Child's Gender, Young Fathers' Crime, and Spillover Effects in Criminal Behavior

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Men who father their first child at a very young age are convicted of significantly fewer crimes in the first years after birth if the child is a son rather than a daughter. This leads to behavioral spillovers that reduce criminal convictions among other young men living in the same neighborhood, with the resulting crime multipliers affecting peers' crime even after the primary impact on the focal individual has dissipated. Through social multipliers, prevention policies that target potential criminals at an early stage, therefore, lead to larger reductions in the cost of crime than suggested by primary effects alone.

I. Introduction

Understanding which mechanisms lead to within-group spillovers in criminal behavior is essential for the optimal design and cost effectiveness of

We thank James Heckman, Courtney Brell, and three anonymous referees for constructive and helpful comments and suggestions. Dustmann acknowledges funding by a European Research Council (ERC) advanced grant (MCLPS 833861), the Deutsche Forschungsgemeinschaft (DFG) grant 1024/1-2 AOBJ:642097, and the NORFACE (New Opportunities for Research Funding Agency Cooperation in Europe) program. Information about the data is provided as supplementary material online. This paper was edited by James Heckman.

Journal of Political Economy, volume 129, number 12, December 2021.

Electronically published October 19, 2021

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crime prevention policies. One key problem is the nonrandom selection of individuals into groups (see Heckman 1979; Heckman and Robb 1986; see Blume et al. [2015] for a discussion), which previous work has addressed by using research designs based on (re)allocation experiments (e.g., Ludwig and Kling 2007; Damm and Dustmann 2014).¹ These designs, while providing insights into whether crime of one individual varies with the broader crime rate in a quasi-random reference group, do not establish whether an individual's behavior is influenced by the behavior or by the characteristics of other group members.² Identifying these mechanisms separately is, nevertheless, crucial as only the former gives rise to multiplier effects, which are fundamental for group dynamics studied in economics (e.g., Glaeser, Sacerdote, and Scheinkman 1996, 2003), sociology, and criminology.³

In this paper, we propose a novel design to estimate the spillovers from interactions in criminal behavior. The basic idea that underlies our identification is to reverse the experiment: rather than studying how variation in the composition of the reference group affects an individual's behavior, we study how an exogenous change to one focal individual's criminal behavior in a fixed group affects the other group members. Any response of other individuals in the group following one individual's exogenous change in criminal behavior must then be due to behavioral interactions.

The key challenges in implementing such a design are to identify exogenous variation in the criminal behavior of a single individual that is not directly affecting others, and then to measure the derived impact this has on peers. Based on administrative data from Denmark, our research design uses the gender of a firstborn child as an exogenous event that induces variation in young fathers' criminal behavior. Our study focuses on males who father a child between the ages of 15 and 20, an age range in which crime rates peak. Fathering a child at such a young age is unusual and signals both adverse characteristics related to risky behavior and a general disadvantaged background. As such, the young men who will go on to be young fathers are a particularly high crime group.

We find sizeable and significant effects of having a son versus a daughter on young fathers' crime rates, measured either as convictions or charges for crimes committed in the years after the first child's birth. Specifically,

¹ See also Case and Katz (1991) for an early nonexperimental study, and Sacerdote (2001), Kremer and Levy (2008), Carrell and Hoekstra (2010), Deming (2011), Drago and Galbiati (2012), and Billings, Deming, and Ross (2016) for related work.

² These two distinct reasons for spillovers are often labeled *endogenous* and *exogenous/contextual* social interactions (Manski 1993, 2000), respectively. In contrast, *correlated* effects are not based on social interactions but on group members facing the same environment.

³ See, e.g., social bond theory (Hirschi 1969), social control theory (Gottfredson and Hirschi 1990), and studies of group dynamics in crime (Thrasher 1927; Short and Strodtbeck 1965; Papachristos 2009).

the probability of being convicted for a crime is about 17% lower for fathers of boys than girls in the first year after the child's birth, and even a decade later the young fathers have accumulated fewer crime convictions if they fathered a boy. This result complements the substantial body of studies providing evidence that parents respond to their children's gender, and in particular the work of Morgan, Lye, and Condran (1988), Dahl and Moretti (2008), Mammen (2008), and Garcia, Heckman, and Ziff (2018), who show that (some) fathers are more invested in their families when they father a boy compared to a girl.⁴ Our results further strengthen the conjecture that males' investments in their families constitute an important factor in their desistance from crime (e.g., Laub, Nagin, and Sampson 1998) and indicate that the young fathers decide to act more responsibly and as a role model when they father a boy.

Having identified a response of young fathers to their child's gender, we then investigate whether the birth of a son rather than a daughter also leads to changes in the criminal behavior of a father's peers, defined as all young men within an age range of ± 3 years from the father's age and who lived in the father's immediate neighborhood before the child was born.⁵ While there are no differences in peers' crime rates before the child is born, we show that the birth of a boy rather than a girl reduces the probability of the father's peers being convicted for a crime committed in the first year after childbirth from 6.29% to 5.85% (a reduction of 7.3% relative to the sample mean). The effect increases (and remains significant) for at least 10 years after birth. We further demonstrate that the childgender effect is driven by fathers with prebirth characteristics that are highly predictive of crime, and that peers' responses are similarly concentrated among younger, at-risk peers, and in the neighborhoods of the most crime-prone fathers.

Furthermore, we analyze victimization rates constructed from individual crime reports. Victimization is a more robust measure of crime, as crime convictions and charges only record crimes for which the offender is identified. Again, there are no differences in the prebirth period between victimization rates in neighborhoods of young men who father a boy and a girl, but significant gaps emerge after birth.

⁵ Our findings are robust to alternative definitions of the peer group. For instance, effects are similar when we define peers as males who were aged 14–25 and lived in the father's neighborhood at the time of the child's birth.

⁴ Lundberg and Rose (2002, 2003) find that children's gender affects marriage probabilities and labor supply. Bennedsen et al. (2007) use gender of first-born children to instrument CEO family successions in Danish firms. Warner (1991), Warner and Steel (1999), and Oswald and Powdthavee (2010) show that parents sympathize more with women's rights and vote more liberal when they have a girl rather than a boy. Washington (2008) shows that a legislator's number of daughters affects voting behavior, particularly on bills relating to reproductive rights. Maurin and Moschion (2009) use children's gender composition to provide exogenous variation in female labor force participation and thereby study spillovers of labor force participation between neighbors.

We also study responses to child gender for fathers who are between 21 and 25 years old when their first child is born. In contrast to the very young fathers who are the focus of our analysis, the observable characteristics of fathers between 21 and 25 are similar to males within the same age range in the general population. We find no effect of child gender on either their crime or on their labor market outcomes. This nonresponse provides us with a "placebo" test by studying whether there are any associations between child gender and peers' crime or victimization rates for this group of fathers. We find none.

We then formulate a linear social interaction model that builds on work by, for example, Glaeser, Sacerdote, and Scheinkman (2003), Calvó-Armengol, Petacchini, and Zenou (2005), Ballester, Calvó-Armengol, and Zenou (2006), Bramoullé, Djebbari, and Fortin (2009), and Blume et al. (2011, 2015). We show that randomness of child's gender identifies the structural parameters of the model that characterize the direct effect of child gender on father's crime and the degree of strategic complementarity (or strength of social ties) between peers. When estimating the structural parameters, we allow the strength of social ties to vary by population density. Our estimates indicate that about 10% of the estimated reducedform effect of child gender on father's crime is due to spillovers back from peers to fathers (i.e., the reduction in father's crime reduces criminal activity of his peers, which in turn feeds back to the father, and so on). Moreover, we find substantial heterogeneity in the strength of social ties by neighborhood population density.

Based on our estimates for the strength of social ties between peers, we estimate the average social multiplier in criminal activity to be 5. This implies that if a young father were to commit one less crime (for which he would have been convicted), this would result in him and his peers being convicted of a total of around five fewer crimes over the following years, because the effects on criminal behavior bounce back and forth between peers. As the strength of social ties differs according to population density, these averages cover a substantial heterogeneity: we estimate the social multiplier to be 3 in low-population-density neighborhoods and 6 in high-population-density neighborhoods.

Thus, our design that relies on the randomness of child's gender allows us to causally establish the existence of a core mechanism in the literature on crime networks (see, e.g., Calvó-Armengol and Zenou 2004; Calvó-Armengol, Petacchini, and Zenou 2005; Ballester, Calvó-Armengol, and Zenou 2006, 2010; Lindquist and Zenou 2014): the spillover of one individual's behavior onto that of other individuals. Our estimates also provide the first causal evidence that population density matters for the magnitude of social multipliers, providing empirical support for Calvó-Armengol and Zenou (2004), whose model predicts increasing social multipliers as the density of network links increases. Moreover, our finding of

stronger multipliers in crime in more densely populated neighborhoods due to higher spillover intensity may also partly explain why crime rates are higher in cities (Glaeser, Sacerdote, and Scheinkman 1996; Glaeser and Sacerdote 1998; Zenou 2003).

