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THE ORIGINS OF INTERGENERATIONAL ASSOCIATIONS IN CRIME: LESSONS FROM SWEDISH ADOPTION DATA

by

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The Origins of Intergenerational Associations in Crime: Lessons from Swedish Adoption Data*

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Abstract

We use Swedish adoption data combined with police register data to study parent-son associations in crime. For adopted sons born in Sweden, we have access to the criminal records of both the adopting and biological parents. This allows us to assess the relative importance of pre-birth factors (genes, prenatal environment and perinatal conditions) and post-birth factors for generating parent-son associations in crime. When considering the extensive margin, we find that pre-birth and post-birth factors are both important determinants of sons' convictions and that mothers and fathers contribute equally through these two channels. At the intensive margin, pre-birth factors still matter, however post-birth factors appear to dominate. In particular, adopting mothers appear to matter most for the probability that sons will be convicted of multiple crimes and/or be sentenced to prison. We find little evidence of interaction effects between biological and adoptive parents' criminal convictions. Having more highly educated adoptive parents, however, does appear to mitigate the impact of biological parents' criminality.

Keywords: adoption, crime, illegal behavior, intergenerational crime, intergenerational mobility, risky behavior.

JEL codes: J62, K42.

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1 Introduction

A large body of research provides evidence of substantial intergenerational associations in criminal behavior.[1] The key findings from this literature are that family background (in general) and parental criminality (in particular) are among the strongest predictors of criminal activity, stronger even than one's own income or employment status. Taken together, this literature produces a rich, descriptive picture that highlights the role of the family in perpetuating crime from one generation to the next. Only a handful of these studies, however, have produced convincing empirical evidence concerning the underlying mechanisms that generate these associations and their relative importance.

We aim to fill at least some of the gap in this literature by using Swedish adoption data combined with police register data to study parent-son associations in crime. For adopted sons born in Sweden, we have access to the criminal records of both the adopting and biological parents. This allows us to assess the relative importance of pre-birth factors (genes, prenatal environment and perinatal conditions) and post-birth factors for generating parent-son associations in crime.[2] Our data also allow us to investigate potential interactions between pre-birth and post-birth factors. Evidence of interaction effects may be of particular interest to policy makers, since they directly address questions concerning the malleability of poor pre-birth factors to post-birth interventions.

[1] The modern branch of this literature dates back to the seminal work of Glueck and Glueck (1950). They find that 66 percent of delinquent boys in Boston, Massachusetts had a criminal father compared to 32 percent of non-delinquents. Economists studying intergenerational criminal correlations include Case and Katz (1991), Williams and Sickles (2002), Duncan et al. (2005) and Hjalmarsson and Lindquist (2010, forthcoming). For instance, using data from the Stockholm Birth Cohort Study, Hjalmarsson and Lindquist (forthcoming) find that sons whose fathers have at least one sentence have 2.06 times higher odds of having at least one criminal conviction than sons whose fathers do not have any sentence. For a review of the non-economics literature, see Rowe and Farrington (1997), Thornberry (2009), and Hjalmarsson and Lindquist (forthcoming).

[2] Our work is inspired by Björklund, Lindahl and Plug's (2006) approach to identifying the effects of pre-birth and post-birth factors on intergenerational associations in education, earnings, and income.

In their review of the existing adoption-crime literature, Ishikawa and Raine (2002, p.90) conclude that, "In total, 15 well-executed adoption studies on antisocial behavior have been conducted in Denmark, Sweden, and the United States."[3] Nine of these studies are based on two data sets that include official criminal conviction records for all four parents of an adopted child. The most extensive data set includes register data on 14,427 non-familial adoptions in Denmark between 1924 and 1947 (Hutchings and Mednick 1974). The second data set, which is now known as the Stockholm Adoption Study, was initially comprised of 2,324 individuals born in Stockholm between 1930 and 1949 and adopted at an early age by non-relatives (Bohman 1978).

Using the Danish adoption data, Mednick, Gabrielli and Hutchings (1984) report a statistically significant correlation between adoptees and their biological parents for property crimes, but not for violent crimes. They found no correlation between adoptees and their adoptive parents and no interaction effects between biological and adoptive parents' criminal convictions. In related work, they find no interaction effect between biological parent criminality and urban environment (Gabrielli and Mednick 1984). However, adopting parents' social class does seem to dampen any inherited propensity towards criminal behavior, which speaks in favor of the existence of gene-environment interaction effects (Teilmann van Dusen et al. 1983). Finally, using the Stockholm data, Bohman (1978) found evidence of a genetic predisposition for alcohol abuse, but not for criminality. He argues that the parent-offspring associations in criminality observed in many studies may, in fact, be a byproduct of the familial nature of alcohol abuse.[4]

[3] Rhee and Waldman's (2002) meta-analysis reports a somewhat larger number of studies (26), but they use a broader definition of antisocial behavior and report multiple publications of the same group of authors using the same data set. The major adoption studies, research teams, and data sets directly concerned with criminal behavior discussed in these two review articles are, for all intents and purposes, identical.

[4] Bohman et al. (1982) reanalyzed a subset of this data (862 men) taking into account the type of crime committed and associations with alcohol abuse. They found that criminals who abused alcohol had higher rates of recidivism, longer jail sentences and had committed more violent crimes than criminals without alcohol problems. Non-alcoholic petty criminals had an excess of biological parents with records of petty crimes and no record of alcohol abuse. In

There are, of course, a number of well known adoption studies published in the economics literature (e.g., Sacerdote 2002, Plug and Vijverberg 2003, Björklund et al. 2004, Plug 2004, Björklund et al. 2006, and Sacerdote 2007). These studies explore the importance of pre- and post-birth factors for explaining intergenerational associations in education and earnings.[5] Our study is, in fact, closely related to this strand of literature, since there is a clear connection between crime and the accumulation of human capital (Lochner 2004) that links outcomes of parents and children (Hjalmarsson and Lindquist, forthcoming; Meghir, Palme and Schnabel 2011).

The analysis presented in this paper is based on a newly constructed data set comprised of a large, nationally representative sample of individuals together with information on *all* adoptees. For each individual in the sample, we have matched on all parents (biological and adoptive), brothers and sisters (biological and adopted), and children (biological and adopted). Official crime records for 1973 – 2007 have been matched on for each individual still alive and living in Sweden during this period. Using this new data set, we can replicate the influential study of Mednick, Gabrielli and Hutchings (1984) on the whole population of adopted sons born in Sweden between 1943 and 1967.

We also make several original contributions to the literature. First, the data include all adopted sons born in Sweden between 1943 and 1967, so we can study later cohorts of adoptees (i.e., born after the 1940s) who have grown up in more recent, higher crime environments. Second, we have 35 years of crime data, while the Danish adoptee data includes only three years of crime data, which, as discussed in the text, can potentially yield biases due to measurement

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contrast, the criminal behavior of violent, alcoholic criminals was uncorrelated with that of their biological and adoptive parents.

[5] See Björklund and Jäntti (2009), Black and Devereux (2010), and Holmlund et al. (2011) for reviews of this and related literature.

error. Third, we have detailed information about where individuals reside over time, which can be important if, for example, a parent lives in the countryside and her offspring lives in a big city with significantly higher opportunities for crime or higher detection and conviction rates.

Fourth, and most importantly, we did *not* construct this data set as an adoption cohort. That is, contrary to previous adoption studies, it is not a sample of adoptees only. Thus, we will be able to speak more directly to the question of the generalizability of our results to the population at large. We use adoptees and the classic adoption design, while at the same time running parallel experiments using a representative sample of biological parents and their own-birth children. Under certain assumptions – spelled out in Section 3 – we can generalize our findings concerning the relative importance of pre-birth and post-birth factors to the population at large. This is important since the relevance of the findings from adoption studies for the development of theory and informing social policy largely depends on their generalizability.

We first estimate a simple linear additive model. When defining crime at the extensive margin (i.e., whether an individual has *any* criminal convictions), we find that both pre-birth and post-birth factors are important determinants of sons' convictions. Mothers and fathers contribute equally through pre-birth and post-birth factors. This stands in stark contrast to the current state of the adoption-crime literature; as far as we know, ours is the first study to report positive correlations between adopted sons' and adoptive parents' criminal behaviors. Our explanation for this important difference in findings is quite simple. We believe and demonstrate that it is primarily due to measurement error, which has biased previous estimates of the correlation between adopted children's crime and their adopting parents' crime towards zero.

The importance of both the biological and adoptive parents also persists when we define crime at the intensive margin (i.e., whether an individual is convicted of two or more offenses and/or sentenced to prison). However, at the intensive margin, post-birth channels appear to be

more important than pre-birth channels. The role played by adoptive mothers appears to be particularly important.

We then go on to study interaction effects. We find little evidence of interaction effects between biological and adoptive parents' criminal convictions. But we do find evidence of a pre-birth/post-birth interaction effect between biological parents' criminality and adoptive parents' education. Having more highly educated adoptive parents appears to mitigate the impact of the biological parents' criminality.

The remainder of this paper is organized as follows. Section 2 defines pre-birth and post-birth effects and briefly discusses some of the related literature. In Section 3, we present our statistical models of intergenerational transmission and discuss issues of identification. Section 4 describes the adoption process in Sweden, our data set, and the creation of the adoption and non-adoption samples. It also provides descriptive statistics. Basic results from the linear model are presented in Section 5. In Section 6, we run an extensive set of sensitivity analyses. Section 7 investigates interaction effects between pre- and post-birth factors. Section 8 concludes.

