A Human Capital Approach.' *International Economic Review*, vol. 45(3):pages pp. 811–843. ISSN 00206598.

Lochner, L. and Moretti, E. (2004). 'The Effect of Education on Crime: Evidence from Prison Inmates, Arrests, and Self-Reports.' *The American Economic Review*, vol. 94(1):pages pp. 155–189. ISSN 00028282.

Lundborg, P., Nilsson, A., and Rooth, D. (2014). 'Parental Education and Offspring Outcomes: Evidence from the Swedish Compulsory Schooling Reform.' *American Economic Journal, Applied Economics*, vol. 6(1):page 253278.

Machin, S., Marie, O., and Vujić, S. (2011). 'The Crime Reducing Effect of Education.' *The Economic Journal*, vol. 121(552).

Machin, S. and Meghir, C. (2004). 'Crime and Economic Incentives.' *The Journal of Human Resources*, vol. 39(4):pages pp. 958–979.

Marklund, S. (1980). 'Från reform till reform: Skolsverige 1950-1975, Del 1, 1950 års reformbeslut.' *Skolöverstylrelsen och Liber Utbildningsförlaget*.

Marklund, S. (1981). 'Från reform till reform: Skolsverige 1950-1975, Del 2, Försöksverksamheten.' *Stockholm: Utbildningsförlaget*.

Meghir, C. and Palme, M. (2003). 'Ability, Parental Background and Education Policy: Empirical Evidence from a Social Experiment.' *IFS working paper*, (WP03/05).

Meghir, C. and Palme, M. (2005). 'Educational Reform, Ability, and Family Background.' *The American Economic Review*, vol. 95(1):pages pp. 414–424.

Merton, R. K. (1938). 'Social Structure and Anomie.' *American Sociological Review*, vol. 3(5):pages pp. 672–682. ISSN 00031224.

Merton, R. K. (1949). 'Social structure and anomie: revisions and extensions.' The family: its function and destiny, pages 226–257. Harper.

National School Board, R. (1959). 'Försöksverksamhet med nioårig skolplikt.' vol. Stockholm, Report 52.

Romano, J. P. and Wolf, M. (2005). 'Stepwise Multiple Testing as Formalized Data Snooping.' *Econometrica*, vol. 73(4):pages 1237–1282.

Sabates, R. and Feinstein, L. (2008a). 'Educational Attainment and Juvenile Crime.' *British Journal of Criminology*.

Sabates, R. and Feinstein, L. (2008b). 'Effects of Government Initiatives on Youth Crime.' *Oxford Economic Papers*, vol. 60(3):pages pp. 462–483. ISSN 00307653.

Schweinhart, L., Montie, J. J., Xiang, Z.-p., Barnett, W. S., Belfield, C. R., and Nores, M. (2005). *Lifetime Effects: The High/Scope Perry Preschool Study Through Age 40*. Ypsilanti, MI: High/Scope Press.

Williams, J. and Sickles, R. C. (2002). 'An Analysis of the Crime as Work Model: Evidence from the 1958 Philadelphia Birth Cohort Study.' *The Journal of Human Resources*, vol. 37(3):pages pp. 479–509. ISSN 0022166X.

A APPENDIX FOR ONLINE PUBLICATION

A.1 Theoretical Background

We consider two channels through which the educational reform could have reduced crime in the subsequent generation: one is through improvements in human capital; the other is through a direct influence of father's criminal behavior on the child.

We start by discussing the human capital channel. We present the chain of events backwards, by showing how an increase in human capital can reduce crime. We then consider the problem of the parent generation and show how the policy reform can lead to an increase in child human capital through increased parental investments. The key ideas draw on Becker and Tomes (1979) and on Cunha, Heckman, and Schennach (2010). To preserve simplicity we use explicit specifications for preferences and the child human capital production function that can reflect key empirical findings from the literature.