We use our estimates to quantify the potential benefits of reducing the crime rates of young males with risk markers that are often observable to policy makers, police, and social workers. Evidence in Heckman et al. (2010) and Elango et al. (2015) illustrates large potential benefits from early childhood interventions to children with disadvantaged backgrounds, including, among others, subsequent reductions in criminal behavior. Our calculations show that social multipliers substantially increase the benefits of crime reductions over those suggested by the primary effects alone, and that this is particularly the case for densely populated neighborhoods.

The paper is structured as follows: In section II we describe the institutional settings of criminal justice in Denmark, as well as our data and samples. In section III we outline our empirical reduced-form approach to identify the effects of child gender. In section IV we first confirm the randomness of child gender using balancing tests, before presenting the effects of child gender on the father's criminal activity, peers' criminal activity, and local victimization rates. In section V we outline and estimate a model of spillovers in crime to identify social multipliers, and we discuss the potential consequences these may have for the effectiveness of policy interventions. Section VI concludes the paper.

II. Background, Data, and Descriptives

A. Criminal Justice and Youth Crime in Denmark

The age of criminal responsibility in Denmark is 15, after which adolescents are considered fully responsible and subject to imprisonment, albeit in different facilities than adults.⁶ We measure crime based on charges or convictions for offenses against the criminal code. Convictions, our preferred crime measure, are court rulings that a suspect is guilty.⁷ Arrests, a common measure of crime in the United States, are not frequent in Denmark, but figure A1 (figs. A1–A7 are available online) shows that charge

 7 We observe all charges and convictions even after deletion of the criminal record from the individual's file.

⁶ This is high by international standards. The United Kingdom, in comparison, sets the age of criminal responsibility at 10, while only a few US states have any limit, usually set between 6 and 12 years (see http://pmg-assets.s3-website-eu-west-1.amazonaws.com/docs/2003/appendices/030310minimumage.htm for more detail). See also the Danish Service Act (https://www.retsinformation.dk/Forms/R0710.aspx?id=167849). Denmark does not have a juvenile court as, e.g., in the United States, but underage criminals (<18) are less often sentenced to imprisonment, and the offender should, if possible, serve his/her sentence in a secured institution. For an extensive overview of the youth crime justice system in Denmark, see Kyvsgaard (2003).

rates in Denmark follow the same age pattern as arrest rates in the United States in both 1995 and 2000.

The Danish Central Police Register categorizes crimes by type (see table A1 (tables A1–A12 are available online) for a detailed breakdown). Throughout the analysis, we omit traffic offenses.⁸ We always relate charges and convictions to the date of the crime itself. Figure 1 shows the probability of receiving a criminal conviction by age, which peaks around age 19 to 20.

B. Data and Samples

We construct three samples from Danish full population register data: (i) a main sample of young first-time fathers, (ii) a neighborhood sample of peers, and (iii) a victim sample. The samples are constructed using information from seven registers: the birth, demographic, crime, income, education, occupational, and residential registers. Each register contains a unique anonymized individual identifier that allows us to link them, and the birth and demographic registers also include parents' unique identifiers allowing us to link families. In addition, the residential register includes a unique anonymized identifier of the home addresses that allows us to link individuals living in the same neighborhood. Appendix A (apps. A and B are available online) describes the data and sample selection in detail.

We define our main sample of young fathers as all males who father their first child at age 20 or younger based on information from the birth register and demographic register. Data with exact information on the date crimes were committed are available from 1990 onward, so we focus on children born between 1991 and 2004, which results in a total of 408,093 first-time fathers. Restricting our sample further to first-time fathers aged 20 or below at childbirth with information on both parents from birth (of the child) onward for up to 5 subsequent years results in 3,579 fathers. Focusing on those who can be matched to neighborhood information results in our main estimation sample of 2,803 first-time fathers.⁹

⁸ We also define three subcategories of crime: *property crime, violent crime*, and a residual *other crime* category (see table A1). Property crime encompasses (from the most to the least prevalent in our sample) theft, fencing, aggravated vandalism, fraud, burglary, forgery, and economic crimes. Violent crime (similarly prioritized) covers simple violence (assault), severe or life-threatening violence, threats, violence against or obstructing a public servant, failure to help or assist an individual in (life-threatening) danger, coercion, and attempted murder or homicide. Other crime (in order of prevalence) includes possession of drugs, sale of drugs, possession of weapons/explosives, giving false testimony in courts, and sexual crimes (e.g., rape).

⁹ Because our neighborhood classification is constructed in 2004 (see below), we are unable to match 441 fathers from earlier cohorts to neighborhoods. When two or more young fathers have their first child in the same neighborhood in the same year (which occurs in 154 neighborhoods for a total of 335 fathers), we exclude these. These exclusions result in a loss of 776 observations. We limit our results to the sample that can be matched uniquely to a neighborhood in a given year to ensure compatibility with the neighborhood analysis, but we report also results for father's crime for the full sample, which are very similar.



FIG. 1.—Probability of being convicted of a crime by age. The figure shows the probability for the full population of males in Denmark in 2003, by age at date of the crime, excluding traffic offenses. Source: Our own calculations based on data from Statistics Denmark.

The neighborhood sample of peers consists of individuals living in the fathers' neighborhoods on January 1 of the year the child was born (i.e., before the child was born). We define neighborhoods based on the classification documented in Damm and Schultz-Nielsen (2008). We link unique anonymized identifiers of home addresses within each neighborhood with the unique anonymized individual identifiers in the full population demographic register. Hence, we identify all individuals in each neighborhood in a given year, including each young father and his potential peers. We discard the young fathers themselves and their family members from the neighborhood sample. We also remove the 154 neighborhoods in which more than one father from our main sample had his first child the same year (included in robustness checks). We then define "peers" as all males ± 3 years from the focal father's age. This resulting sample contains 101,132 males from 2,114 different neighborhoods, and each individual is linked to the crime registers. In an alternative analysis, we define "peers" as all males in the neighborhood between the ages of 14 and 25 at the time of the child's birth. In both cases the peer group is composed of individuals residing in the same neighborhood as the focal father on January 1 of the year the child is born, no matter whether fathers or peers move out of the area after that date.

Figure A2 shows the distributions of peer group sizes. Most neighborhoods include around 20-40 males within ± 3 years of fathers' age and 30-60 males aged 14–25 at the child's birth. To enhance the homogeneity of

neighborhood sizes and to avoid potential confounding influence of outliers, we exclude the largest and smallest 5% of neighborhoods from most estimations, but excluding only the largest 1% produces similar results, as we show below.

We also show results for peers of first-time fathers aged 21–25 (sample constructed as described for young fathers). As we will show in section IV, in contrast to the young fathers in our main sample, these slightly older fathers do not respond to the gender of their child, and so we do not expect any response from their peers.

The construction of the victim sample is based on information in the Danish register data about individuals who report having been the victim of a crime, which is available from 2001 onward. Our victim sample includes all individuals who lived in the same neighborhood as the father as of January 1 of the year when the child was born, no matter whether they leave the area after childbirth. This results in 702 different neighborhoods (a number smaller than for the neighborhood sample of peers due to the shorter time span with available victim data) in which we identify the exact number of individuals in each neighborhood who were victims of a crime.¹⁰ Again, we exclude the smallest and largest 5% of neighborhoods to avoid any potential confounding influence of outliers, thereby arriving at a sample of 524,314 individuals. We also generate a victim sample for fathers aged 21–25.

C. Descriptive Evidence

1. Sample Characteristics

Figure 2*A* shows the age distribution of the young fathers and corresponding mothers at the birth of the father's first child. Whereas our sample selection truncates the distribution of fathers at age 20, the age distribution of the mothers is relatively symmetric around age 20, with a sizeable fraction being over 20 at childbirth.¹¹ The fathers studied here are far younger than the modal age of 29 for first-time fathers in Denmark between 1991 and 2004 (as seen in fig. 2*B*).¹² This deviation from the norm is reflected

¹⁰ The victimization and crime conviction estimates are not identical for two reasons. First, not all crime is solved, and we can only match a crime to a father or his peer if they are identified as the offenders (i.e., convicted or charged). In contrast, the victimization data record crimes irrespective of whether the offender is apprehended or not. Second, the victimization data only record the crimes committed against individuals (and not, e.g., shoplifting), and therefore predominantly contain violent crimes.

¹¹ We find no significant differences in the effects of a child's gender on fathers' crime across mothers' age.

¹² There were no nationwide initiatives to young parents from 1991 to 2004, apart from the general services that all parents receive: prenatal ultrasound screening, general practitioner/midwife counseling, and postnatal home-nurse visits.