2 Intergenerational Transmission Mechanisms: Pre-Birth and Post-Birth Factors

What are pre-birth factors and why do we believe that they may be important for the reproduction of crime from one generation to the next? Pre-birth factors are the sum of genetic influences, prenatal conditions and perinatal factors, plus all potential interaction effects. Prenatal conditions include intrauterine environmental factors while perinatal factors include obstetric complications and health problems arising shortly after birth.

There are a number of intrauterine environmental factors such as smoking, drinking, taking drugs, exposure to toxic environments and infectious diseases that are directly related to a

child's birth weight, mental and physical health, and cognitive abilities.[6] All of these factors are known correlates of antisocial behavior, including crime. Thus, many researchers believe that poor intrauterine environments play a role in the etiology of criminal behavior (See Mednick and Kandel 1988 and Raine 1993 for reviews of this literature). One example of this type of research from within economics is the paper by Almond (2006). He finds that cohorts that were *in utero* during the 1918 pandemic flu acquired less education, had lower incomes, and higher incarceration rates as adults.

However, since we are trying to explain the observed associations in crime between parents and their offspring, we must be careful when thinking about pre-birth factors such as intrauterine environment and obstetric complications. Purely random effects (such as the 1918 influenza pandemic) that affect unborn children, but are unrelated to a mother's own health status or behavior, will weaken, not strengthen, parent-offspring associations in antisocial behavior. In contrast, a drug using mother's behavior may hurt her child in a way that makes it more likely that her child also uses drugs or exhibits other forms of antisocial behavior. This type of pre-birth mechanism can readily produce correlations in criminal behavior across generations.

A second transmission mechanism is genetics. A large number of conditions and mental disorders are known correlates of criminal behavior and are believed to be (at least partially) genetically inherited. These include (but are not limited to) autism, schizophrenia, alcoholism, attention deficit hyperactivity disorder, aggression, reading disorders, and low cognitive abilities. Thus, genes may affect the chance of developing one (or more) of these conditions. In turn, these types of conditions and disorders tend to raise one's propensity to engage in antisocial behavior and crime (see, e.g., Moffitt and Mednick 1988, Bock and Goode 1996 and Raine 1993).

[6] For brief reviews of the economics literature concerning the "fetal origins" hypothesis, see Almond (2006) and Almond and Currie (2010).

Family resemblances in personality traits and personality disorders may also be partly due to genetics (Loehlin 2005). For instance, genetics may partially determine preferences for giving, risk taking and overconfidence (Cesarini et al. 2009a, Cesarini et al. 2009b) or the propensity to trust others (Reuter et al. 2009). While we know that some personality disorders are related to (and, in some cases, even defined as) antisocial behavior, one could also hypothesize that even more ordinary personality traits such as generosity, trust, and self-confidence may also play a role in determining an individual's propensity to commit crimes.

Despite the potentially large role played by pre-birth factors, most social scientists and psychologists tend to think of the etiology of crime in terms of post-birth factors. These include social mechanisms (e.g., poverty), behavioral mechanisms (e.g., role modeling), psychological mechanisms (e.g., childhood traumas and abuse) and biological mechanisms occurring well after birth (e.g., a head injury or exposure to environmental toxins, such as lead). The mechanisms that are most relevant in this context are those that can help explain criminal behavior and, at the same time, generate parent-offspring correlations.

One such mechanism is that having criminal parents decreases the relative costs of committing a crime, either because there is less stigma associated with having a criminal record or because parental criminality weakens the family's bonds (ties) with legitimate society. Sanctions imposed on a parent as a result of their criminal activity can also affect children's participation in criminal activities. Incarcerating a parent, for instance, can lower the needs-adjusted family income if the parent is a net contributor, yield stigma and decreased supervision for a child, and be a generally disruptive, traumatizing event for a child, which according to strain theory (Agnew, 1992) could increase a child's criminal activity. On the other hand, incarcerating a parent may decrease a child's criminal activity by removing a bad role model, causing a child to

update his beliefs about the expected relative cost of crime, and/or increasing the needs-adjusted family income (if the incarcerated parent was not a net contributor).

Social learning theory posits that individuals learn to engage in crimes through their associations with others, such as peers, classmates, neighbors, and families. Parents, in particular, can serve as role models for their children. They can teach their children (either explicitly or by example) beliefs that are favorable to crime, instead of teaching them that crime is wrong.[7] Social learning is the predominant theory used to explain, for example, the intergenerational transmission of intimate partner violence (Hines and Saudino, 2002). Alternatively, there may be a direct transference of specific criminal capital where, for instance, children are introduced into the parent's networks for obtaining/selling drugs or learn from their parents how to steal a car.[8]

Parental investments in their children's human capital may also generate correlations in criminal activity. Individuals who are endowed with higher schooling from their parents will be most likely to continue investing more in schooling, earn higher wages, and commit fewer crimes. They (and their parents) commit fewer crimes since both generations have higher opportunity costs associated with criminal activity and incarceration. Thus, intergenerational criminal correlations may arise because socioeconomic status is correlated across generations.[9] Neighborhood environments can also generate intergenerational correlations in crime.[10]

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[7] Duncan et. al. (2005) stress the importance of parents as role models for their children. Hjalmarsson and Lindquist (forthcoming) conduct two exercises aimed at testing for potential role model effects. The first exercise focuses on the timing of the father's crime. The second exercise examines whether the intergenerational criminal relationship varies with the quality of the father – child relationship. The results from these two exercises provide indirect evidence that role modeling may play a role in the reproduction of crime from one generation to the next.

[8] See Bayer et. al (2009) for evidence of the transference of crime specific capital amongst peers. See also Butterfield's (2002) *New York Times* article entitled, "Father Steals Best: Crime in an American Family".

[9] We know of two studies within economics that measure the causal impact of parents' socio-economic status on children's crime. Akee et al. (2010) demonstrate that parental income has a causal impact that lowers the probability of minor offences among children and lowers the likelihood that a child self-reports that he/she has sold drugs. Meghir, Palme and Schnabel (2011) show that parental education has a negative causal impact on children's crime.

[10] Evidence concerning the importance of neighborhoods is provided by Ludwig, Duncan and Hirschfield's (2001) and Kling, Ludwig and Katz's (2005) analyses of the Moving to Opportunity experiment. For instance, the latter finds that, relative to control groups, the offer to relocate to lower-poverty areas reduces arrests among female youths

The adoption research design used in this paper does not allow us to separately identify the specific roles of social, behavioral, or psychological mechanisms in the intergenerational transmission of crime. We can only identify their joint importance and relate this quantity to the joint importance of the different pre-birth mechanisms listed above (mainly intrauterine environment and genes). Thus, the purpose of this paper is not to study (for example) the causal impact of parents' crime on their children's crime, but rather to study the relative importance of pre- and post-birth factors in generating correlations in crime across generations. The adoption research design, which we turn to now, also enables us to test for potential interactions between these broad categories of pre- and post-birth factors.

3 Intergenerational Transmission Models

3.1 Linear Model: Identifying Pre- and Post-birth Effects

Equation (1) depicts the typical model used by researchers studying intergenerational criminality.

$$C_j^{bc} = \beta_0 + \beta_1 C_j^{bp} + \nu_j^{bc} \tag{1}$$

Measures of criminal convictions for biological children (superscript *bc*) and their biological parents (superscript *bp*) in family *j* are given by C_j^{bc} and C_j^{bp}, respectively. β_1 indicates the strength of the intergenerational correlation and represents the total effect of the many pre- and post-birth mechanisms described above. We take advantage of the fact that we have crime data for both biological and adoptive parents of adopted children to decompose this correlation into the share due to pre-birth factors and that due to post-birth factors. Specifically, for a sample of adopted individuals, we estimate the following linear, additive model, where criminal convictions

for violent and property crimes and arrests among male youths for violent crimes, though an increase in property crime and other problem behaviors was also observed for males. Even biological determinants of anti-social behavior, such as lead poisoning, may be shared by parents and offspring living in the same toxic environment (Reyes 2007, Currie 2010).

for adopted children (superscript *ac*) and their adoptive parents (superscript *ap*) in family *i* are given by C_i^{ac} and C_i^{ap}, respectively. The terms ν_j^{bc} and ν_i^{ac} are regression error terms.

(2) $$C_i^{ac} = \alpha_0 + \alpha_1 C_j^{bp} + \alpha_2 C_i^{ap} + \nu_i^{ac}$$

Due to large gender differences in criminal convictions and the fact that crime is a predominantly male behavior, equations (1) and (2) are only estimated for sons. Year of birth dummies for sons and each parent are included in the regression to account for the effect of different crime and conviction rates over time and at different stages of the life-cycle. Similarly, we control for county of residence dummies at 5-year intervals for sons and each parent to account for variations in crime and conviction rates across geographic areas and over time.

Under certain assumptions (discussed directly below), α_1 and α_2 are direct measures of the pre-birth and post-birth effects, respectively. Furthermore, if our simple, linear additive model is approximately correct, then the sum of α_1 and α_2 should equal β_1.