A.1.1 Crime in the Child Generation

Denote child human capital by h, which we measure in monetary units, having normalized its price to one, without loss of generality. If a person does not participate in crime they obtain utility $V_h = F(h)$, where $F(h)$, is an increasing and concave function of h. To participate in crime an individual gives up $1 - \alpha$ fraction of their lawfully earned income and if they are not caught, earn overall $y^c = \alpha h + r(h)$, where $r(h)$ is income from crime. If caught, they get no return from crime and incur utility cost $g(h)$. The probability of being caught is $p(h)$. The expected utility of crime participation with an uncertain outcome is $\tilde{V}_c = (1 - p(h))F[\alpha h + r(h)] + p(h)(F[\alpha h] - g(h)) + e \equiv V_c + e$, where e is a random preference component, known to the individual, and drawn from a logistic distribution with

parameter $\mu > 0$. Hence the probability of crime participation P_c is given by

$$P_c \equiv Pr(e > V_h - V_c) = \frac{1}{1 + e^{\mu(V_h - V_c)}}. \tag{4}$$

In what follows prime denotes a derivative. Then the effect of increased human capital on participation in crime is given by

$$\frac{\partial P_c}{\partial h} = -P_c(1 - P_c)\mu \times$$
$$\left\{ F'(h) + p'(h) \left[F^s - (F^f - g) \right] - \left[(1 - p(h)) \left[\alpha + r'(h) \right] F^{s\prime} + p(h) [\alpha F^{f\prime} - g'] \right] \right\} \tag{5}$$

where $F^s \equiv F[\alpha h + r(h)]$ and $F^f \equiv F[\alpha h] > 0$. A sufficient condition for crime participation to decline with human capital is that the probability of being caught $(p(h))$ remains constant (or indeed increases, $p'(h) \geq 0$) with respect to human capital and that the expected marginal psychic cost of crime is larger than the expected marginal utility of h when participating in crime $p(h)g' \geq (1 - p(h))(\alpha + r'(h))F^{s\prime} + p(h)\alpha F^{f\prime}$. This ensures that the expected marginal utility of income from crime declines with human capital.

We now show how improving the human capital of the parent could improve that of the child. This provides the link we require from the original policy, which has been shown empirically to improve parental human capital.

A.1.2   Child Human Capital

Parents are linked to their children altruistically. Parental preferences over their own consumption (c_p) and child human capital (h) are assumed to be

$$V^p(c_p, h) = log(c_p) + \lambda U^k(h), \tag{6}$$

where λ is the altruism parameter and $U^k(h) = E_e max\{V_h, V_c + e\}$ is the expected child utility with respect to the random preference term e and with V_h, V_c defined above. The expectation

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is taken with respect to the distribution of child random preferences, e. $V^p(c_p, h)$ is assumed increasing in child human capital, and with sufficient uncertainty on child preferences e it is differentiable in both c_p and h. We simplify the analysis by assuming that parents can only influence child utility by investing in their human capital and not by direct monetary transfers. Since we measure h in monetary units, it effectively represents lifetime income and is equal to lifetime consumption.

The production function of human capital is assumed to be $h = (\gamma_0 + \gamma_1 \varsigma_p) \iota_p \equiv \Gamma(\varsigma) \iota_p$ where ι_p are parental investments and ς_p is parental human capital. These may be complements or substitutes in the production of child human capital depending on the sign of γ_1.[27] The production function introduces two separate channels through which parental schooling can affect child skills: through the productivity of investments controlled by γ_1 and through the level of investments, which are a parental choice.

Given the above, parents choose c_p and ι_p to maximize utility, subject to the production function and the budget constraint $c_p + \iota_p = y_p(\varsigma_p)$, where $y_p(\varsigma_p)$ is parental income, which is increasing in human capital ς_p. The solution to the utility maximization problem implies the following investment relationship

$$\iota_p = y_p(\varsigma_p) - \frac{1}{\lambda U^k(h)'(\gamma_0 + \gamma_1 \varsigma_p)} \tag{7}$$

The effect of increasing parental human capital ς_p on parental investments in children is then given by

$$\frac{\partial \iota_p}{\partial \varsigma_p} = \frac{y_p' + \gamma_1 \frac{\lambda}{x^2} U^k(h)' (1 + R)}{1 - \frac{\lambda}{x^2} \Gamma^2 U^k(h)''} \tag{8}$$

where $R = h U^k(h)'' / U^k(h)'$ is the coefficient of relative risk aversion and $x = \lambda U^k(h)'(\gamma_0 + \gamma_1 \varsigma_p)$. The denominator is positive assuming concavity of $U^k(h)$. For $1 + R \geq 0$ this expression

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[27]We assume throughout that $\gamma_0 + \gamma_1 \varsigma_p \geq 0$. We ignore time inputs for simplicity. They can cause a trade-off between investing time in children and earning more. Still, empirically higher parental human capital is associated with improved human capital for children (Cunha, Heckman, and Schennach, 2010).

in positive if parental human capital (ς_p) and child investments are complements in the production function for human capital ($\gamma_1 \geq 0$). If they are substitutes ($\gamma_1 < 0$) the sign of the impact is ambiguous and depends on the return to parental human capital (y_p'). Given the literature on human capital production functions the most empirical relevant case is that of $\gamma_1 \geq 0$.[28] In turn improved investments raise child human capital as shown empirically by both experimental and observational studies.[29] Putting these arguments together, defines one of the channels through which the educational reform in Sweden reduced crime in both the exposed and the child generation.