B) Full population density of age at childbirth for all first time fathers, 1991-2004



FIG. 2.—Histogram of parents' age at childbirth. Panel A shows a histogram of age at childbirth for our main sample of fathers and a histogram of age at childbirth for the mothers (of the fathers' first child). Panel B shows the histogram of age at first child for the full population of first-time fathers from years 1991–2004. The vertical line marks the age cutoff we use in our sample definition. Source: Our own calculations based on data from Statistics Denmark. A color version of this figure is available online.

in table 1, which shows summary statistics for the main sample of young fathers in column 1 and differences in these characteristics across child gender in column 2. Column 3 presents the *p*-value for the null hypothesis that these characteristics are the same between fathers who father a boy

	Sample of Young Fathers (1)	Boy/Girl Difference (2)	<i>p</i> -Value of Boy/Girl Difference (3)	Age/Year Matched Sample to the Young Fathers (4)
Gender of child $(1 = male)$.505			
Father's ware income	(.500)			
(1 000 9010 LISD)	14 599	- 440	212	10 774
(1,000 2010 USD)	(11544)	(426)	.515	(12 019)
Father was redshirted in	(11.344)	(.430)		(13.018)
primary school	946	- 001	070	118
primary school	(481)	(016)	.570	(292)
Father is nonnative	(.431)	(.010)		(.323)
(immigrant/descendant)	149	015	954	040
(initingrant/ descendant)	(340)	(013)	.434	(194)
Father's parents are married	(.343)	(.013)		(.154)
or cohabiting	578	-0.90	176	750
or contabiling	(494)	(015)	.170	(433)
Father's parents' household wage	(.151)	(.013)		(.155)
income (1 000 2010 USD)	59 464	-2.002	150	78 497
meome (1,000 2010 CSD)	(36844)	(1.392)	.150	(47100)
Father of father's years of	(00.011)	(1.002)		(17.100)
schooling	10 556	-071	254	12 099
sentooning	(2824)	(107)	.401	(3139)
Father of father is employed	687	.007	664	.851
runter of numer is employed	(.431)	(.016)	.001	(.356)
Father of father is unemployed	.109	.004	.688	.058
	(.289)	(.011)		(.234)
Mother of father's years of schooling	9.826	.118	.187	11.544
8	(2.373)	(.090)		(2.976)
Mother of father is employed	.602	.003	.883	.800
1 /	(.466)	(.018)		(.400)
Mother of father is unemployed	.134	$003^{'}$.838	.067
1 7	(.325)	(.012)		(.250)
Observations	2,803	. ,		30,360

		TABL	E 1		
SUMMARY	STATISTICS	OF MAIN	SAMPLE OF	f Young	FATHERS

SOURCE.—Our own calculations based on data from Statistics Denmark.

NOTE.—Column 1 shows summary statistics for the main sample of young fathers and their parents. Column 2 shows mean differences of the variables by gender of the child, and col. 3 shows *p*-values from *t*-tests for differences of the means. Column 4 shows the equivalent measures for a sample drawn from the full Danish population with the same age and year distribution as the sample of young fathers. Standard deviations appear below the sample means in cols. 1 and 4, and standard errors appear below mean differences in col. 2.

versus a girl. None of these background characteristics differ significantly by children's gender, something we will return to in sections III and IV.

For comparison, column 4 shows characteristics of a sample from the full Danish population, matched to the young fathers by age and year of observation. This reveals stark differences in average characteristics as compared to our sample of young fathers shown in column 1. Young fathers have less

schooling and are far more likely to be redshirted during school (from delayed school entry or by repeating a grade). The share of young fathers who are nonnative is more than 3 times the share for similarly aged males. They also have lower wage income, and their fathers and mothers have lower employment rates, higher unemployment rates, and fewer years of schooling.¹³ All this suggests that individuals who father a child at a very young age are from disadvantaged backgrounds. Figure A3 illustrates that the disadvantage generally began long before the father's first child was born, with their parents' employment rates consistently below employment rates of average young males' parents, and with young fathers' parents being less likely to be married or cohabiting.

2. Crime and Convictions

We define *crime* as any criminal act (except traffic offenses) for which the perpetrator is later convicted. Alternatively, we measure crime as charges. We measure victimization by crimes reported against a person or his/her property, no matter whether the offender was identified or not. Our precise information on date of birth and crime allows us to calculate the exact time between a birth and a given crime, and so we construct variables for being convicted (charged) for a crime and the number of convictions (charges) for crimes committed within each year from the first to the tenth year after childbirth.

Table 2 reports the fractions of young fathers who have been convicted for a crime committed prior to the conception of their first child, as well as analogous conviction rates for male family members of the focal father, and other young males in the neighborhood (cols. 1, 3, and 5, respectively). In columns 2, 4, and 6 we report the equivalent conviction rates for random samples of males from the general Danish population matched by age and year to the young fathers (col. 2), from the full population (col. 4), and from the general population matched by age and year to the peer groups of focal fathers (col. 6). A comparison across columns shows that not only are the young fathers highly prone to commit crimes (34% carry a conviction for a crime committed before the pregnancy compared to 12% of equally aged males in the same years); they also come from families whose other male members have a high conviction probability (30% vs. 16% for the overall Danish male population).¹⁴ The conviction rate for other young men between the ages of 14 and 25 who live in the focal father's

 $^{^{13}}$ The 14.2% of young fathers with nonnative background are 7.92% of Turkish, 1.50% of (former) Yugoslavian, 0.82% of Pakistani, 0.68% of Lebanese or Palestinian, and 0.96% of European origin. The remaining 2.35% are of various nonwestern backgrounds.

¹⁴ Average crime rates in Denmark (Scandinavian countries) are comparable with those in the United States (see OECD [2005, 207] and http://www.oecdbetterlifeindex.org/topics /safety), but differ in the rates of specific crime types such as gun violence and homicides.

		Random Sample of		Full Male		Matched to Young
	Main Sample of Young Fathers (1)	Males Matched to the Young Fathers (2)	Male Family Members (3)	Population Aged 15–60 (4)	Young Males in Neighborhood (5)	Males in Neighborhoods (6)
Crime	.339	.124	.303	.158	.173	.119
	(.473)	(.329)	(.460)	(.365)	(.783)	(.234)
Property crime	.287	.098	.228	.108	.126	160.
	(.452)	(.297)	(.419)	(.311)	(.607)	(.288)
Violent crime	.065	.019	.076	.028	.016	.021
	(.247)	(.136)	(.265)	(.166)	(.150)	(.143)
Observations	2,803	30,360	3,797	1,691,931	152,660	132,414

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60 year olds from 1991 to 2004 with the same year distribution as the main sample of fathers. The sample in col. 6 consists of young males in a random sample of neighborhoods, where the young males in the random sample are weighted by age and year to match the young males in the main sample's NOTE.— The table shows the fraction of individuals who have been convicted of a crime for the main sample of young fathers, their maie family mem-bers, and young males in the young fathers' neighborhoods in cols. 1, 3, and 5, respectively. The random sample in col. 2 has been drawn from the full Danish population weighted by age and year to match the young fathers. The sample in col. 4 is a random draw from the full male population of 15– neighborhoods. Standard deviations appear in parentheses below means.

neighborhood in the year of childbirth are, at 17%, substantially below the analogous rate for young fathers, but roughly 5 percentage points (45%) higher than the average for 14–25 year olds with a similar age profile. Thus, young fathers appear to live in neighborhoods with peers that are more crime prone than the average young male.

Overall, this suggests that young fathers are particularly predisposed to criminal activities, and that they come from crime-prone and disadvantaged families. Further, peers in the young fathers' neighborhoods are more likely to carry convictions compared to similar youths in Denmark. But even compared to their peers, the young fathers are among the most criminal individuals. Many young fathers commit crime after the birth of their first child (and continue to have higher crime rates than their peers; cf. the outcome means presented in tables 3 and 5 below), and the young fathers' prepregnancy crime convictions strongly predict postbirth crime (table A2).

III. Empirical Approach and Identification of Child-Gender Effects

Our basic empirical analysis proceeds in two steps, where we first estimate the average effect of the birth of a boy versus a girl on young fathers' crime, and then estimate how this same event affects the crime of other young males living in the fathers' immediate neighborhoods when the child is born.

We measure crime $y_{it,n(i)}^F$ as either the probability that father *i* living in neighborhood n(i) has committed a crime in year *t* after childbirth for which he is later convicted (charged), or as the accumulated number of crimes he committed from the birth until year *t* for which he is later convicted (charged). We estimate regressions of the following form:

$$y_{it,n(i)}^{F} = a + \beta_{i}^{F} g_{i,n(i)} + X_{i,n(i)} b + \epsilon_{it,n(i)},$$
(1)

where the dummy $g_{i,n(i)}$ equals 1 if the child born to father *i* in neighborhood n(i) is a boy and zero otherwise. The parameter β_t^F measures the causal effect of child gender on crime outcomes in year *t* after childbirth.¹⁵ The vector $X_{i,n(i)}$ collects variables that represent individual-specific or family characteristics, measured at the time of the child's conception.¹⁶ Given the exogeneity of child gender (i.e., that $E(\epsilon_{it,n(i)}|g_{i,n(i)}) = \text{Cov}(g_{i,n(i)}, X_{i,n(i)}) = 0$), these variables do not affect the point estimates but only improve precision.

¹⁵ We report heteroskedastic-consistent standard errors for all regression results. Standard errors for eq. (2) are clustered at the level of the young fathers.

¹⁶ The vector $X_{i,n(i)}$ includes father's and mother's age, preconception cohabitation status, years of schooling, and income (if any), as well as indicators for crime convictions in the father's family before the child's conception.