3.2 Identification Issues

To interpret α_1 and α_2 in Equation (2) as pre- and post-birth factors, we have to make two assumptions. First, we assume that adoptees are randomly assigned to families or that they are assigned to families according to rules/characteristics that we as researchers can observe and control for. If adoption agencies use information about the biological parents to match children to adoptive parents, then the pre- and post-birth characteristics will be correlated, yielding biased coefficients. Second, we assume that children move immediately to their adopting family. If this assumption is violated, i.e. children do not move until after they are one year old, for instance, then it is possible that the estimated pre-birth effects are too high since they capture some of the post-birth environment; in contrast, the estimated post-birth effects will be too low.

To compare β_1 with $(\alpha_1 + \alpha_2)$, we must make three additional assumptions. First, biological and adopted children are drawn from the same distribution of children. That is, adopted away children have the same pre-birth characteristics as own-birth children. Second, biological and adopting parents are drawn from the same distribution of parents. That is, adoptive parents provide the same post-birth environment as own-birth parents. Third, parents treat adopted and own-birth children similarly.

Many of these assumptions are easily violated. Thus, Section 6 discusses the extent to which the first four assumptions are satisfied and the potential sensitivity of the baseline results to violations of these assumptions.[11]

3.3 Nonlinear Models: Interaction Effects

We then extend equation (2) to allow for possible interactions of pre- and post-birth factors.

$$C_i^{ac} = \alpha_0 + \alpha_1 C_j^{bp} + \alpha_2 C_i^{ap} + \alpha_3 C_j^{bp} C_i^{ap} + u_i^{ac} \quad (3)$$

If the interaction coefficient, α_3, in equation (3) is positive, then this indicates that pre- and post-birth factors are complements in the production of child criminality. That is, children with criminal birth parents who are adopted by criminal adoptive parents are even more likely to become criminal than a similar child who is adopted by non-criminal parents.

However, an adoptive parent's criminality may not be the only relevant variable through which a non-linear effect can occur. Thus, we explore interaction effects between pre-birth

[11] Unfortunately, due to data limitations, we cannot directly test the last assumption. As done by Björklund, Lindahl and Plug (2006), one can potentially test the assumption that parents treat adopted and biological children the same by restricting the analysis to families with both adopted and biological children and comparing the intergenerational correlations. However, we do not pursue this analysis since the sample of such families is relatively small, particularly if one takes into account the fact that we are only studying males and that the guidelines followed by the Swedish authorities indicated that children up for adoption should be placed with families without biological children (and who do not expect to have such children in the future). Thus, families with both biological and adopted children may not be representative of adoptive families in general.

factors and other post-birth, environmental factors, such as education. The question that we want to address is whether or not such post-birth characteristics can offset the effects of pre-birth characteristics? How malleable are the effects of inherited traits with respect to environmental interventions? Equation (4) extends equation (2) to allow for an interaction between the criminal record of the birth parent and characteristics of the adoptive parent, X^{ap}.

$$C_i^{ac} = \alpha_0 + \alpha_1 C_j^{bp} + \alpha_2 C_i^{ap} + \alpha_3 C_j^{bp} X_i^{ap} + \alpha_4 X_i^{ap} + \eta_i^{ac} \tag{4}$$

For comparison purposes, we will also estimate equation (5) for own-birth children, where X_j^{bp} represents post-birth, environmental characteristics of their parents.

$$C_j^{bc} = \beta_0 + \beta_1 C_j^{bp} + \beta_2 C_j^{bp} X_j^{bp} + \beta_3 X_j^{bp} + \eta_j^{bc} \tag{5}$$

4 Institutions and Data

4.1 Adoptions in Sweden

In this subsection, we present a brief overview of the Swedish adoption process. Since the adoptees used in this study are all born in Sweden between 1943 and 1967, we concentrate on the adoption rules and regulations for native born children during this time period.[12] We are particularly interested in three aspects of this process: (i) the timing of the child's placement in the adoptive home, (ii) the selection process used to match children with prospective parents, and (iii) the populations from which these two groups are drawn. These aspects of the process speak directly to the identification strategy used in this and other adoption studies.

In Sweden, all adoptions are decided by the court, which takes into account the advice of the local social authorities concerning the suitability of the prospective adopting parents. The

[12] Our description is based primarily on information taken from three sources: Allmänna Barnhuset (1955), Bohman (1970) and Nordlöf (2001).

placement should be in the child's best interest and no payments were required or allowed from the adopting parents. The biological parents must both give their consent if they are married; only the mother's consent is needed if she is unwed (which was typical).

Adoption of small children was done anonymously.[13] However, the identities of the biological parents (when known) and adopting parents are all recorded in the court decision and kept in the census records as well. In fact, one of the first jobs of the adoption agency's social worker assigned to the case was to attempt to identify the biological father. This is how we can link adopted children to their biological and adopting parents.

There were very few explicit legal requirements concerning who was eligible to adopt a child. Adopting parents had to be at least 25 years old and free of tuberculosis or sexually transmitted diseases. Adoption by relatives was allowed, but very rare. Informally, the local social authorities used the following rules and recommendations. The adopting family must have adequate housing and the adopting father should have a steady income. The couple should be legally married and the adopting mother should be able to stay at home, at least while the child was small. The adopting couple should not have any biological children and it should be highly unlikely that they could in the future. The adopting parents should not be too old; it should be feasible that the mother is the child's biological mother.

The social authorities recommended not placing children with parents with alcohol problems, mental illness or who were engaged in criminal activities. However, prior criminal convictions or drunken incidents did not always preclude parents from adopting. The guidelines

[13] Until 1959, adoptions in Sweden were so-called "weak" adoptions. That is, not all ties between the biological parents and their adopted away child were permanently cut. Biological parents still had a legal responsibility to support the child economically if the new, adopting family could not. Furthermore, the adopted child would still inherit from his/her biological parents. The legalities concerning weak adoptions, however, did not lead to any direct contact between the adopted away child and his/her biological parents. Starting in 1959, all legal ties between biological parents and their adopted away children were permanently cut. From then on, only "strong" adoptions were allowed. In 1971, all weak (pre-1959) adoptions were turned into strong adoptions.

stated that a single drunken incident or petty shoplifting when younger, for example, should not necessarily be grounds for denying a prospective parent the opportunity to adopt. The guidelines recommended looking at the number and types of offenses together with how much time had elapsed since the last offense. Convicted sex offenders, however, were not allowed to adopt.

In their guidelines to social workers, the central social authority (*Socialstyrelsen*) argues that children should never be placed into a particular home at random – not even after conditioning on household income and marital stability. Whenever possible, the social authorities wanted to match children based on their biological parents' intellectual capabilities (i.e., the social worker's subjective opinion concerning intellectual abilities, talents, etc.) and physical appearance (e.g., hair color, eye color, height, etc.). Their hope was that parents would "recognize" themselves in their adopted child and that the child would feel a sense of belonging.

However, after conditioning on a set of readily observables characteristics (age, marital status, income and education), the evaluation literature (reviewed in Bohman 1970) finds no evidence that the social authorities were able to predict which parents would provide the needed emotional environment. It was hard to say *ex ante* who would grow into their role as a parent and who would not. The evaluation literature also argues that it is actually these types of less well defined variables (emotional environment, parenting skills, marital harmony, etc.) that are correlated with adopted children's maladjustment, school performance and anti-social behavior; adoptive parents income, education, etc. are not (Bohman 1970). In this sense, many important "environmental" factors are conditionally randomly assigned to children.[14]

[14] One example of this is that prospective parents were interviewed on health issues and marital harmony. The explicit goal of these interviews was to place children in stable homes with lower chances of dissolution due to death or divorce. Despite these efforts, the sample studied by Bohman (1970) experienced the same rate of parental death and divorce as the population at large and the same rate as the sample of parents who were approved as adoptive parents, but for some reason or another did not end up with an adopted child.

There were four alternative initial placement strategies for newborn children: a special nursery, a home for unwed mothers, temporary foster care, or the home of the adopting family. The relative importance of these four types of placement changed over time. In Stockholm County, for example, the share of babies placed initially in a nursery rose from 15 percent in 1940 to 86 percent in 1973, while the share placed directly in the adopting family fell from 62 to 7 percent (Nordlöf 2001). The share of children that were permanently placed in their adoptive homes before age one rose between 1940 and 1973 from 63 to 83 percent (Nordlöf 2001). The share of children arriving at their permanent adopting home between ages one and two fell from 16 to 11 percent and ages two and three from 10 to 3 percent (Nordlöf 2001). Thus, 90 – 97 percent of all children were permanently placed before age three during this time period.[15]

In general, children born to single, unwed mothers had lower birth weights and poorer health outcomes (Bohman 1970). But prior to 1970, children with visible handicaps, severe health problems or whose parents suffered from severe cases of mental illness, alcoholism or criminality were not always put up for adoption. In many instances, these children were either put into foster care or institutional care. This means that those children who were put up for adoption were a positively selected group from a somewhat negatively selected pool of children (in terms of birth weight, health outcomes and parental histories). The sample of adoptees studied by Bohman (1970), for example, had the same average birth weight and health outcomes (at ages 10 – 11) as their non-adopted peers in school.

[15] The actual placement guidelines in 1945 suggested that a child should be adopted at age one after a six month trial period in the home. In 1968, the guidelines suggested that the baby should be placed with its new family at age 3 – 6 months and be adopted 3 – 4 months later. When these guidelines were not followed, the tendency was to place the baby earlier (rather than later) with the adopting family (Nordlöf 2001). Note also that some adoptees may be misclassified as "late" adoptees, because they were first placed in a foster home and later adopted by their foster parents (Bohman 1970).