A.2 Definitions and Implementation of the Reform

Figure 1: Number of individuals in sample assigned to the reform
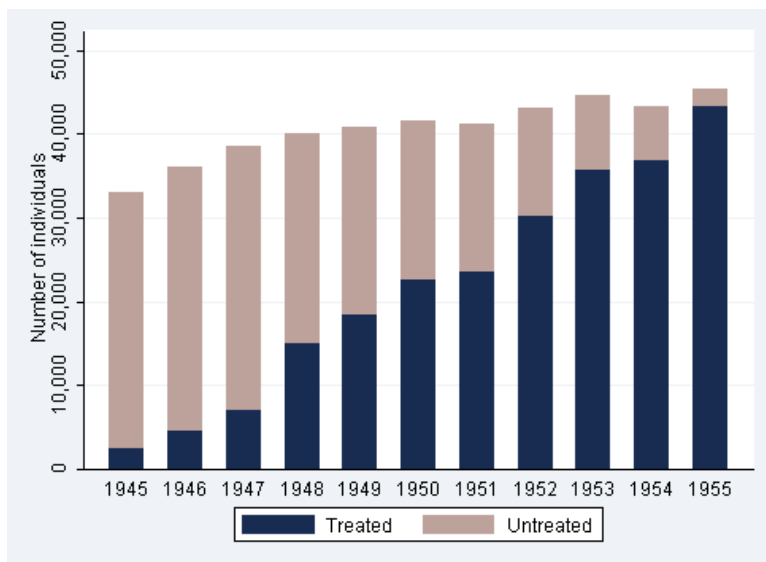
For each conviction we have detailed information on the type of crime for the main violation within the conviction and the age when it was committed.[30] We categorize crimes

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[28]See Cunha, Heckman, and Schennach (2010), and Attanasio, Cattan, Fitzsimons *et al.* (2020) amongst others

[29]See Cunha and Heckman (2008); Cunha, Heckman, and Schennach (2010); Gertler, Heckman, Pinto *et al.* (2014) and Attanasio, Cattan, Fitzsimons *et al.* (2020) amongst others.

[30]Types of crimes are detailed in several variables that specify the chapter, paragraph, moment, piece and point in the section of the relevant penal code (law-book). Details of the types-of-crime variables in the conviction data are in Brå Variabelbeskrivning Lagföringsregistret (2009) and the documentation of coding

Table 8: Description of the different types of crimes included in the study.

Type	Description
Violent Crimes	Crime against Chapter 3 or 4 in the Swedish Criminal Code. Includes murder, assault, battery as well crime against liberty and peace.
Property Crimes	Crime against Chapter 8 in the Swedish Criminal Code. Includes theft and robbery and stealing.
Traffic Crimes	Crime against the Road traffic regulation (The Highway Code in the US). Includes traffic crimes serious enough to lead to a court appearance such as driving under the influence of drink or drugs, causing serious accidents or serious speeding violations. It *excludes* minor traffic offenses, punishable by a fine without a court appearance
Fraud Crimes	Crime against Chapter 9, 10, 11, 14 and 15 in the Swedish Criminal Code. Includes embezzlement, breach of trust, dishonesty against creditors, falsification, tax fraud and perjury.
Other Crimes	Crimes against the following chapters of the Swedish Criminal Code: Chapters 5 (Defamation), 6 (Sexual Crimes), 7 (Crimes against the Family), 12 (Crimes Inflicting Damage), 13 (Crimes Involving Public Danger), 16 (Crime against Public Order), 17 (Crime against Public Activity), 19 (Crime against the Security of the Realm), and 20 (Misuse of Office)

into seven types: violent crimes, property crimes, fraud and tax evasion, traffic crimes, drug and trafficking violations, sex crimes and others containing crimes that cannot be categorized as any of the latter six categories.[31] The traffic crimes need to be serious enough to lead to a court case and do not include speeding and parking offenses. Table 8 shows our categorization.

Figure 1 shows the number of observations in our sample in each year birth cohort and

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crime types can be found in Brå Kodning av brott (2010). The crime register also contains information on the number of crimes within each individual's conviction, the date of conviction, the age of the offender, as well as the penalty for each crime.