In the second step, we seek to identify spillovers from the effect that child gender has on fathers onto other young males living in the neighborhood. Here, we focus on all males ± 3 years of the father's age, or alternatively all males age 14–25 at the birth of the focal father's child. We estimate the following:

$$y_{jt,n(i)}^{P} = \tilde{a} + \beta_{t}^{P} g_{i,n(i)} + \eta_{j,n(i)}, \qquad (2)$$

where $y_{jt,n(i)}^{p}$ measures convictions/charges of peer *j*, or whether peer *j* has been convicted/charged at least once, *t* years after the child's birth in neighborhood n(i) where father *i* is living when the child is born. The parameter β_t^p measures the effect of father *i* in neighborhood n(i) fathering a boy rather than a girl on peers' crime *t* years after childbirth.

The reduced-form parameters β_t^r in (1) and β_t^p in (2) measure not only the direct effect that child gender has on fathers' crime and peers' crime via the fathers' response, but also subsequent recursive spillovers through peers influencing each other. Hence, the estimates are scaled up by a social multiplier that depends on the dynamics of social connections and criminal behavior in peer groups.¹⁷

We run similar individual level regressions for the victim sample, with the dependent variable $y_{jt,n(i)}^{V}$ representing whether individual *j* living in neighborhood n(i) on January 1 in the year the child was born was a victim of crime in year *t* after the child's birth. We also investigate heterogeneity in fathers' responses to child gender and in spillovers to peers by including interactions between child gender and prebirth characteristics.

In section V, we link the reduced-form parameters β_t^F and β_t^P in equations (1) and (2) to structural parameters that characterize a linear social interaction model of crime. Using the model, we estimate the pure child-gender effect net of feedback from peers, the strength of social ties that determine spillover effects, and the social multiplier.

IV. Results

A. Balancing Tests

The key assumption for our identification strategy is that child gender is unrelated to preconception characteristics of the father and the neighborhood he lives in. The .505 share of boys in our sample of 2,803 children is very similar to the .502 share of boys in the population of all 408,093 firstborn children born between 1991 and 2004 (*p*-value of .72), which is a first indication of no selective determination of fatherhood based on child

 $3^{2}74$

¹⁷ Glaeser, Sacerdote, and Scheinkman (2003) define social multipliers as a recursive series of spillovers between all individuals in a network. Alternatively, Dahl, Løken, and Mogstad (2014) analyze one-way spillovers. In both settings, multipliers depend on how individuals are linked and whether spillovers are one-way or recursive.

gender (see table A3). As a first balancing test of this assumption, we inspect differences in characteristics between fathers of boys versus fathers of girls (table 1, col. 2) and *p*-values (col. 3). We find no significant differences between characteristics of the fathers or their parents. As an additional test we predict the father's probability of receiving a crime conviction in the first 5 postbirth years using different sets of preconception explanatory variables and then regress these predictions on child's gender (table A4). All estimated coefficients are insignificant and close to zero regardless of whether we only focus on individual characteristics of the father's parents and his neighborhood.¹⁸ Hence, child gender does not appear correlated with observable characteristics predicting future criminal behavior.

One further possible concern is selective abortions, which could induce a correlation between child's gender and father's criminal propensity. Our balancing tests above and the similarity between the share of boys in our sample and in the overall population suggest that this is not the case. Moreover, abortions motivated by gender are practically impossible in Denmark. Abortion is possible for any reason up until week 12 of the pregnancy. After this date, only abortions by medical indication are legal. We nevertheless test for whether selective abortion could be a confounding factor. Table A6 reports estimates for all relevant abortions in terms of gender selectivity for the mothers in our main sample. The results show that mothers' previous abortions are not significantly associated with their live-born children's gender, suggesting that there is no gender selection.

To address the concern that the courts decide differently on a case depending on whether the defendant is father to a son or a daughter, we use alternatively charges rather than convictions as an outcome variable. Charges are levied at the police level at the site of the crime and/or when the offender is apprehended and cannot depend on the gender of an individual's child, because police in the field only have information of criminal records and not of children and marital status.¹⁹

B. The Effect of Child Gender on Father's Crime

In figure 3 we provide a first visual analysis of the effect of child's gender on the father's crime conviction rate. Figure 3A shows the accumulated number of crime convictions of young fathers from 3 years prior to their child's birth to 5 years after it, distinguishing between the fathers of boys (solid line) versus girls (dashed line).

¹⁸ We also regress child's gender directly on these same three different sets of covariates for both mothers and fathers using both OLS and probit estimators (table A5). We find no evidence suggesting that covariates are significantly related to child gender: *p*-values range between .37 and .77.

 $^{^{19}}$ We have also regressed the ratio of convictions to charges on the child's gender. That coefficient in year 1 after the child's birth is -0.001 (standard error 0.031).



Fie. 3.—Young fathers' crime before and after the birth of their first child, by child gender. Panel A shows the accumulated number of crime convictions per person before/after childbirth (time 0) by child gender, for the main sample of young fathers. Panels B and C show the estimated child-gender differences in years 1–10 after childbirth in the accumulated probability of being convicted of a crime and the accumulated number of crime convictions, respectively. Source: Our own calculations based on data from Statistics Denmark. A color version of this figure is available online.

Prior to the child's conception, there are no differences between the average number of crime convictions for individuals who will later father a boy versus a girl. After the child is born (indicated by the zero line), however, the two crime conviction rates diverge and the difference increases slightly over the subsequent years, with fathers of boys accumulating fewer crime convictions than fathers of girls. Sixty months after conception, fathers who had a boy have roughly 0.13 fewer crime convictions than fathers who had a girl. Figures 3*B* and 3*C* extend this finding by plotting the estimated child-gender differences in fathers' accumulated crime for years 1–10 after childbirth. The figures show that the child-gender gap in young fathers' accumulated crime, which emerges in the first years after childbirth, persists for at least 10 years.

We provide more detail in table 3, where we present the corresponding estimates for the effect of child's gender for each of the first 5 years after

		Time	Relative	to Childe	IRTH	
	Year -1 (1)	Year 1 (2)	Year 2 (3)	Year 3 (4)	Year 4 (5)	Year 5 (6)
Probability of crime conviction:						
Yearly:						
β^{F}	009	025 **	033 **	023*	.013	003
	(.012)	(.013)	(.013)	(.013)	(.012)	(.012)
Mean		.135	.145	.134	.130	.115
Accumulated from childbirth:						
β^{F}	009	025^{**}	040 ***	044 ***	023	017
	(.012)	(.013)	(.015)	(.016)	(.017)	(.017)
Mean		.135	.222	.275	.313	.337
Number of crime convictions:						
Accumulated from childbirth:						
β^{F}	005	030	102^{***}	130***	122^{**}	121*
	(.017)	(.021)	(.034)	(.046)	(.059)	(.069)
Mean		.185	.384	.570	.757	.910
Observations	2,803	2,803	2,803	2,803	2,803	2,803

TABLE 3

YOUNG FATHERS' PROBABILITY OF HAVING BEEN CONVICTED OF A CRIME, BOY VERSUS GIRL

SOURCE.—Our own calculations based on data from Statistics Denmark.

NOTE.—The table shows results from OLS regressions of the probability of having been convicted of a crime and number of crime convictions for crimes committed in the year before conception and over the first 5 years from childbirth on the gender of the first child. Having a girl is the reference category; i.e., the table shows the estimated change from having a boy instead of a girl. The regressions are conditional on father's age, mother's age, whether the father and mother are married/cohabiting, father is enrolled in education, father's income, mother is enrolled in education, mother's income, crime in nearest family (all measured before conception), and year of childbirth fixed effects. Standard errors appear in parentheses below coefficients. "Mean" refers to the mean value of the dependent variable in the estimation sample.

* p < .10.** p < .05.*** p < .01. the child's birth.²⁰ We report yearly and accumulated effects measured from the date of childbirth. The first part of the table shows the estimated child-gender effects on the probability of being convicted for a crime and the second part shows effects for the number of crime convictions. Column 1 summarizes the effect of having a girl versus a boy on crime in the year before estimated conception, which serves as a placebo test for unobservables affecting gender as well as crime propensities. As already suggested by figure 3*A*, these latter estimates are small in every specification and insignificant throughout.

For postbirth years, the first part of table 3 shows a 2.5 to 3.3 percentage point reduction in the probability of being convicted of a crime in the first 2 years when the child is a boy rather than a girl, which approximately implies a 19% reduction in the probability of being convicted of a crime for fathers of sons rather than daughters. The effect increases slightly in year 2 but decreases again from year 3 onward. The accumulated effect, however, remains sizeable as also evidenced by figure 3B.²¹ From the second part of table 3 we see that the estimated effects on the number of crime convictions are larger than for the probability of receiving a crime conviction. In the years after childbirth, fathers of boys receive on average approximately 0.13 fewer crime convictions than fathers of girls.²²

Table 4 presents further specifications and robustness checks. Again, column 1 shows the placebo results obtained from regressions 1 year before conception. Rows 1 and 2 report estimates when using charge probabilities and counts as dependent variables. Charges are a noisier measure of crime than convictions but are unrelated to any potential bias in the judicial system toward fathers of boys versus girls as mentioned above. Overall, results are similar to those in table 3.