4.2 The Data Set and Descriptive Statistics

The data used in this paper were assembled as follows. Statistics Sweden began by drawing a 25 percent random sample from Sweden's Multigenerational Register, which includes all persons born from 1932 onwards who have lived in Sweden at any time since 1961. Statistics Sweden also identified *all* individuals adopted by at least one parent in Sweden. Mothers and fathers, brothers and sisters, and children of each adopted individual as well as each index person in the 25 percent random sample were matched onto the sample. This resulted in a total sample size of 7,551,519 individuals.

Since adoption in Sweden is a centralized legal procedure, the registry data identifies whether a person has been adopted and identifies all adoptive mothers and fathers. For adoptees born in Sweden, we can also identify approximately 64% of their biological mothers and 41% of biological fathers. Longitudinal data concerning, for example, income, education, and geographical location for each individual were then matched on to this sample.

The data set created by Statistics Sweden was then matched with Sweden's official crime register by Sweden's National Council for Crime Prevention. Thus, for all 7.5 million people in our data set, we also have a full record of their criminal convictions for the years 1973 to 2007. As is the case with all studies using administrative crime data, we cannot directly observe criminal behavior, and rather, use convictions as a proxy for criminality. We use this data to construct a number of crime variables. The first variable, *crime*, is a measure of crime at the extensive margin. That is, it is equal to one if a person has ever been convicted of a crime between 1973 and 2007 and zero if he has not. Speeding tickets, parking tickets and other forms of minor disturbances (ticketable offenses) are not included in our crime measure. It must be an offense that is serious enough to be taken up in court and that results in an admission of guilt or a

guilty verdict. We also create variables indicating whether a person has been convicted of each of three types of crimes – violent, property, and other – between 1973 and 2007.[16, 17]

We also create variables that capture the 'degree' of criminal behavior. Specifically, we identify whether each individual has been convicted of two or more crimes, i.e. an intensive margin measure of crime. We also create a variable that indicates whether he has ever been sentenced to prison, *prison*, and determine the total number of days sentenced to prison.

We create two samples – an adoptive sample and a non-adoptive sample – that are used in our baseline analyses. Table 1 lists the sample restrictions that we impose and the corresponding impacts on sample sizes. Our raw data set contains 7,408,029 non-adopted individuals and 143,490 individuals adopted by at least one parent. Restricting our adoption sample to those adopted by both parents reduces it to 91,447 individuals. Further restricting the sample to those for whom *both* the biological mother and father are identified decreases the adoption sample to 12,296 individuals.[18] We create our non-adoption sample by first restricting the sample to the 2,448,397 index persons (i.e. those in the original 25% random sample) and then to the 1,995,876 individuals with both biological parents identified.

For both the adoption and non-adoption samples, we impose the following additional restrictions. Because many of the adoptees with non-identified biological parents are born outside

[16] Violent crimes, or crimes against persons, are crimes covered by chapters 3-7 in the Swedish criminal code (*brottsbalken*). Property crimes are those included in chapters 8-12 in the criminal code. These are standard definitions used by Sweden's National Council for Crime Prevention. All remaining crimes are labeled as "other". The five most common violent crimes are (in order of frequency) assault, molestation, unlawful threat, aggravated assault and aggravated unlawful threat. The five most common property crimes are petty theft (mainly shoplifting), theft, vandalism, larceny and fraud. The five most common "other" crimes are dangerous driving, driving without a license, unlawful driving, smuggling and minor narcotic offenses.

[17] One conviction may include several crimes. Our crime type variables are created by looking over all of the crimes within a single conviction. Thus, if you steal a car, then commit an armed robbery and then get caught after a high-speed chase, you will have one trial and one sentence that include convictions for at least three crime types. In this case, the individual would receive violent = 1 (armed robbery), property = 1 (car theft), and other = 1 (serious traffic offense + resisting arrest).

[18] Section 6.3 addresses the concern that excluding the relatively large proportion of adoptions with unknown biological fathers affects the representativeness of our sample.

Sweden, we eliminate all immigrants. We then eliminate individuals born in 1968 or later. We choose this year as our cutoff because (i) the birth control pill was approved in 1965 and (ii) legal abortions were gradually introduced in Sweden from 1965 to 1975. As a result of these medical and legal changes, biological parents of adopted away children became more negatively selected over time.[19, 20] We also omit individuals born before 1943, as parents of these individuals are quite possibly too old to have a criminal record from 1973 to 2007. Children who died or emigrated from Sweden before 1974 are dropped from the sample, as they cannot show up in the crime data. Likewise, we omit any child who had at least one parent (biological or adoptive) die or emigrate from Sweden before 1974. Finally, we restrict our data to males. Together, these sample restrictions yield a non-adoption sample of 312,747 males and an adoption sample of 4,061 males.

Descriptive statistics are shown in Table 2. The first panel presents statistics for the samples of own-birth (non-adopted) and adopted children. Consistent with the literature that finds that adopted children generally have worse outcomes, we see that adopted sons are more criminal than own-birth sons. A staggering 51% of adopted sons have been convicted, while "only" 36% of own-birth sons have been convicted.[21, 22] Adoptees also have higher conviction

[19] Around 1967 in our data, we see a marked decrease in the average education levels of the biological parents of adopted children relative to the average education level among parents with own-birth children, while the relative education level of adoptive parents is quite stable over time. Similarly, we see an increase in the criminal records of biological parents of adopted away children, but not for other parents.

[20] We have also conducted analyses that consider how sensitive our results are to the chosen cutoff year; the results are, in fact, quite robust. These are available from the authors upon request.

[21] Though these conviction rates may sound high, they are in line with that found in previous research. Using the Stockholm Birth Cohort data, Hjalmarsson and Lindquist (2011) also report that 33% of males born in 1953 and living in Stockholm in 1963 have a criminal record.

[22] One potential concern is that our sample selection procedure yields adoption and own-birth samples that are not representative of the population in terms of crime rates. When considering males born between 1943 and 1967, we find that 51.2% of adopted males who are included in our sample have at least one conviction compared to a conviction rate of 47.9% for adopted males who are excluded from our sample. This difference, however, is completely accounted for by the year of birth. Similarly, own-birth index males who are included in our sample have a higher conviction rate than those that are excluded (36.4% versus 30.9%). This difference is partially explained by

rates than own-birth children in each of the three crime categories. Likewise, 34% of adopted sons compared to 21% of own-birth sons are convicted of two or more crimes and 13% of adoptees have at least one prison sentence while just six percent of own-birth sons do. Finally, adopted children in our sample are approximately two years younger than own-birth children.

The middle panel of Table 2 presents comparable statistics for the birth parents of both own-birth and adopted sons. For adopted children, 16% of biological mothers and 41% of biological fathers have a conviction; this compares to 6 and 19% of biological mothers and fathers for own-birth children. These differences are also observed within each crime category, at the intensive margin, and when considering prison sentences. It is important to note that because we are studying sons born between 1943 and 1967 and because our crime data begins in 1973, all parental crime variables in our study capture crimes committed *after* the birth of the child. Finally, birth parents of adopted children tend to be younger in 1973 (by about six years) than birth parents of own-birth children.

The bottom panel presents the corresponding statistics for adoptive parents. Just 5% of adoptive mothers have a criminal conviction while 14% of adoptive fathers have a record; very few adoptive parents have a violent crime conviction or prison sentence. Only 1% and 4% of adoptive mothers and fathers, respectively, have been convicted of two or more crimes. Finally, adoptive mothers and fathers are approximately 49 and 51 years old in 1973, respectively.

Taken together, these statistics indicate that adopted children come from a negatively selected group of biological parents (i.e., who are more criminal than the birth parents of own-birth children) and are adopted by a positively selected group of parents (i.e., who are less criminal than the birth parents of own-birth children). They also highlight the importance of

variation in the year of birth across the two samples. But, it is also important to point out that the excluded own-birth sample actually has a higher conviction rate for violent crime than the included sample (7.3% versus 6.8%).

controlling for year of birth in the empirical specifications, as adopted children tend to be younger than own-birth children and adoptive parents tend to be older than biological parents.[23]

5 Basic Results: The Linear Model

5.1 The Linear Model for Crime at the Extensive Margin

Table 3 presents the intergenerational transmission estimates for our aggregate measure of criminal convictions at the extensive margin separately for own-birth and adopted children. All regressions include year of birth dummies and county of residence dummies (at 5 year intervals) for all individuals included in the regressions, though for the ease of presentation, these coefficients are not reported.

The top panel of Table 3 presents the results of estimating equation (1) for own-birth children. Overall, these specifications indicate that more criminal parents (mothers and fathers) have more criminal sons. Having a father with at least one conviction increases the sons' chance of conviction by 12.1 percentage points (column 1) while a criminal mother increases his chance of conviction by 13.4 percentage points (column 2). When both the father and mother are simultaneously included (column 3), the mother's effect decreases just slightly to 11.5 percentage points and that of the father to 11.3 percentage points. These decreases indicate that there is some assortative mating with respect to crime. But these decreases are relatively small, suggesting that such sorting may occur less with respect to crime than other dimensions, such as education. Thus, the criminal records of the mother and father appear to play equally important roles in determining the son's likelihood of having a criminal record.

[23] We also see some evidence that the birth parents of adopted children are slightly negatively selected in terms of their average education and income levels. In contrast, adoptive parents are slightly positively selected in terms of education and income.