[31]Other crimes include defamation, family law, vandalism, hazardous general crimes, crimes against public order, violation of general business, Crimes against national security, misconduct, Environmental law, Alcohol law, Weapon and knife law, Immigration law, Copyright law, Working environment law, visiting rights law - harassment of ex-spouse etc., privacy and data protection.

the proportion of the parent generation assigned to the reform.

Figure 2: Crime age profiles

(a) Age profile of crime rate for the Parent Generation by cohort

(b) Age profile of crime rate for the Child Generation by cohort
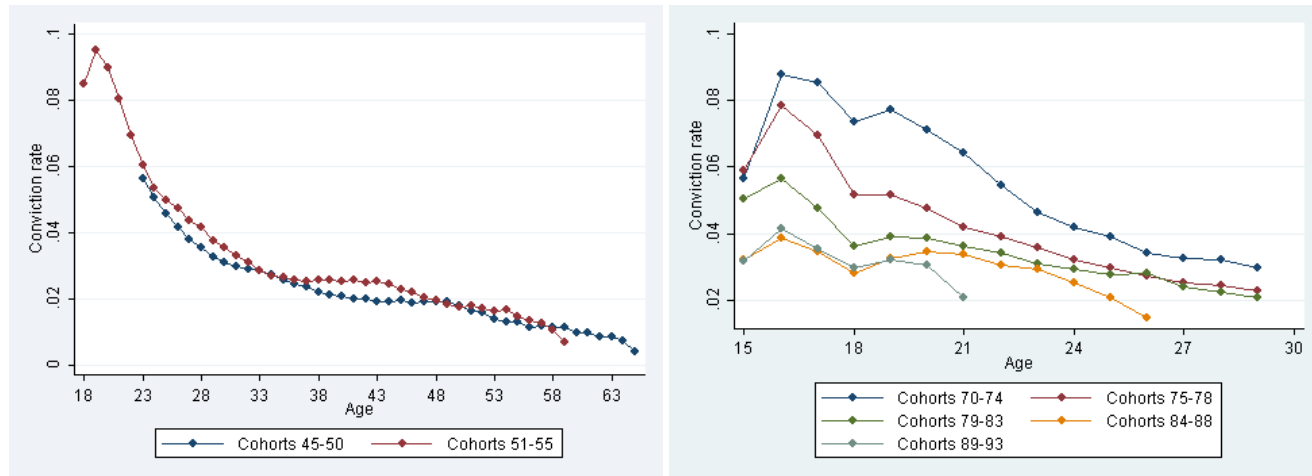
A.3 Education and Crime in the Parent Generation

We use the difference-in-differences regression (1) to estimate the impact of the reform on educational attainment for the parent generation for all potentially affected cohorts (1945-55). As in all results we use a reform assignment based on the municipality of birth. The the reform increased years of schooling by of 0.319 for men and 0.206 for women (see Table 10). Both effects are highly significant and confirm earlier results by Meghir and Palme (2005) obtained on just two of the cohorts (1948 and 1952).

In Table 9 we show the effects of the reform on crime in the parent generation. The analysis is carried out for the subset of people born in the period 1952-55 for whom we have criminal records at a young enough age. Here we include all, whether they have children or not. For men the reform significantly reduced the incidence of having any conviction by 1.5 percentage points (pp) and importantly it also reduced significantly the incidence of repeat convictions by 1.5 percentage points from a lower base, representing a decline of about 8 percent. For women we find no impacts. These results confirm earlier findings of the impact

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of compulsory schooling reforms on crime in the US (Lochner and Moretti, 2004), in the UK (Machin, Marie, and Vujić, 2011), and in Sweden using the same reform (Hjalmarsson, Holmlund, and Lindquist, 2015).