During the first postbirth year, young fathers convicted of crimes spend an average of 2 weeks in prison, with the most prone to crime being the most incapacitated by imprisonment. In table 4, row 3, we proxy how large the gender effect would be in each postbirth year if incapacitation through imprisonment had not occurred by dividing the (accumulated) number of convictions by the fraction of the year that the individual is not incarcerated. The resulting estimates are slightly larger, albeit similar overall to the

²⁰ All results are robust to inclusion of year-of-childbirth fixed effects. Results are also robust to excluding observations for specific years of birth (i.e., excluding data for children born in 1991, 1992, . . ., 2004).

²¹ Because the table reports probabilities, the year effects do not sum up to the accumulated effects.

²² In figs. A4*A* and A4*B*, we break overall crime down into crime types and find reductions for both property and violent crime. Young fathers' reduction is mainly driven by property crime (theft or larceny), while the change in violent crime is a composite of small changes to different types of violence.

		Time	RELATIVE	to Childe	BIRTH	
	Year -1	Year 1	Year 2	Year 3 (4)	Year 4	Year 5
	(1)	(2)	(3)	(4)	(5)	(0)
	А.	Young Fa	thers Matc (Main S	hed to Nei Sample)	ghborhoo	ods
(1) Probability of being charged						
with a crime	008	027 **	028*	031*	020	012
	(.013)	(.013)	(.016)	(.017)	(.017)	(.017)
(2) Number of charges	014	043*	119***	141 **	143*	143
	(.018)	(.025)	(.042)	(.058)	(.074)	(.088)
(3) Number of crime convic-	0.00	050m	105 4044	150000	1 Eostada	100%
tions/time not in prison	006	050**	135***	179***	178**	180*
	(.019)	(.025)	(.044)	(.059)	(.079)	(.100)
	B. You	ng Father	s, Includin	g Those W	le Cannot	Match
			to Neighl	borhoods		
(4) Probability of having been						
convicted of a crime	005	- 020*	- 026*	024	011	006
connected of a chine	(.011)	(.011)	(.014)	(.015)	(.015)	(.016)
(5) Number of crime convictions	001	022	083***	098**	079	072
	(.015)	(.019)	(.031)	(.043)	(.055)	(.064)
			C. Mo	others		
(6) Probability of having been						
convicted of a crime, mothers	.001	006	008	.001	009	.002
,,,,,,	(.006)	(.005)	(.006)	(.005)	(.006)	(.006)
			D. Fathe	rs 21–25		
(7) Probability of crime convic-						
tion, fathers 21–25	002	.001	.004	.004	.004	.004
	(.002)	(.002)	(.002)	(.003)	(.003)	(.003)

TABLE 4 Alternative Crime Outcomes and Robustness Checks, Crime of Fathers, Boy versus Girl

SOURCE.—Our own calculations based on data from Statistics Denmark.

NOTE.—The table shows results from OLS regressions of crime outcomes for crimes committed in the year before conception and accumulated for the first 5 years from childbirth on the gender of first the child. Having a girl is the reference category; i.e., the table shows the estimated change from having a boy instead of a girl. Standard errors appear in parentheses below coefficients. The regressions are conditional on father's age, mother's age, whether the father and mother are married/cohabiting, father enrolled in education, father's income, mother enrolled in education, mother's income, crime in nearest family (all measured before conception), and year of childbirth fixed effects. Panel A: Young fathers whom we can uniquely match to a neighborhood. Observations: 2,803. Panel B: Young fathers disregarding neighborhood match. These data include the sample from panel A plus fathers have children within the same year. Observations: 3,549. In row 3 the number of crime convictions has been divided by time not spent in prison; i.e., 1 crime leading to a conviction committed during a year in which 6 months were spent in prison is equal to 2 crime convictions without any time in prison.

*
$$p < .10$$
.

** $^{r} p < .05.$

***^{*i*} *p* < .01.

estimates in table 3. Finally, in rows 4 and 5 of table 4 we present results using the entire sample of young fathers, including those we cannot match to a neighborhood, and fathers from neighborhoods where we have two observations in the same year. Again, estimates are very similar to those of the main specification.

In panel C of the table, we report estimates for mothers. Here, we cannot detect any response. Also, crime rates of mothers are lower than those of fathers, although still above those of comparable females drawn from the overall population.

In panel D we report findings for fathers who were 21–25 years old at childbirth. The estimates show that these fathers do not respond to their child's gender. This could be related either to compositional effects or to the fact that older fathers are beyond the peak age of crime, or it could be simply because the behavioral responses we illustrate above are age related.²³ The group of very young fathers on whom we focus seems therefore well suited to study possible spillovers, because of their strong responses to child gender, their high criminal propensities, and their disadvantaged background. This is illustrated in figure 4, where we plot crime the first year after the birth of first child by fathers' age and child gender. While we see large differences for very young fathers, fathers' postbirth crime rates are exactly alike once age at first child is higher than 20.

To further characterize the subset of young fathers that adjust their criminal behavior according to their child's gender (the compliers), we compute the average "complier characteristics" (see, e.g., Almond and Doyle 2011) by treating child gender as an instrument for whether young fathers' receive a crime conviction after childbirth.²⁴ Young fathers who respond to their child's gender by changing criminal behavior come from even more disadvantaged backgrounds than young fathers on average. They have lower wage income prior to childbirth, and are more likely to have nonnative origin, low socioeconomic status background, parents whose education does not exceed compulsory schooling, been redshirted in primary school, and a conviction for crime committed

²³ Table A7 reports fractions of individuals with a crime conviction for fathers age 21–25 (crime committed before the child was conceived), their equal aged neighborhood peers, and a random sample of equally aged males. Crime conviction rates of fathers age 21–25 are much lower than those of very young fathers (see table 2), and on par with equally aged neighborhood peers and equally aged males in the full population.

Average complier characteristics are given by $[(\pi_{\epsilon} + \pi_{a})/\pi_{\epsilon}]\{E(X|y^{F} = 1, Z = 1) - [\pi_{a}/(\pi_{\epsilon} + \pi_{a})]E(X|y^{F} = 1, Z = 0)\}$, where y^{F} is an indicator of fathers' crime after childbirth, Z is child gender (girl = 1), π_{a} is the fraction of fathers of boys who commit crime (always takers), π_{a} is the fraction of fathers of girls who do not commit crime (never takers), and $\pi_{\epsilon} = 1 - \pi_{a} - \pi_{a}$ is the child-gender differences in crime rates after childbirth (compliers). In our specific setting child gender can be thought of as an instrument for crime, young fathers' responses are first-stage estimates, and the responses of peers are reduced-form estimates of the outcome regressed on child gender (the instrument).



FIG. 4.—Fraction of fathers with a conviction for crime committed in the first year after the first child's birth, by age at first child and child's gender. Panel A shows the fraction of fathers with a crime conviction for a crime committed the first year after the birth of the first child by child gender across age at the birth of first child. Panel B shows the difference in the fraction with a crime conviction across child gender. We estimate 90% nonparametric confidence intervals as empirical bootstrap confidence intervals from 1,000 bootstrap samples. Source: Our own calculations based on data from Statistics Denmark. A color version of this figure is available online.

before the conception of their first child. Detailed results can be found in table A8.

We also investigate responses to child gender other than criminal behavior (and similar to those examined in studies such as Lundberg and Rose [2002, 2003] and Dahl and Moretti [2008]). We find that having a boy rather than a girl increases the probability of employment or education enrollment and makes fathers who were previously not cohabiting with the mother more likely to move in with her. Also, having a boy reduces the probability of the father having another child in the year following the birth, increases the period between the father's first and next child, and, in couples not cohabiting at the time of the birth, increases the likelihood that the father lives with the child. When performing a similar analysis for mothers (results available upon request) we find no behavioral changes. The only exception is that some mothers are less likely to live with their parents after childbirth if they have a boy rather than a girl. This simply mirrors the results just discussed where fathers who did not cohabit with the mother before childbirth are more likely to do so afterward if the child is a boy. Results can be found in table A9.

Overall, the effects on other outcomes are both indicative of role model behavior toward sons as well as a more "responsible" conduct of a young father when his child is a boy, which in itself may inhibit fathers' criminal activity.

C. The Effect of Child Gender on Crimes Committed by Others

We now turn to the question of whether young fathers' crime-related responses to the birth of a son or daughter spill over onto other young men living in the immediate neighborhood. To do so, we estimate equation (2) for males living in the father's immediate vicinity in the year of the child's birth and who are within ± 3 years of the father's age. We run all regressions on the individual level of the peers.

Figure 5A illustrates the evolution of the average monthly number of crime convictions for peers who lived in the father's neighborhood on January 1 of the year when the child was born, from 24 months before birth up until 5 years after birth, with the solid and dashed lines representing neighborhoods in which a boy or girl is born, respectively. Whereas no differences in average crime conviction rates are observable among peers in girl-child versus boy-child neighborhoods before the child's birth, after the event, rates are noticeably lower in boy-child neighborhoods. This gap in the number of crime convictions each month opens in the first 3 years after birth and remains roughly constant until the end of the observation period. As crime levels continue to differ, the estimated child-gender differences when we consider the accumulated number of crime convictions (reported per 10 peers) continue to increase over the first 10 years after childbirth (fig. 5*B*).