The middle panel of Table 3 presents the results of estimating equation (2) for the sample of adopted sons. Column (1) shows that the criminal records of the biological and adoptive fathers have approximately equal effects (0.072 and 0.089, respectively). Column (2) finds that the criminal records of the biological and adoptive mothers also have approximately equal, and highly significant, effects on the son's criminal record (0.108 and 0.132). In addition, the mother coefficients are 50% larger than the corresponding father coefficients (i.e., biological mother versus biological father and adoptive mother versus adoptive father); however, these differences are not statistically significant. Including all parents simultaneously (column (3)) minimally affects the coefficients. Though the adoptive parent coefficients increase somewhat and those on the biological parents decrease somewhat, the standard errors are large enough such that these coefficients do not significantly differ from each other.

The result that both adoptive mothers and fathers matter sharply contrasts the findings of Mednick, Gabrielli, and Hutchings (1984), who find no relationship between the criminal records of adoptees and their adoptive parents. One possible explanation for this important difference is that the Danish adoption data set only contains three years of crime records. Given that adoptive parents tend to be positively selected in terms of criminality and that, for the adoptive parents, crime is not being measured at the peak of the crime lifecycle, it is likely that there is a substantial amount of measurement error introduced into the Danish measures of adoptive parent crime. We explored the feasibility of this explanation by "worsening" our data. In particular, we create crime measures that are based on just 3-year time periods (1974-76, 1984-86, 1994-96, and 2004-06) and then re-run our baseline linear model. All of the estimates become substantially

noisier; significant adoptive father effects are found only when crime is measured from 1984-86 and significant adoptive mother effects are never found.[24]

In the bottom panel of Table 3, we report the sums of the biological and adoptive parent coefficients and the corresponding standard errors and confidence intervals. The sums of the biological and adoptive father coefficients do not significantly differ from the own-birth biological father coefficient. However, the sums of the mother coefficients tend to be somewhat larger than the own-birth mother coefficients; the own-birth mother coefficient falls just outside the 95% confidence interval around the sums.

There are a number of lessons that can be taken away from these adoption results. First, biological mothers and fathers matter. Second, the criminal records of both adoptive mothers and fathers matter; the adoptive mother appears particularly important. The third lesson is based on a comparison of the strength of the adoptive and biological coefficients. Pre- and post-birth maternal factors are equally important. That is, a mother's influence on her son's criminality occurs equally through pre- and post-birth channels. Similarly, pre- and post-birth paternal channels are equally important. The fourth lesson indicates that the act of being adopted has minimal impact on the strength of the father-son intergenerational criminal relationship, as the total impact of the biological and adoptive fathers' criminality on the criminality of the adopted sons is very similar to the impact of the criminality of the biological fathers on that of their biological sons. However, the sums of the biological and adoptive mother coefficients are somewhat larger than the mother coefficients for own-birth children (we return to this result in Section 6).

[24] Results are available from the authors upon request.

5.2 The Linear Model for Crime at the Extensive Margin Across Crime Categories

Table 4 presents extensive margin results by crime type for our three sub-categories of crime: violent, property, and other. We consider these specifications to see whether the baseline results presented in Table 3 are driven by a particular type of crime and to compare our findings to those in the prior literature. It is not our goal to test hypotheses about the differential role of nature versus nurture across crime categories.

We begin with the results for own-birth children. First, we see that mothers and fathers have an approximately equal impact in all three crime categories. Having a violent mother increases the likelihood that the son has a conviction for a violent crime by approximately 13 percentage points while having a violent father increases the likelihood by about 12 percentage points. For property crimes, the corresponding intergenerational relationship for both mothers and fathers is an impact of about 15 percentage points while it is 10 percentage points for other crimes. Therefore, the same pattern is seen across crime categories as when looking at overall convictions – the criminal records of mothers and fathers are equally important.

The middle panel of Table 4 presents the results of estimating equation (2) for the sample of adopted sons for each crime category. Biological fathers play a significant role in each crime category. Having a biological father convicted of a violent crime increases the likelihood that the son has such a conviction by 6.9 percentage points. In contrast, Mednick et al. (1984) and Bohman et al. (1982) found no correlation in violent crime between adopted children and their biological parents.[25] Violent criminal convictions of the adoptive father, on the other hand, do not

[25] Once again, this can potentially be explained by there being a substantial amount of measurement error in the Danish measures of parents' violent crime, due to the 3-year time period during which the data spans. As we did for the extensive margin total crime results, we explored the feasibility of this explanation by creating measures of violent crime based on just 3-year time periods (1974-76, 1984-86, 1994-96, and 2004-06) and re-ran the set of experiments presented in this Section. Again, all of the estimates become substantially noisier and we no longer find a significant correlation between biological parents' violent crime and that of their adopted away son.

play a significant role. (It is important to recall, however, that the proportion of adoptive fathers with a violent criminal record is extremely low.)

The same pattern (important biological father, unimportant adoptive father) is also seen for property crimes, with a biological father coefficient of 0.098. For the 'other' crime category, we see that *both* biological and adoptive fathers are about equally important. Having a biological father convicted of an 'other' crime increases the likelihood that the son has such a conviction by 10.4 percentage points, while the corresponding effect of the adoptive father is 8.6 percentage points. Thus, it appears that it is adoptive fathers convicted of other crimes, as opposed to violent or property crimes, who are driving the estimate of the baseline adoptive father effect (Table 3).

Biological mothers also play a significant role in each crime category. Having a biological mother convicted of a violent crime increases the likelihood of a son's conviction by 13.9 percentage points. The corresponding estimates for the biological mother for property crimes and other crimes are 16.0 and 11.5 percentage points, respectively. Adoptive mothers have a large and significant impact on both the son's property crime record (0.104) and other crime record (0.141).

How do these crime specific results relate to the lessons learned from the baseline extensive margin specifications? The first lesson was that biological mothers and fathers matter. This pattern persists across all three crime categories. The second lesson was that the criminal records of both adoptive mothers and fathers matter. We see that the adoptive father result is being exclusively driven by the "other" crime category and that the adoptive mother result is being driven by both the property and other crime categories. The third lesson indicated that pre- and post-birth channels were equally important. This statement only holds true for both maternal and paternal factors with respect to other crimes and maternal factors for property crimes. Pre-birth factors may matter more than post-birth factors for violent crimes. This result, however,

may be an artifact of small sample bias, since so few adoptive parents have been convicted of violent crimes. Finally, the fourth lesson indicated that the act of being adopted has minimal impact on the strength of the father-son intergenerational criminal relationship and increases the strength of the mother-son relationship (somewhat). Looking at the 95% confidence interval around the sums of the biological and adoptive coefficients, we see that the violent crime and property crime own-birth coefficients fall within the intervals. In contrast, three of the four 'other' crime own-birth coefficients fall just below the interval. It should also be noted that some of these intervals are quite large.

5.3 The Linear Model for Crime at the Intensive Margin

Table 5 presents the intergenerational transmission estimates for those who have been convicted of two or more crimes[26] (column 1), for those who have been sentenced to prison at least once (column 2), and for the total number of days an individual has been sentenced to prison (column 3). These specifications are meant to measure the degree of intergenerational transmission of more serious criminal behavior, where we are proxying for more serious criminal behavior with repeat offending and crimes serious enough to warrant a prison sentence. As in Table 3, the top panel presents the results for own-birth children, the middle panel presents the results for adoptive children, and the bottom panel presents the sums of the coefficients from the adoptive children regressions.

The top panel of Table 5 indicates that sons whose fathers (mothers) have been convicted of two or more crimes are 15.3 (18.0) percentage points more likely to be convicted of multiple

[26] An individual is defined as having been convicted of two or more crimes if he has only one conviction that includes two or more crimes or if he has two or more convictions. The same qualitative pattern of results is seen when this intensive margin variable is defined as those who have been convicted of three or more crimes. These estimates, however, are not as precise due to a substantial decrease in the proportion of individuals who have committed three or more crimes.

crimes themselves. In the adoptive son regressions, the coefficients for all four parents are significant. Column (1) shows that sons are 7.1 percentage points more likely to have been convicted of multiple offenses if their biological father has been convicted of multiple offenses and 14.5 percentage points if their adoptive father has been convicted of multiple offenses. The corresponding effects of the biological and adoptive mothers are 8.2 and 25.6 percentage points, respectively.[27] Thus, as was the case in the extensive margin: (i) *both* biological mothers and fathers matter and (ii) *both* adoptive mothers and fathers matter. In contrast to the extensive margin, however, post-birth channels appear to be somewhat more important than pre-birth channels. Finally, none of the sums of the biological and adoptive parent coefficients in the bottom panel significantly differ from the corresponding own-birth regression coefficients.[28]

Our estimates of the intergenerational transmission of receiving a prison sentence and the total length of the prison sentence show a similar pattern. For own birth sons, we see significant effects of both the biological mother and father, with the mother effect being significantly larger. For instance, own-birth sons are 10.6 percentage points more likely to be sentenced to prison if their father has a prison sentence and 18.9 percentage points more likely if their mother has a prison sentence. For adoptive sons, the point estimates for the adoptive mother and father are larger than the respective biological mother and father estimates. However, these estimates are also much less precisely measured, and only the biological father and adoptive mother coefficients are significant. We caution the reader with respect to these results, however, as a

[27] Specifications that consider the intensive margin by crime type indicate that the large adoptive mother effect is not driven by a single crime category. In contrast, the adoptive father effect at the intensive margin appears to be driven by the "other" crime category, just as it was at the extensive margin. Overall, the results from the intensive margin regressions by crime type do not lead us to amend the lessons learned.