Table 9: Impact of the Reform on crime in the parent generation

	Convictions		Breakdown by type of crime					
	Any[+]	Multiple[++]	Violent	Property	Drugs	Traffic	Fraud	Other
Men born 52-55, Convicted at age 15-65, Obs. 176,232								
Reform	-1.464	-1.476	-0.364	-0.783	-0.427	-1.391	-0.334	-0.149
	(0.556)	(0.491)	(0.297) [>0.5]	(0.347) [0.12]	(0.294) [0.44]	(0.473) [0.018]	(0.269) [>0.5]	(0.419) [>0.5]
Mean of dep var %	38.62	18.90	6.16	9.37	7.23	22.59	7.02	13.66
Women born 52-55, Convicted at age 15-65, Obs. 167,588								
Reform	0.389	-0.033	0.039	-0.209	0.190	0.414	-0.120	-0.062
	(0.315)	(0.202)	(0.084)	(0.214)	(0.135)	(0.238)	(0.135)	(0.137)
$\bar{y}$ %	10.22	3.74	0.61	2.80	1.63	4.64	1.92	1.66

Notes: The impact is measured in percentage points and the dependent variable is percent of the population. Sample includes people from the 1952-55 cohorts, whether they have children or not. [+]Any convictions: having ever been convicted. [++]Multiple Convictions: two or more convictions at different times. Results are percentage points. Robust standard errors, clustered by birth municipality, in parentheses; Romano-Wolf step down p-values in square brackets for the six different types of crime. No RW p-values for women since no impact is significant at the individual significance level. All regressions include a full set of birth municipality, birth cohort indicator variables, and father's education levels.

A.4 Robustness Tests: Common Trends Assumption

A key assumption underlying our empirical approach is that cohort effects are common across municipalities. The assumption may be violated if there are changes in the municipalities affecting cohorts in ways that are relevant for crime. We now bring to bear evidence on this issue using three different approaches. First, we repeat our estimation assuming that the reform took place at a different date than it actually did (placebo estimations). Second, we explicitly include municipality specific trends. Third, we plot residuals to show that they do not display a trend. In all the above we group municipalities by the earliest cohort for which they implemented the reform and we look for omitted trends specific to each of these groups.

Placebo Tests For the placebo estimations, where we pretend that the reform was implemented later, we only use the sample of sons whose fathers were treated by the reform. To construct placebo treatment and control groups we then pretend that the reform was implemented successively one year later, two years later, etc. We (falsely) assign the first treated cohort (the first two treated cohorts, the first three treated cohorts, etc.) in each municipality group to be untreated and the remaining ones to the treated group. This provides five placebo estimates.

Similarly, for the placebo estimations where we pretend that the reform was implemented earlier, we restrict the sample to sons whose fathers were not treated by the reform.[32] The placebo treatment groups are defined by (falsely) assigning the two last untreated cohorts (the three last untreated cohorts, the four last untreated cohorts, etc.) to the treated group and the remaining cohorts stay in the comparison group. This provides an additional five placebo estimates.

Figure 3: Placebo estimations sons
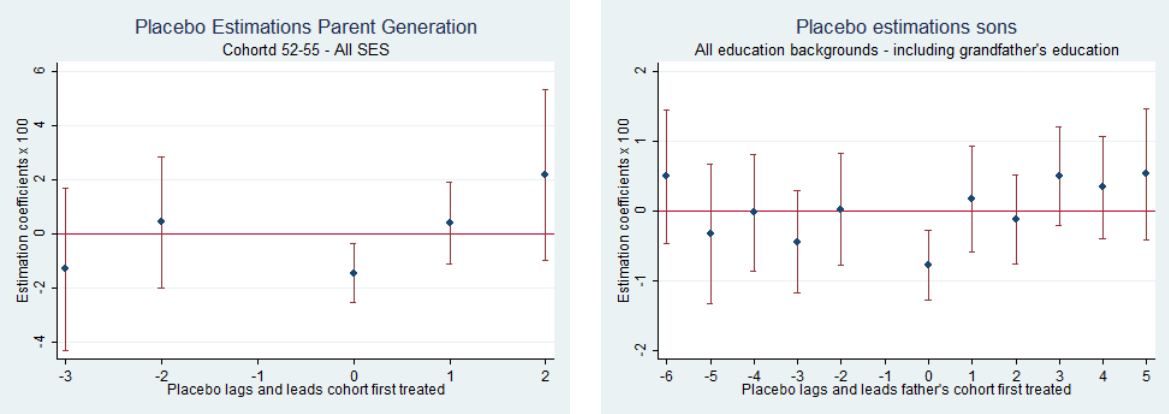
The results are all brought together in the right panel of Figure 3. Each dot represents the estimate assuming the reform took place at the specified period on the x-axis (relative to when it actually took place, which is the zero point). The outcome variable is the summary measure

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[32]We require at least two treated cohorts and one untreated cohort in each municipality group to implement the estimator. This means that we start our first placebo estimation pretending the reform was implemented two years earlier than it actually was.

of any conviction. The vertical line around the dot represents the 95 percent confidence interval. The graph shows that the largest (in absolute value) and only significant effect is obtained when we use the correct timing for the reform assignment (that is at zero). In all other cases we estimate insignificant effects and no particular pattern shows up implying there is nothing systematic taking place biasing the results towards an effect on crime. Finally, we tested the joint hypothesis that each placebo effect is equal to the true effect. The p-value of this test, which was carried out using the bootstrap, is zero implying that the placebo and the real effects are indeed significantly different.