Table 5, which has a structure similar to that of table 3, reports estimates for the number of convicted individuals in the neighborhood in the first



FIG. 5.—Number of crime convictions, neighborhood peers, birth of boy versus girl. The figure shows crime differences for males living in the neighborhood when a young father has his first child, by the gender of that child using neighborhoods within the 5th to 95th percentiles of neighborhood sizes. Panel A shows monthly number of crimes per person by males age 14–25 at time of childbirth in the father's neighborhood before and after birth (time 0), by gender of child. Panel B shows the estimated child-gender differences for years 1–10 after childbirth in the accumulated number of crime convictions per 10 males ±3 years of father's age in neighborhood. Standard errors are clustered at the level of neighborhood by year of childbirth. Source: Our own calculations based on data from Statistics Denmark. A color version of this figure is available online.

part, year-by-year and accumulated from childbirth. The second part reports the estimates for the number of crime convictions accumulated from childbirth. The coefficient estimates measure the difference in the number of convicted individuals and the number of crime convictions in the respective year per 10 peers when a boy is born as compared to a girl. The estimates show that in a group of 10 peers, the number of individuals in the neighborhood convicted for a crime drops by 0.044 in the first year after the child's birth if the focal father has a son rather than a daughter. In other words, in neighborhoods where the child is a girl, the average probability that a peer within ± 3 years of the father has committed a crime for which he is later convicted is 6.29% in the first year after childbirth, whereas the corresponding probability is only 5.85% in neighborhoods where the child is a boy. This effect persists in the subsequent years and

in the 1	Neighbor	ноор, Вс	OY VERSUS	Girl			
	TIME RELATIVE TO CHILDBIRTH						
	Year -1	Year 1	Year 2	Year 3	Year 4	Year 5	
Convicted individuals:							
Yearly:							
β^{p}	009	044*	047 **	037*	029	019	
	(.020)	(.023)	(.022)	(.022)	(.020)	(.019)	
Mean	.477	.607	.593	.566	.516	.482	
Accumulated from childbirth	:						
β^{p}	009	044*	063**	077**	092 **	087*	
1-	(.020)	(.023)	(.031)	(.036)	(.040)	(.042)	
Mean	.477	.607	.993	1.265	1.466	1.627	

 $-.073^{**}$ $-.125^{**}$

(.062)

1.596

82,475

(.034)

.801

82,475

-.185 **

(.088)

2.356

82,475

-.259*

(.134)

82.475

3.697

-994 * *

(.111)

3.048

82.475

TABLE 5 CONVICTED INDIVIDUALS AND NUMBER OF CRIME CONVICTIONS, PER 10 MALES

82,475 SOURCE.—Our own calculations based on data from Statistics Denmark.

-.005

(.029)

.612

NOTE.—The table shows results from OLS regressions of convicted individuals per 10 males ±3 years of father's age residing in the neighborhood, for crimes committed in the year before conception and over the first 5 years from childbirth on gender of first child, using neighborhoods within the 5th to 95th percentiles of neighborhood sizes. The regressions include year of childbirth fixed effects. Standard errors appear in parentheses below coefficients and are clustered at the level of neighborhood by year of childbirth. "Mean" refers to the mean value of dependent variable in the estimation sample. Estimation is performed on level of individual peers, thus weighted by number of males ± 3 years of father's age in each neighborhood (such that larger neighborhoods receive more weight). Having a girl is the reference category; i.e., the table shows the estimated change from the focal father having a boy instead of a girl.

* p < .10.

 β^p

Mean

Observations

** $^{'} p < .05.$

Number of crime convictions: Accumulated from childbirth:

-

it combines the direct spillover effect from fathers to neighborhood peers and the multiplier effect through peers affecting each other. The second part of the table shows that the estimates for the number of convictions continue to increase even in the years after the effects for the fathers have stabilized (cf. fig. 3). This phenomenon is in line with a social multiplier where effects continue to ripple through the peer group over time. Once crime is broken down by type (figs. A5A and A5B), effects are again observable for both property and violent crimes. Property crime effects are mainly theft or larceny, and burglaries. When focusing on violent crime, we see that the effects, particularly in years 5–10 after childbirth, are driven by lower incidence of simple assault.

Table 6 reports further specifications and robustness checks. Panel A reports the same specifications as in table 5 using charges rather than convictions as outcome, while panel B assigns equal weight to all neighborhoods, regardless of neighborhood size (row 2), and considers all neighborhoods except for the largest 1% (row 3). Panel C reports results for an alternative and broader definition of the peer group, where we include all individuals who lived in the young father's neighborhood at childbirth and were between the ages of 14 and 25 at the time of childbirth. All estimates are very similar to those in table 5. In panel D, we report results for peers of fathers who were age 21-25 at the birth of their first child. As we have illustrated above, older fathers do not respond to child gender in terms of their crime and are far more similar to their peers in terms of family background and criminal behavior. Hence, we should not expect any change in peers' convictions for these fathers, which is exactly what the estimates in rows 7 and 8 show. Neither the number of convicted individuals in the neighborhood nor the number of crime convictions differs by child gender for this age group.²⁵

We also investigate whether a child's gender affects the father's peers' educational attainment or labor market outcomes (see table A10, panel A, where we report regressions similar to those for fathers in table A9). All estimates are close to zero and insignificant, pointing at criminal behavior itself as the major channel of spillovers.

D. Father's Crime Propensity and Spillovers

We illustrate above that our sample of young fathers consists of young men who are particularly crime prone, with more than one in three having committed a crime for which they would later be convicted before the child is

²⁵ Panels B and C in table A10 show results on labor market outcomes and education for young fathers' peers aged 14–25 and for the peers of fathers aged 21–25. Table A11 summarizes placebo estimates for different crime measures and different peer group definitions of older fathers. We find no significant child-gender differences.

		Time	RELATIVE	to Child	BIRTH	
	Year -1	Year 1	Year 2	Year 3	Year 4	Year 5
	A. M	ales in Nei	ghborhood	ds, ±3 Year	s of Father	's Age
(1) Number of charges	016 (.022)	080** (.035)	149** (.062)	217** (.095)	273** (.119)	290** (.142)
	B. Ma	ales in Neig All Neig	ghborhood ghborhood	ls, ±3 Years ls Weighteo	s of Father d Equally	's Age,
(2) Convicted individuals, 5th to 95th percentiles						
neighborhood size	008	044^{*}	062*	075^{**}	089^{**}	083^{*}
(3) Convicted individuals, all but 1% largest	(.020)	(.023)	(.032)	(.037)	(.010)	(.042)
neighborhoods	015 (.020)	046^{**} (.023)	070^{**} (.032)	086** (.037)	094^{**} (.041)	087^{**} (.043)
	С. М	lales in Nei	ighborhoo	ds Age 14–	-25 at Chile	lbirth
(4) Convicted individuals	013 (.015)	026 (.018)	043^{*}	060^{**}	064* (.034)	068*
(5) Number of crime	- 094	- 046*	_ 089*	_ 12/*	_ 159*	_ 109*
convictions	(.021)	(.026)	(.049)	(.071)	(.091)	(.110)
(6) Number of charges	018 (.015)	056** (.027)	097* (.050)	158** (.077)	186* (.098)	230* (.119)
	V	D. Placeb Where Fath	o Test: Mal ers Were A	les in Neig Age 21–25 :	hborhoods at Childbir	s th
(7) Convicted individuals	.014	004	001	.006	.008	005
(8) Number of crime	(.000)	(.011)	(.011)	(.011)	(.010)	(.010)
convictions	.014 (.014)	.003 (.016)	.005 (.030)	.009 (.043)	.018 (.055)	.011 (.066)

 TABLE 6

 Alternative Crime Outcomes and Robustness Checks, per 10 Males

 in the Neighborhood, Boy versus Girl

SOURCE.—Our own calculations based on data from Statistics Denmark.

NOTE.—The table shows results from OLS regressions of crime outcomes per 10 males residing in neighborhood for crimes committed in the year before conception and accumulated over the first 5 years from childbirth on gender of first child. Standard errors appear in parentheses below coefficients and are clustered at the level of neighborhood by year of childbirth. Estimation is performed on level of individual peers. Panel A: Peers whose age is within ±3 year range of father's age, defined by exact dates of birth. Weighted by neighborhood size. Observations: 82,475. Panel B: Assigning equal weights to all neighborhoods disregarding the number of males ±3 years of father's age in each neighborhood. Neighborhoods within 5th to 95th percentile, observations: 94,688. Panel C: Neighborhood size. Observations: 152,660. Panel D: Peers aged 14–25 in neighborhoods of fathers aged 21–25 at time of first child. Neighborhoods size.

* *p* < .10.