[28] When we define the intensive margin as multiple convictions, instead of multiple crimes, then the adoptive father and biological father coefficients are of equal magnitude. The adoptive mother coefficients, however, still dominate the biological mother coefficients.

very small proportion of parents, particularly adoptive fathers and mothers, have prison sentences (see Table 2).

6 Robustness of Basic Results and Comparison to Educational Outcomes

6.1 Nonrandom Assignment

The above discussions interpret the coefficients on the biological parents as pre-birth factors and those on the adoptive parents as post-birth factors. Interpreting the results in this way implies that we are assuming that adoptees are randomly assigned to families, or that they are assigned to families according to rules/characteristics that we as researchers can observe and control for. This section considers the extent to which nonrandom assignment is an issue in our study.[29]

We first investigate the relationship between the criminal records of the adoptive and biological parents in Table 6. If there is random assignment of adopted children to adoptive parents, then the criminal records of the biological parents should be unrelated to those of the adoptive parents. The top panel presents the analysis using the extensive margin crime variable while the bottom panel uses the intensive margin (i.e., 2 or more crimes) variable. In columns (1) and (2), we regress the criminal record of the adoptive father on those of the biological father and mother. At the extensive margin, adopted sons with criminal biological fathers are 3.9 percentage points more likely to have a criminal adoptive father. At the intensive margin, adopted sons with criminal biological fathers are 1.7 percentage points more likely to have a criminal adoptive father. However, at both margins, there is no relationship between the criminal records of the biological mother and adoptive father. To allow for the possibility that any non-random assignment is driven by year of birth or geography, column (3) controls for year of birth and 5-

[29] It is important to note that random assignment is an assumption that is implicit in most adoption studies. One of the unique features of our data set is that we can actually test the extent to which this assumption is true. Many adoption studies cannot do this, as they often lack information about the biological parents.

year county of residence dummies. Column (4) adds controls for the biological mother and father's education and the log of average real income. These additional controls decrease the magnitude of the extensive margin biological father coefficient to 0.027 and that of the intensive margin coefficient to 0.004, which becomes insignificant. Columns (5) – (8) replicate this analysis for the adoptive mother. Even when no controls are included, there is no relationship between the criminal records of either of the biological parents and adoptive mothers at both the extensive and intensive margins.

Thus, this analysis finds some evidence of non-random assignment and that Swedish authorities placed adopted children with adoptive parents similar to their biological parents. This is particularly true for the matching of biological and adoptive fathers. However, even in this case, some of the relationship is accounted for by observables (all of it in the intensive margin case).

Another way to think about the issue of nonrandom assignment is as an omitted variables problem. That is, we would expect omitted pre-birth factors to be correlated with the adoptive parents' criminal record, biasing our estimate of α_2, and omitted post-birth factors to be correlated with the biological parents' criminal record, biasing our estimate of α_1. How concerned should we be about omitted variables? To answer this question, we define column (1) of Table 3 as the baseline result for fathers (biological and adoptive). Similarly, we define column (2) of Table 3 as the baseline results for mothers. These estimates are reported in row (1) of Table 7. Row (2) of Table 7 considers how sensitive the adoptive parent coefficients (i.e., the post-birth estimates) are to excluding the variables for the biological parents. The coefficients on the adoptive father and mother change minimally. Row (3) conducts the same exercise for biological parents: that is, how sensitive are the pre-birth estimates to excluding the criminal

records, year of birth, and region of residence dummies for the adoptive parent? Again, there is very little impact on the baseline results for the biological parents.

Rows (4) and (5) conduct the opposite exercise. Rather than excluding biological and adoptive parents' characteristics, we assess how sensitive the baseline results are to adding information about the parents. Row (4) controls for the biological parent's years of education and income and row (5) controls for comparable measures for the adoptive parent. Including these controls has virtually no impact on the estimated coefficients. Thus, despite the fact that we find some evidence of the existence of nonrandom assignment, Table 7 indicates that our baseline results are not particularly sensitive to this issue.

6.2 Adoption Age

Thus far, we have been working under the assumption that adopted children are placed in their new adoptive families at birth. If a significant number of adoptees are not placed in their new families as babies, then we risk overestimating pre-birth effects and underestimating post-birth effects. Unfortunately, we do not have any reliable information concerning the date of adoption. We do know, however, that very few children stayed with their birth parents after being born (Bohman 1970, Nordlöf 2001, Björklund et al. 2006) and can, therefore, safely assume that the birth parent estimates include only pre-birth influences of these parents.

Our post-birth effects, however, could still be biased (downwards) if children experience two post-birth environments (the post-delivery placement and the adoptive family environment) that have differential impacts on a child's later outcomes. Nordlöf (2001) reports that the share of children in Stockholm County that were permanently placed in their adoptive homes before age one rose between 1940 and 1973 from 63 to 83 percent (Nordlöf 2001). Using nationwide data

drawn from the same sources as our own data, Björklund et al. (2006) report that 80 percent of adoptees born in the 1960s were living with their new families before age one.

Although a large majority of our children were most likely placed as babies, a non-trivial share may have experienced extended post-delivery placements longer than 12 months.[30] If such placements affected later outcomes in a manner different than what otherwise would have occurred if the child had been placed directly in the adopting family, then we may be underestimating the post-birth effects of these children's adopting parents.[31] This, in turn, would lower the average effect in the whole sample.

6.3 Unknown fathers

Another concern is that our estimates are biased as a result of the restriction that both biological parents are identified. Given that the biological father is only known for about 40% of Swedish born adoptees, it is certainly possible that this sample is not representative. To assess the extent to which this is a concern, row (6) of Table 7 presents results when extending the sample of adoptees to all adoptions where the biological mother is identified, i.e. regardless of whether the biological father is known. This increases the sample of adopted males to 8,403. Though the coefficients on the biological and adoptive mother decrease somewhat compared to our baseline, these changes are generally not significant and the same qualitative pattern is seen. Pre- and post-birth maternal factors are still equally important determinants of the son's criminal record.

[30] Some adoptees may be misclassified as "late" adoptees, because they were first placed in a foster home and later adopted by their foster parents (Bohman 1970).

[31] We say "may be" biased because this bias also assumes a particular form of the family production function. In particular, it assumes that parents cannot or do not compensate for their child's extended post-delivery placement with larger investments. It could also be that the particular lesson of "don't steal" only needs to be learned once or that it cannot be taught to children until they have reached a certain age.

6.4 Comparable Samples

Here, we address the potential problem that adopted children and their parents are different from other children and parents. Adoptive parents tend to be somewhat older and less likely to appear in the police register while biological parents of adopted away children are younger and more likely to appear in the register.

Despite these apparent differences, we have, thus far, been comparing our intergenerational estimates for adoptees directly to the full population of own-birth children and parents. To investigate whether this is a reasonable comparison, we re-estimate our baseline results using two different, more comparable samples. The first sample addresses the issue that adoptive parents tend to be positively selected, so that adopted children may face advantageous post-birth environments. In particular, we create a sample consisting of own-birth children and their parents, but we require that the parents have similar observables to those of *adoptive parents*. In contrast, the second new sample consists of own-birth children and their parents, where the parents are required to have similar observables to the *biological parents of adopted away children*. This sample addresses the issue that adopted children may be endowed with less advantageous pre-birth characteristics, since biological parents tend to be negatively selected. Both samples are created using a propensity score matching method.[32]

Rows (8) and (9) of Table 7 present the results of re-estimating our baseline intergenerational association for these new samples of own-birth children and parents. We assess whether these new estimates are similar to the baseline presented in column (3) of Table 3 (see

[32] We employed a nearest neighbor matching method without replacement. In case of a tie, we included both neighbors. Adopted sons were matched to own-birth sons using an estimated propensity score. The propensity score was estimated using a probit model with adopted (yes=1, no=0) as the dependent variable. Regressors included the child's birth year, mother's age at child's birth, father's age at child's birth, mother's income, father's income, mother's education, father's education, mother's criminal record and father's criminal record. When estimating the propensity score for our first sample of "positively" selected parents, we included both biological parents with own-birth children and adoptive parents. When estimating the score for our second sample of "negatively" selected parents, we included biological parents with own-birth children and the biological parents of adopted away children.

also row (7) of Table 7). Three out of four new point estimates are not significantly different from the baseline estimates and are very close to their baseline counterparts. The new estimate for slightly older and positively selected mothers (0.186) reported in row (8) of Table 7 is significantly larger than our baseline mother estimate at the 10% level, but is quite close to the sum of biological and adoptive mother coefficients (0.205) reported earlier in Table 3. Taken together, these results imply that slightly older mothers in families with somewhat higher incomes and educations may have a larger influence over their sons' criminal activity than the average mother.

The main message from this exercise, however, is that our baseline estimates (and comparisons) are generally not sensitive to the fact that adopted children and their adoptive parents are different from other parents and children. These differences do not translate into meaningful differences in the estimated intergenerational association in crime.