In the left panel of the Figure we show the results from the corresponding placebo tests for the fathers in the parental generation.

Including Differential Trends   For our second approach, the inclusion of heterogeneous trends in the empirical specification, has a p-value of 0.23 for the child generation and 0.69 for the parent generation. Moreover, including them does not change the parameters either: the p-value for parameter equality between the model that allows for heterogeneous trends and the one that does not is 0.854 for the child generation and 0.797 for the parent generation.[33]

Residual Plots   Our third approach to evaluate the common trends assumption is to plot residuals to show that they do not display a trend. In Figure 4 we plot the residuals from the difference-in-differences regressions for all convictions for sons (with the estimated average impact added back in). Each point corresponds to an average residual across cohorts in different municipalities grouped by their years to implementation.[34] The straight line on each graph is fitted by weighted least squares across the grouped residuals, with the weight

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[33]Parameter values with differential trends available upon request.

[34]For example if municipality 1 implemented the reform for the 1948 cohort, this cohort would contribute to the zero point on the graph, the 1947 cohort contributes to -1 and so on. Going forward 1949 would contribute to +1, 1950 to +2 etc. This is repeated for all municipalities by time to implementation. The residuals are then averaged by this time to implementation because presenting these trends one by one is too noisy to be visually informative. Groups closer to zero include many more observations and are thus more precise.

being the inverse of the variance in each group. In Figure 5 we plot the residuals from the same exercise for the type of crimes where the effects were significant.

Figure 4: Residual graph for overall conviction rate for sons

(a) Residual Graph including grandfather's education

(b) Residual Graph excluding grandfather's education
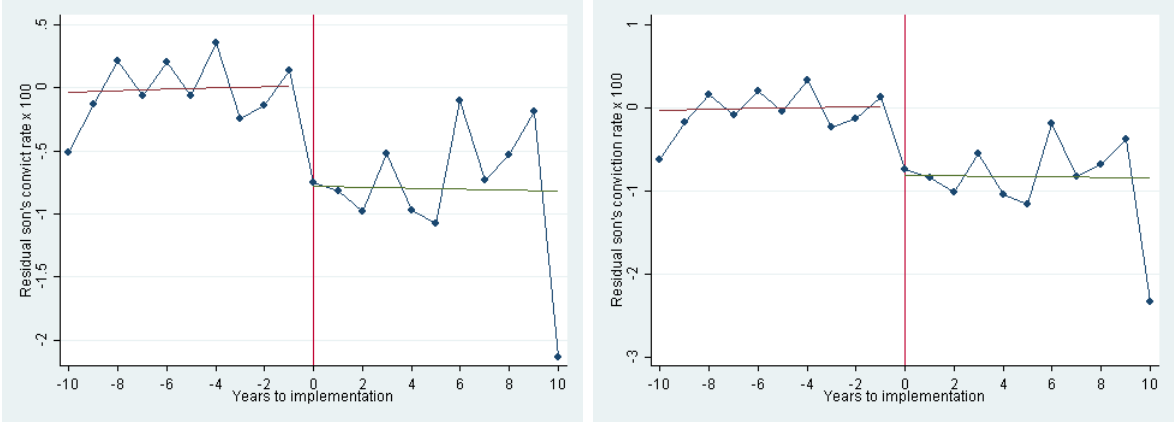
Note: Regression lines fitted to the grouped data using weighted least squares with the weights being the inverse of the variances of each group

If there are systematic trends related to early or late implementing municipalities these would show up as a trend in these residuals because the composition of municipalities changes as we move along the x-axis to different times to implementation. However these residuals display no significant trend either for the overall conviction rate or for each type of crime separately. This is true whether we condition on grandfathers education or not. We also tested formally for the null of zero slopes using a bootstrap based test and the p-values are all above 0.2. Finally, we reach the same conclusion for daughters as well as for the parents - not shown here for brevity. This completes what we view as conclusive evidence that the results we present on the intergenerational impacts of the reform are robust and not a spurious artifact of other events in the data.