** p < .05.

conceived. However, not all fathers are potential criminals. Obviously, only fathers who would otherwise commit crimes can respond to the child's gender, and only in those neighborhoods should we expect responses by peers (if peers only respond through the fathers' initial response). To investigate this further, we create a variable measuring an individual's preconception crime propensity, by constructing an index of "crime potential" that combines preconception information on the individual himself with that of the family and the immediate neighborhood and normalize this index to range between 0 and $1.^{26}$

In table 7, we provide estimates for fathers and peers, where we distinguish between fathers (neighborhoods with fathers) with a normalized index smaller and larger than .6 to proxy low and high crime potential. The estimates show that the impact of having a son versus a daughter on fathers' crime convictions is far more pronounced for those fathers whose crime propensity is high. The estimates also show that it is exactly in those neighborhoods where fathers who have a high crime propensity live that peers respond as well, which reinforces our hypothesis that the effect on peers works through fathers' crime response.²⁷

E. Characteristics of Peers and Neighborhoods

Having shown that it is mainly crime prone fathers and their peers who drive results, we next investigate which peers respond to the fathers' behavioral changes. As for fathers, we separate peers by their predicted "crime potential" based on preconception information into two groups, those above and below the median of predicted crime potential within each neighborhood. Figure A6A shows that spillovers are driven by the more crime-prone peers within each neighborhood, with effects increasing over the 10 year period.

Next, we ask whether these behavioral spillovers differ across peers' age, defining three peer groups: (i) those born within 1 year from the father, (ii) those who are more than 1 year younger than the father, and (iii) those who are more than 1 year older than the father. Crime reductions (measured by the number of convicted individuals and the number

²⁶ We estimate the crime index by running a principal-factor model on preconception crime variables and subsequently rank the predicted factor values from 0 to 1. We estimate the factor model using a jackknife procedure excluding each father from the estimation that is used to create his predicted factor. The crime index is balanced by child gender (p = .79 for a *t*-test of difference in means).

²⁷ Expanding the time horizon to 10 years confirms that the effects on fathers' crime are driven by the most crime-prone fathers (fig. A6*B*) and the effects on peers' crime is observed in neighborhoods where the crime-prone fathers live (fig. A6*C*).

		Time Relative to Childbirth					
	Year 1	Year 2	Year 3	Year 4	Year 5		
Fathers:							
Boy \times low crime index	002	018	022	005	.003		
	(.016)	(.019)	(.020)	(.021)	(.021)		
Boy \times high crime index	058 ***	071 ***	076 ***	051 **	049*		
, 0	(.020)	(.024)	(.025)	(.026)	(.026)		
Observations	2,803	2,803	2,803	2,803	2,803		
Peers:							
Boy \times low crime index	.020	.001	007	031	036		
,	(.028)	(.038)	(.044)	(.049)	(.051)		
Boy \times high crime index	088**	098**	114**	117 **	098		
, 0	(.034)	(.046)	(.052)	(.057)	(.060)		
Observations	82,475	82,475	82,475	82,475	82,475		

 TABLE 7

 Probability of Being Convicted of a Crime by Preconception Crime Propensity, Boy versus Girl

SOURCE.—Our own calculations based on data from Statistics Denmark.

NOTE.—The table shows results from OLS regressions of the probability of being convicted for a crime committed during the years after the birth of first child where child gender is interacted with the fathers' crime index. Shown are results for fathers and results for peers (males ± 3 years of father's age) in the fathers' neighborhoods. The model is fully saturated such that child gender has been interacted with 1[crime index > .6] as well as (1 - 1[crime index > .6]), while we condition on both 1[crime index > .6] and (1 - 1[crime index > .6]). Thus, e.g., coefficients for (boy × high crime index) show the additional response to a boy vs. girl for fathers with high crime index. Standard errors appear in parentheses below coefficients, for peers clustered at the level of neighborhood by year of childbirth. Regressions include year of childbirth fixed effects.

* p < .10.** p < .05.*** p < .01.

of crime convictions) are largest for peers who are more than 1 year younger than the father, slightly smaller for peers born within 1 year of the father, but close to zero for peers who are more than 1 year older than the young father (fig. 6).²⁸ This suggests that spillovers in crime work mainly from older to younger individuals.

We next investigate whether spillover effects are heterogeneous across neighborhood types, where we distinguish between neighborhoods of different population density (measured as residents per square kilometer). Table 8 shows child-gender effects for fathers and peers separately for those who live in low- and high-density neighborhoods. While the effects for fathers appear of similar magnitude across neighborhoods with different population density, the effects on peers' crime are driven

²⁸ We find similar results within families, where effects can be found for younger but not older brothers of fathers with a high crime index. This finding should be interpreted with caution as brothers may respond directly to the child's gender (and not via the father's response as we expect for peers).



FIG. 6.—Peers' crime, boy versus girl, by peers' age and years from childbirth. The figure shows results from OLS regressions of the number of convicted individuals (*A*) and the number of crime convictions (*B*) per 10 males ± 3 years of the father's age in the neighborhood, for crimes committed in years 1–10 after childbirth, on the gender of the first child, using neighborhoods within the 5th to 95th percentiles of neighborhood sizes. The estimated child-gender differences in crime between peers are presented in years 1–10 after childbirth with peers separated into three groups: those born within 1 year of the father, those who are younger, and those who are older. Standard errors are clustered at level of neighborhood by year of childbirth. Source: Our own calculations based on data from Statistics Denmark. A color version of this figure is available online.

		Time Relative to Childbirth						
	Year 1	Year 2	Year 3	Year 4	Year 5			
Fathers:								
Boy \times low-density neighborhood	031	120 **	156 **	119	112			
, , , ,	(.026)	(.047)	(.063)	(.082)	(.096)			
Boy \times high-density neighborhood	022	093*	123*	152	161			
, , , , ,	(.034)	(.053)	(.075)	(.096)	(.112)			
Peers:								
Boy \times low-density neighborhood	001	012	031	070	105			
, , ,	(.035)	(.061)	(.084)	(.108)	(.129)			
Boy \times high-density neighborhood	121 **	193 **	277 **	305*	331*			
	(.049)	(.088)	(.126)	(.158)	(.190)			

TABLE 8
FATHERS' AND PEERS' CRIME CONVICTIONS BY NEIGHBORHOOD POPULATION DENSITY,
Boy versus Girl

SOURCE.—Our own calculations based on data from Statistics Denmark.

NOTE.—The table shows results from OLS regressions of fathers' number of crime convictions and the number of crime convictions per 10 males ± 3 years of father's age on gender of first child. The results are shown by neighborhood population density (separated into those below/above median density in our sample). Standard errors appear in parentheses below coefficients, for peers clustered at the level of neighborhood by year of childbirth.

* p < .10. ** p < .05.

by neighborhoods with high population density. Taking the average across years 2–5, the point estimates for peers are 5 times larger in high-density neighborhoods than in low-density neighborhoods. These findings have important consequences for the magnitude of social multipliers and the crime intensity in neighborhoods with different population density, as well as the efficacy of crime prevention programs, which we discuss in section V.

F. Crime Measured by Victimization Rates

We next turn to the effects on victimization. Our dependent variable is now whether an individual living in the father's neighborhood of residence on January 1 of the year the child is born reported being a victim of crime in any of the subsequent 5 years. Because victimization data are only available from 2001 and onward, we explore the relation between child's gender and victimization using only a subset of the years previously used.

Figure 7 gives a first visual impression of how the gender of the child affects victimization. In the 2 years before the child's birth, there is no difference in victimization rates between neighborhoods in which girls and boys will be born. However, after the birth, the two lines diverge, with victimization rates being higher in neighborhoods with girls.



FIG. 7.—Number of victimizations per 10 individuals, birth of boy versus girl. Panel A shows the monthly number of victimizations per 10 individuals for inhabitants in the focal individuals' neighborhoods before and after birth (time 0), by gender of child. Panel B shows the difference in the number of victimizations across child gender. We estimate 90% nonparametric confidence intervals as empirical bootstrap confidence intervals from 1,000 bootstrap samples clustered at the level of neighborhood by year of childbirth. Source: Our own calculations based on data from Statistics Denmark. A color version of this figure is available online.

We investigate this further in table 9, which displays the estimated effect of child's gender on yearly reported victimizations for all potential victims living in the neighborhood when the child was born. These estimates show a difference in reported victimizations in the postbirth years,

	Time Relative to Childbirth						
	Year -1	Year 1	Year 2	Year 3	Year 4	Year 5	
Yearly:							
$\beta^{v'}$.006	003	017 **	013*	008	017 **	
	(.006)	(.008)	(.007)	(.007)	(.007)	(.007)	
Mean	.107	.080	.091	.096	.100	.102	
Accumulated from childbirth:							
$\beta^{_V}$.006	003	020	032*	040*	057 **	
	(.006)	(.008)	(.013)	(.017)	(.022)	(.027)	
Mean	.107	.080	.171	.266	.365	.467	
Observations	524,314	524,314	524,314	524,314	524,314	524,314	

TABLE 9	
NUMBER OF CRIME VICTIMIZATIONS PER 10 INDIVIDUALS,	BOY VERSUS GIRL

SOURCE.—Our own calculations based on data from Statistics Denmark.