6.5 Comparison to Educational Outcomes

Before continuing with our exploration of potential interaction effects, we would like to compare our results from Tables 3 and 5 with similar estimates for high school completion and years of schooling.[33] These estimates (reported in Table 8) are comparable to those reported in Björklund et al. (2004, 2006). There are two results in Table 8 that we would like to emphasize. First, the own-birth intergenerational association in high school completion is about twice that for our extensive margin measure of crime. It lies closer to our intensive margin measure of crime, especially for mothers. The second, perhaps more interesting result is that for our crime outcomes, the adoptive mother and father coefficients are larger than the corresponding

[33] Our dichotomous variable for high school completion (yes=1 or no=0) is defined as having completed a 3-year gymnasium degree or a higher degree. Education levels, 1 to 7, are translated into years of schooling as follows; level 1 = 7 years, level 2 = 9 years, level 3 = 11 years, level 4 = 12 years, level 5 = 14 years, level 6 = 15.5 years, and level 7 = 19 years.

biological parent coefficients for both the extensive and intensive margin crime specifications. In contrast, the reverse is true in three out of four cases for our educational outcomes. Thus, an intriguing hypothesis is that "nurture" matters relatively more for intergenerational associations in crime than it does for intergenerational associations in education. In particular, the role of adopting mothers is much larger for criminal outcomes than for educational outcomes.

7 Nonlinear Models

Table 9 presents the results of estimating equation (3) using our baseline measure of crime (at least one conviction in any crime category). However, in order to raise the precision of our estimates, we look at biological and adopting parents as couples. Thus, we create variables indicating whether: (i) neither biological parent has any convictions, (ii) just one biological parent has a conviction, and (iii) both biological parents have a conviction. We also create a parallel set of variables for adoptive parents. Using these measures rather than looking at the criminal behavior of each parent separately does not change the main lesson taken away from our baseline specifications: both biological and adoptive parents matter for the transmission of crime and parents contribute equally through pre- and post-birth channels.

In addition, in column (1), we see that the intergenerational transmission of criminal convictions is particular strong for sons with parents who both have at least one conviction. This is seen for both biological parents and adopting parents. Relative to sons from no conviction households, sons are more than 18 (23) percentage points more likely to have a conviction if both biological (adoptive) parents have been convicted. These effects are more than twice the size of those for sons from households with just one convicted parent. This may be due to selectivity, or it may arise from a type of nonlinearity that we have not discussed so far. It may be the case that

parental crime *within* a biological or adopting couple may not have an additive effect on children's crime and could possibly be multiplicative.

The specification presented in column (1) also includes interactions between these biological parent conviction variables and a dummy indicating that neither adoptive parent has a conviction. We find negative (crime reducing) effects of the interactions. However, these estimates are both quite small and very imprecise.[34] The small size of these effects speaks in favor of the linear additive model of intergenerational transmission of crime.

However, crime of the adopting parents may not be the most salient environmental factor. We, therefore, investigate the possibility that the adoptive parents' education may interact with pre-birth factors. More generally, we are interested in knowing how malleable pre-birth factors are to post-birth interventions, such as the provision of public schooling.

These results are reported in column (2) of Table 9. Once again (to make things more precise) we treat mothers and fathers (both biological and adopting) as couples and not separately as individuals. To measure adoptive parent schooling, we create a dichotomous variable that equals one if the sum of the adopting mother's *and* father's schooling is greater than the median. Column (2) includes interactions between this measure of the adoptive parents' education and whether: (i) one biological parent has been convicted, and (ii) both biological parents have convictions. We see that both of the interaction terms are negative. Furthermore, the interaction term between having two biological parents with convictions – but being adopted into a family with a high level of education – is negative, large, and significant at the 10% level. Thus, there is some evidence that placement with highly educated adoptive parents mitigates the effect of coming from a poor pre-birth environment.

[34] When we try looking at parents one at a time, as opposed to treating them as couples, these estimate become even more imprecise.

8 Conclusions

There are a number of lessons that can be learned from our paper about the origins of intergenerational criminal associations. First, biological parents – fathers and mothers – matter. In addition, we see that biological parents matter for sons at both the extensive and intensive margins and in all crime categories: violent, property, and other. This contrasts previous studies that have only found correlations between biological parents' and their adopted away children's convictions for property crimes (see, e.g., Bohman et al. 1982 and Mednick et al. 1984).

The second lesson is that the criminal records of both adoptive mothers and fathers matter, regardless of whether crime is measured at the extensive or intensive margin; adoptive mothers, however, appear to be particularly important. These new results stand in sharp contrast to the existing adoption-crime literature, which reports no significant associations between the criminal records of adopted children and their adopting parents (see, e.g., Bohman et al. 1982 and Mednick et al. 1984). In fact, this is the first study that we know of that documents a positive correlation between adopted sons' and adoptive parents' criminal behavior. As argued in the paper, we believe that earlier studies were plagued by measurement error that biased their results towards zero.

The third lesson is that, at the extensive margin, a mother's influence on her child's criminality occurs approximately equally through pre-birth and post-birth channels. The same holds true for a father's influence. However, at the intensive margin, post-birth channels appear to be more important than pre-birth channels and adoptive mothers are particularly important. The fourth lesson indicates that the act of being adopted has minimal impact on the overall strength of the intergenerational criminal relationship.

Finally, consistent with Mednick, Gabrielli, and Hutchings (1984), we find little evidence of an interaction effect between biological and adoptive parents' convictions. We do, however,

find significant interactions between adoptive parents' education and biological parents' criminality. Most importantly, we find that adoptive parents' education appears to mitigate the negative impact of poor pre-birth factors. This implies that parental education may play a particularly important role in preventing crime and that poor pre-birth factors do not necessarily lead to poor life outcomes in a purely deterministic fashion.

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Table 1. Sample Restrictions

Sample Restriction	Index Non-Adoptees	All Adoptees	Change in Non-Adoptees	Change in Adoptees
All individuals adopted by at least one parent		143,490		
Keep Only those Adopted by both parents		91,447		52,043
All non-adopted individuals	7,408,029			
All index non-adopted individuals	2,448,397		4,959,632	
Keep those for whom both biological parents are identified	1,995,876	12,296	452,521	79,151
Keep Non-immigrants	1,896,197	12,226	99,679	70
Drop individuals born in 1968 or later	849,378	9,553	1,046,819	2,673
Drop individuals born in 1942 or earlier	670,201	9,316	179,177	237
Omit those who died or emigrated from Sweden before 1974	659,908	9,250	10,293	66
Omit those who had at least one parent die or emigrate from Sweden before 1974	611,139	7,732	48,769	1,518
Keep males	312,747	4,061	298,392	3,671

Table 2. Descriptive Statistics

	Own birth children		*Adopted Children*	
	Mean	*SD*	*Mean*	*SD*
Son's Crime	0.36	0.48	0.51	0.50
Son's Violent Crime	0.07	0.25	0.13	0.33
Son's Property Crime	0.14	0.35	0.26	0.44
Son's Other Crime	0.31	0.46	0.45	0.50
Son's Crime > 1	0.21	0.40	0.34	0.48
Son's Prison	0.06	0.25	0.13	0.34
Son's Days Prison	26.0	249	62.7	370
Son's Age in 2007	51.6	7.34	49.2	6.52
Son's Birth Year	1955	7.34	1958	6.52
		Birth Parents		
Mother's Crime	0.06	0.23	0.16	0.37
Mother's Violent Crime	0.002	0.04	0.01	0.11
Mother's Property Crime	0.02	0.15	0.10	0.30
Mother's Other Crime	0.04	0.19	0.09	0.28
Mother's Crime > 1	0.02	0.13	0.08	0.27
Mother's Prison	0.001	0.04	0.01	0.11
Mother's Days Prison	0.33	27.6	4.97	96.1
Mother's Age in 1973	45.5	10.0	39.2	8.76
Father's Crime	0.19	0.39	0.41	0.49
Father's Violent Crime	0.02	0.13	0.09	0.28
Father's Property Crime	0.05	0.21	0.18	0.38
Father's Other Crime	0.16	0.37	0.33	0.47
Father's Crime > 1	0.08	0.27	0.25	0.44
Father's Prison	0.03	0.16	0.11	0.31
Father's Days Prison	5.12	92.2	34.0	263
Father's Age in 1973	48.9	10.58	42.8	9.77
		Adoptive Parents		
Mother's Crime			0.05	0.21
Mother's Violent Crime			0.001	0.02
Mother's Property Crime			0.02	0.13
Mother's Other Crime			0.03	0.18
Mother's Crime > 1			0.01	0.09
Mother's Prison			0.001	0.02
Mother's Days Prison			0.01	0.67
Mother's Age in 1973			48.5	9.63
Father's Crime			0.14	0.35
Father's Violent Crime			0.01	0.07
Father's Property Crime			0.02	0.15
Father's Other Crime			0.12	0.32
Father's Crime > 1			0.04	0.20
Father's Prison			0.01	0.09
Father's Days Prison			1.44	32.0
Father's Age in 1973			51.2	9.77

Table 3. Baseline Results (Any Conviction)

	(1)	(2)	(3)
Own Birth Children			
crime_biofather	0.121***		0.113***
	[0.002]		[0.002]
crime_biomother		0.134***	0.115***
		[0.004]	[0.004]
Adoptive Children			
crime_biofather	0.072***		0.058***
	[0.018]		[0.020]
crime_biomother		0.108***	0.097***
		[0.024]	[0.026]
crime_adfather	0.089***		0.090***
	[0.025]		[0.028]
crime_admother		0.132***	0.138***
		[0.041]	[0.045]
Sum of biological and adoptive father coefficients	0.162		0.148
	[0.030]		[0.034]
	0.102-0.221		0.082-0.214
Sum of biological and adoptive mother coefficients		0.24	0.235
		[0.048]	[0.052]
		0.147-0.333	0.132-0.337
Year of Birth Dummies	YES	YES	YES
5 Year County of Residence Dummies	YES	YES	YES
Biological Observations	312747	312747	312747
Adoptive Observations	4061	4061	4061

This table presents results from OLS regressions of a dummy variable indicating whether the child has been convicted of at least one crime on a dummy variable indicating whether the parent has been convicted of at least one crime. Robust standard errors in brackets; * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 4. Extensive Margin Baseline Results by Crime Type: Violent, Property and Other.