A.5 Additional Results

Figure 5: Correlation of Residuals with omitted trends

(a) Residual Graph Violent Crimes

(b) Residual Graph Traffic Crimes

(c) Residual Graph Fraud Crimes

(d) Residual Graph Other Crimes
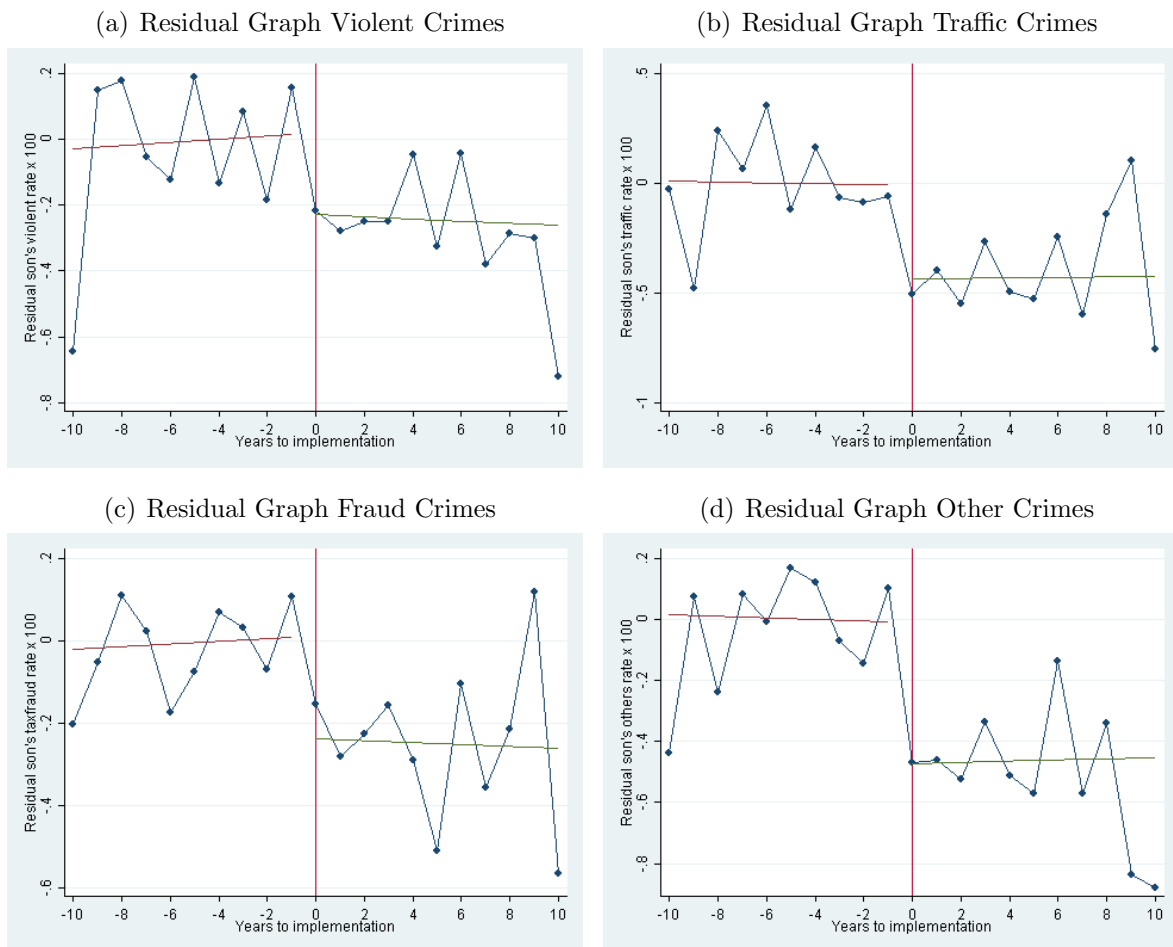

Note: Regression lines fitted to the grouped data using weighted least squares with the weights being the inverse of the variances of each group