	Violent Crime			Property Crime			Other Crime		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Own Birth Children									
crime_biofather	0.117***		0.113***	0.155***		0.143***	0.104***		0.099***
	[0.003]		[0.003]	[0.003]		[0.003]	[0.002]		[0.002]
crime_biomother		0.134***	0.124***		0.153***	0.133***		0.107***	0.092***
		[0.010]	[0.010]		[0.004]	[0.004]		[0.004]	[0.004]
Adoptive Children									
crime_biofather	0.069***		0.073***	0.098***		0.105***	0.104***		0.088***
	[0.022]		[0.024]	[0.021]		[0.023]	[0.019]		[0.021]
crime_biomother		0.139***	0.169***		0.160***	0.151***		0.115***	0.108***
		[0.051]	[0.058]		[0.026]	[0.029]		[0.031]	[0.034]
crime_adfather	-0.055		-0.042	0.005		-0.027	0.086***		0.094***
	[0.085]		[0.091]	[0.051]		[0.056]	[0.027]		[0.030]
crime_admother		-	-		0.104*	0.122*		0.141***	0.108**
					[0.061]	[0.067]		[0.049]	[0.054]
Sum of biological and adoptive father coefficients	0.014		0.031	0.103		0.078	0.19		0.182
	[0.088]		[0.094]	[0.055]		[0.060]	[0.032]		[0.035]
	-0.158-0.186		-0.153-0.215	-0.004-0.210		-0.040-0.196	0.128-0.253		0.113-0.251
Sum of biological and adoptive mother coefficients		0.139	0.169		0.265	0.273		0.255	0.216
		[0.051]	[0.058]		[0.066]	[0.073]		[0.057]	[0.063]
		0.039-0.238	0.055-0.284		0.134-0.395	0.130-0.416		0.143-0.368	0.092-0.339
Biological Observations	312747	312747	312747	312747	312747	312747	312747	312747	312747
Adoptive Observations	4061	4061	4061	4061	4061	4061	4061	4061	4061

Standard errors in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%. All specifications include year of birth dummies and five year county of residence dummies.

Table 5. Results for Multiple Crimes and Prison Sentences.

	(1) 2 or More Crimes	(2) Prison (yes=1, no =0)	(3) Log(Days Sentenced to Prison+1)
Own Birth Children			
Biofather	0.153***	0.106***	0.136***
	[0.003]	[0.004]	[0.006]
Biomother	0.180***	0.189***	0.283***
	[0.007]	[0.021]	[0.031]
Adoptive Children			
Biofather	0.071***	0.095***	0.111***
	[0.022]	[0.023]	[0.025]
Biomother	0.082**	0.053	0.060
	[0.037]	[0.068]	[0.072]
Adfather	0.145***	0.115	0.190
	[0.047]	[0.099]	[0.139]
Admother	0.256**	0.429†	0.550†
	[0.105]	[0.271]	[0.343]
Sum of biological and adoptive father coefficients	0.215	0.209	0.300
	[0.052]	[0.100]	[0.140]
95% confidence interval	0.114-0.317	0.013-0.406	0.025-0.575
Sum of biological and adoptive mother coefficients	0.338	0.483	0.610
	[0.110]	[0.280]	[0.351]
95% confidence interval	0.120-0.491	-0.066-1.032	-0.077-1.298
Year of birth dummies	YES	YES	YES
County of residence dummies at 5 year intervals	YES	YES	YES
Biological Observations	312747	312747	312747
Adoptive Observations	4061	4061	4061

This table presents results from OLS regressions. Robust standard errors in brackets; † significant at 11%; * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 6. Testing for Non-Random Assignment: Regressions of Adoptive Parent Crime on Biological Parents

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent Variable:		Crime_adfather				Crime_admother		
Extensive Margin: Any Crime Conviction								
crime_biofather	0.039***	0.039***	0.025**	0.027**		-0.001	-0.006	-0.007
	[0.011]	[0.011]	[0.012]	[0.013]		[0.007]	[0.008]	[0.008]
crime_biomother		0.015	-0.005	-0.002	0.001	0.001	-0.005	-0.005
		[0.015]	[0.016]	[0.016]	[0.009]	[0.009]	[0.010]	[0.010]
R-squared	0	0	0.14	0.14	0	0	0.15	0.15
Intensive Margin: 2 or More Convictions								
crime_biofather	0.017**	0.017**	0.006	0.004		0.001	0	0
	[0.007]	[0.007]	[0.008]	[0.008]		[0.003]	[0.004]	[0.004]
crime_biomother		-0.006	-0.01	-0.008	0.005	0.005	0.005	0.004
		[0.012]	[0.013]	[0.013]	[0.005]	[0.005]	[0.006]	[0.006]
R-squared	0	0	0.14	0.14	0	0	0.11	0.11
Year of Birth and 5-year region of residence dummies	NO	NO	YES	YES	NO	NO	YES	YES
Education and Income controls	NO	NO	NO	YES	NO	NO	NO	YES
Observations	4061	4061	4061	4061	4061	4061	4061	4061

Standard errors in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 7. Sensitivity Analysis: Alternative Samples and Specifications for the Overall Crime Conviction Variable

		Fathers		Mothers		
		Bio	Adopt	Bio	Adopt	N
	Adopted Children					
(1)	Baseline Results (from Table 3)	0.072***	0.089***	0.108***	0.132***	4,061
		[0.018]	[0.025]	[0.024]	[0.041]	
	Test for Non-Random Assignment					
(2)	Exclude biological parent crime and characteristics		0.091***		0.128***	4,061
			[0.024]		[0.039]	
(3)	Exclude adoptive parent crime and characteristics	0.078***		0.114***		4,061
		[0.017]		[0.023]		
(4)	Include biological parent education and income	0.062***	0.090***	0.104***	0.132***	4,061
		[0.018]	[0.025]	[0.024]	[0.041]	
(5)	Include adoptive parent education and income	0.072***	0.088***	0.108***	0.134	4,061
		[0.018]	[0.025]	[0.024]	[0.041]	
	Missing Biological Fathers					
(6)	Include all with identified biological mothers			0.078***	0.075***	8,403
				[0.016]	[0.027]	
	Own-Birth Children					
	Comparable Samples					
(7)	Baseline Results (column (3) of Table 3)	0.113***		0.115***		312747
		[0.002]		[0.004]		
(8)	Positively Selected Parents: Characteristics match those of adoptive parents	0.138***		0.186***		3921
		[0.026]		[0.040]		
(9)	Negatively Selected Parents: Characteristics match those of biological parents with adopted away children	0.123***		0.111***		3538
		[0.020]		[0.026]		

Regressions include birth year dummies and county dummies (at 5 year intervals) for all persons. Robust standard errors in brackets; * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 8. A Comparison of Crime Outcomes to Educational Outcomes.

	Convicted of one or more crimes	Education level: 3-year high school or more
Own birth children		
Birth father	0.113***	0.263***
	[0.002]	[0.002]
Birth mother	0.115***	0.201***
	[0.004]	[0.003]
Adopted children		
Biological father	0.058***	0.088***
	[0.020]	[0.034]
Biological mother	0.097***	0.107***
	[0.026]	[0.030]
Adoptive father	0.090***	0.212***
	[0.028]	[0.044]
Adoptive mother	0.138***	0.058
	[0.045]	[0.039]

	Convicted of two or more crimes	Years of schooling
Own birth children		
Birth father	0.153***	0.222***
	[0.003]	[0.002]
Birth mother	0.180***	0.160***
	[0.007]	[0.002]
Adopted children		
Biological father	0.071***	0.080***
	[0.022]	[0.022]
Biological mother	0.082**	0.091***
	[0.037]	[0.024]
Adoptive father	0.145***	0.074***
	[0.047]	[0.020]
Adoptive mother	0.256**	0.042*
	[0.105]	[0.022]

Regressions include birth year dummies and county dummies (at 5 year intervals) for all persons. Robust standard errors in brackets; * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 9. Non-Linear Specifications for Adopted Sons.

	(1)	(2)
Biological mother OR father convicted	0.065	0.063**
	[0.048]	[0.031]
Biological mother AND father convicted	0.188**	0.233***
	[0.084]	[0.053]
Adopting mother OR father convicted	0.083**	0.092***
	[0.039]	[0.027]
Adopting mother AND father convicted	0.230***	0.269***
	[0.084]	[0.083]
Biological mother OR father convicted *Adopting parents have NO convictions	-0.006	
	[0.052]	
Biological mother AND father convicted *Adopting parents have NO convictions	-0.019	
	[0.093]	
Adopting parents have education above median		-0.008
		[0.031]
Biological mother OR father convicted *Adopting parents have education above median		-0.007
		[0.042]
Biological mother AND father convicted *Adopting parents have education above median		-0.139*
		[0.077]

Dependent variable is *Crime*. Regressions include birth year dummies and county dummies (at 5 year intervals) for all persons. Robust standard errors in brackets; * significant at 10%; ** significant at 5%; *** significant at 1%.