Table 10: Impact of the Reform in the Parental Generation

	Men			Women		
	$\widehat{\beta}$	$\overline{y}$	N	$\widehat{\beta}$	$\overline{y}$	N
Log annual earnings (%)	0.964**	9.12	5,997,559	0.293	8.67	5,794,669
	(0.403)			(0.328)		
Cognition (prop of st d)[1]	0.144**	0	8,656	-		
	(0.054)					
Social skills (prop of st d)[1]	0.171***	0	8,656	-		
	(0.077)					
Years of schooling	0.319***	11.34	698,567	0.206***	11.68	672,687
	(0.024)			(0.022)		
Number of children	0.008	1.85	729,257	0.002	1.99	694,388
	(0.006)			(0.005)		
Age at birth childbirth	0.025	27.2	581,947	0.011	24.3	604,562
	(0.034)			(0.037)		
Child born when teenager %	0.096	2.4	729,257	-0.013	13.5	694,388
	(0.074)			(0.217)		
Spouse years of schooling	0.057	11.08	1,323,198	0.093***	10.62	1,311,918
	(0.061)			(0.035)		
Spouse annual Earnings at 40	1,022**	100,799	601,157	1,449**	124,827	587,549
	(402)			(599)		

Notes: [1]The results for cognitive and non-cognitive skills are from Meghir, Palme and Simeonova (2013) and are obtained from a sample restricted to those born in 1948 and 1953 and is therefore much smaller than the full sample used for the other results. The data for cognitive skills are obtained from summing the scores from the four test done for the military enlistment. The score for the non-cognitive skills are obtained from a summary measure of the psychological assessment. Both measures are standardized to have zero mean and unit standard deviation.

Effects on all outcomes are based on the difference-in-differences strategy described in the paper. Standard errors in parenthesis clustered at the municipality level. Spouses annual earnings are based on data from labor earnings including zeros between 1968 and 2014. Year fixed effects are included in the specification and the effects are measured in SEK 1968 prices. SEK 1,022 and 1,499 corresponds to 945 and 1,335 US \$ in 2023 prices, respectively. ***p-value<0.01, ** p-value<0.05.

Table 11: Impact of the Mother's exposed to the Reform on crime in the child generation

Men 429,114								
	All	Multiple	Violent	Property	Drugs	Traffic	Fraud	Others
Reform	-0.092	0.232	0.122	0.255	0.023	-0.062	-0.021	0.030
	(0.337)	(0.198)	(0.107)	(0.188)	(0.100)	(0.201)	(0.095)	(0.168)
Men dep var	25.65	10.77	4.63	8.63	3.12	12.29	3.35	8.08
Women 405,710								
	All	Multiple	Violent	Property	Drugs	Trafic	Fraud	Others
Reform	-0.067	0.089	0.048	-0.045	0.082	-0.024	0.050	-0.055
	(0.147)	(0.066)	(0.040)	(0.102)	(0.051)	(0.063)	(0.065)	(0.050)
Mean	8.11	1.55	0.63	4.13	0.75	1.63	1.54	0.91

Notes: [+]Any convictions: having ever been convicted. [++]Multiple Convictions: two or more convictions at different times. Results are percentage points. Robust standard errors, clustered by birth municipality, in parentheses; The sample are sons and daughters of women born 1945-55 who are fully observed from age 15-29. All regressions include a full set of mother's birth municipality, mother's birth cohort indicator variables, and grandfather's education levels. For the types of crime the counterfactual is "not that crime", whether that is no conviction or some other conviction.

Table 12: Prescribed drugs by main ATC code

	Sons	Daughters
Breakdown of Prescribed Drugs		
Metabolism	-2.66	2.13
	(4.22) [>0.5]	(3.49) [>0.50])
Average doses over the period	165.5	190.8
Cardiovascular	3.91	1.25
	(4.84) [>0.5]	(3.05) [>0.50]
Average doses over the period	154.7	95.1
Nervous system (N)	-15.592*	-8.617
	(6.41), [0.055]	(8.36), [>0.50]
Average doses over the period	316.6	511.0
Respiratory	-3.79	-11.84**
	(3.71) [>0.5]	(4.38) [0.038]
Average doses over the period	197.9	263.9
Breakdown of Nervous System Drugs		
Prescribed drugs, pain killers (N2)	-3.788**	0.261
	(1.35), [0.014]	(2.56), [>0.5]
Average doses over the period	41.8	80.9
Prescribed drugs, calming effect (N5)	-4.690	-10.084**
	(3.55), [0.19]	(3.63), [0.012]
Average doses over the period	96.2	122.9
Prescribed drugs, anti-depressive (N6)	-7.11	1.206
	(3.94), [0.19]	(5.28), [>0.5]
Average doses over the period	178.6	307.2

Notes: Standard errors clustered at the municipality level in round brackets. Romano Wolf step down p-values for each group (Cognitive and non-cognitive skills, Education, Health, drugs and breakdown of drugs) in square brackets. IN this men and women are treated separately *** significance at 1% ** Significance at 5% and * Significance at 10% both based on the RW p-values