NOTE.—The table shows results from OLS regressions of the probability of victimization per 10 individuals in neighborhood in the year before conception and for the first 5 years from childbirth on the gender of the first child. That is, the table shows the estimated change from focal individuals having a boy instead of a girl. Standard errors appear in parentheses below coefficients and are clustered at the level of neighborhood by year of childbirth. "Mean" refers to the mean value of the dependent variable in the estimation sample. Estimation is performed at the level of each individual, thus weighted by number of individuals in each neighborhood. The estimation sample only includes neighborhoods within the 5th to 95th percentiles of neighborhood sizes.

**
$$p < .05$$
.

which accumulate until year 5. Specifically, if the young father has a boy rather than a girl, there are 0.057 fewer victimizations per 10 individuals within the first 5 postbirth years.²⁹

V. Interpretation and Implications

The reduced-form estimates in section IV show that child's gender induces exogenous variation in young fathers' crime, which in turn creates spillovers to the crime of young fathers' peers and changes in victimization rates in their neighborhoods. These findings confirm behavioral spillovers in criminal behavior and are in themselves intriguing. To further assess the economic and policy relevance of our results, we now interpret the estimates of child's gender on the crime of fathers and peers within

²⁹ In table A12 we present estimates by crime type. The effects are particularly pronounced for violent crimes, which is not surprising given that property crime in the victimization data does not cover crimes directed at commercial property (e.g., shoplifting). Hence, the magnitude of the estimates relative to mean victimization rates in table 9 does not reflect the aggregate crime reduction but predominantly the reduction in violent crime, which constitutes approximately 15%–20% of all crime convictions. In table A11, panel E, we report the same regressions for victimizations, but for the child-gender effect of fathers who are between 21 and 25 years old at birth of their first child. As for the other outcomes for fathers age 21–25, we do not find any effects of child's gender on victimization.

a linear social interaction model of crime as in, for example, Calvó-Armengol, Petacchini, and Zenou (2005) and Ballester, Calvó-Armengol, and Zenou (2006).

Our analysis in this section will be restricted to considering equilibria of a social interaction model. As such, we will not consider the detailed dynamics involved in the spread of behavioral spillovers from one individual to another. Empirically, this process—by which the system transitions from one equilibrium to another—may take some time. In our estimation of the parameters of our model, we will therefore focus on outcomes measured several years after the birth of the focal father's child, by which time we can assume equilibration to have occurred. In practice, we measure these outcomes 5 years after the child's birth, but our results are robust to alternative choices.

A. The Model

Each neighborhood (or network) *n* consists of one young father and N-1 potential peers who maximize their payoff u_i by choosing the optimal level of crime $y_i \ge 0$, with i = 1, ..., N:

$$u_{i} = \psi_{i} y_{i} - \frac{1}{2} y_{i}^{2} + \frac{\gamma}{P_{i}} \sum_{j=1}^{N} d_{ij} y_{i} y_{j}.$$
(3)

The first term on the right-hand side of equation (3) is the direct benefit of criminal activity, which is the product of committed crimes y_i , and the individual's direct payoff from committing a crime, ψ_i , with $\psi_i = \kappa_i + \xi_i (f_0 + \xi_i)$ f_1g). Here κ_i is the individual specific gain from committing a crime, which could be a function of variables characterizing individuals and neighborhoods. The variable ξ_i equals 1 if individual *i* is the young father in the specific neighborhood and zero otherwise. Thus, the father's payoff from crime differs from that of his peers by f_0 .³⁰ Moreover, if the focal father has a boy, the variable g = 1, which allows for a different payoff from crime by f_1 for fathers of boys compared to those of girls. The second term in equation (3) denotes the quadratic effort cost of crime. The third term reflects the "peer effect" of crime and consists of the product of *i*'s crime level y_i and the crime of others in *i*'s network y_i . Social connections within the neighborhood are expressed by the indicator variable d_{ii} , equal to 1 if i and *j* are connected, and where $d_{ii} = 0$. Connections are symmetric such that $d_{ii} = d_{ii}$. The parameter γ measures the strategic complementarity (or strength of social ties) of crime between individuals *i* and *j* when *i* and *j* are connected, and $P_i = \sum_i d_{ii}$ denotes the number of peers of individual *i*. It follows from (3) that if $d_{ii} = 0 \forall i, j$, individuals choose separately their optimal level of crime $y_i^* = \psi_i$. Connectedness between some individuals *i*, *j*

³⁰ As fatherhood (other than child gender) is not exogenous, this parameter is not identified.

leads to complementarities and higher crime levels (assuming $\gamma > 0$). The two structural parameters that are identified through the randomness of child's gender and that we estimate are f_1 (the difference in the payoff to committing a crime between fathers of sons vs. daughters) and γ (the strategic complementarity in criminal activity between individuals).

An equilibrium of this system is characterized by individuals maximizing equation (3) taking actions of all other individuals as given, which results in the "best response" function for individual i:

$$y_i = \psi_i + \frac{\gamma}{P_i} \sum_{j=1}^N d_{ij} y_j.$$

$$\tag{4}$$

Equation (4) implies that crime of individual *i*, *y_i*, is the sum of the direct gain from crime $\psi_i = \kappa_i + \xi_i (f_0 + f_1 g)$ and spillover effects from the criminal behavior of each of individual *i*'s peers *y_i*.

In practice, we will assume a completely connected social interaction graph within each neighborhood, such that $d_{ij} = 1$ for $i \neq j$, giving $P_i = N-1$.

B. Estimation of Structural Parameters

In appendix B, we solve this system of equations to derive the Nash equilibrium. Moreover, as our reduced-form estimates showed different responses to the gender of the child in more versus less densely populated neighborhoods, we allow the complementarity parameter γ to differ by neighborhood density and denote this by the subindex ρ . We operationalize this dependence in our empirical specification by specifying $\gamma_{\rho} = \gamma + 1[\rho \leq \text{median}] \times s$, so that γ captures strength of strategic complementarity in above-median-density neighborhoods and *s* is the difference in this parameter between above- and below-median-density neighborhood labels on the density ρ and size *N*, though of course these will both vary with neighborhood *n*.

It follows from the equilibrium conditions that father's crime $y_{i,n}^F$ and peers' crime $y_{j,n}^P$ can be written as a linear function of g_n , the gender of the child of the focal father in neighborhood *n* (see app. B for details):

$$y_{i,n}^{F} = \alpha_{n} + f_{1} \left(1 + \frac{\gamma_{\rho}^{2}}{(1 - \gamma_{\rho})(N - 1 + \gamma_{\rho})} \right) g_{n} + e_{i,n},$$
(5a)

$$y_{j,n}^{P} = \tilde{\alpha}_{n} + f_{1} \frac{\gamma_{\rho}}{(1 - \gamma_{\rho})(N - 1 + \gamma_{\rho})} g_{n} + v_{j,n}.$$
 (5b)

As child's gender is orthogonal to the error terms $e_{i,n}$ and $v_{j,n}$ (as well as all characteristics varying by neighborhood n), it follows that for fathers

 $E(y_{i,n}^{F}|g_n = 1) - E(y_{i,n}^{F}|g_n = 0) = E[f_1(1 + {\gamma_{\rho}^2/[(1 - \gamma_{\rho})(N - 1 + \gamma_{\rho})]})]$ and for peers $E(y_{j,n}^{P}|g_n = 1) - E(y_{j,n}^{P}|g_n = 0) = E[f_1(\gamma_{\rho}/[(1 - \gamma_{\rho})(N - 1 + \gamma_{\rho})])]$. These expressions correspond to the reduced-form parameters β^{F} and β^{P} in equations (1) and (2), respectively. They show that the parameter β^{F} consists of the sum of the direct effect of fathering a boy rather than a girl, f_1 , and the indirect effect arising through feedback between father's crime and that of his peers. Likewise, the reduced-form effect β^{P} captures the feedback effects between peers' crime responses to fathers of a son versus a daughter. It is clear from (5a) and (5b) that without strategic complementarities of crime between connected individuals ($\gamma = 0$), $\beta^{F} = f_1$ and $\beta^{P} = 0$.

In principle, the structural parameters f_1 and γ are uniquely identified from the estimated reduced-form parameters β^F and β^P . However, equations (5a) and (5b) also show that these effects depend on the size of the network *N*, which reflects the weaker role the focal father's change in criminal activity plays in large neighborhoods. Our reduced-form estimates average over different neighborhood sizes. When we recover the structural parameters f_1 and γ , we account for different peer group sizes N-1 across neighborhoods as well as for different neighborhood densities using a nonlinear least squares estimator that minimizes $\sum_{n,i} [e_{i,n}\xi_{i,n} + v_{j,n}(1 - \xi_{i,n})]^2$ with respect to γ , *s*, and f_1 .

Equations (5a) and (5b) describe the equilibrium effect on fathers' and peers' crime induced through the initial direct child gender shock on the father, as well as through feedback within the social network. To reach this new equilibrium takes time, as the initial effect ripples through the peer group. Table 5 illustrates just that, with the reduced-form effect on peers increasing over the first few years. When we estimate the structural parameters γ , *s*, and *f*₁ we consider therefore the accumulated number of crimes up to year 5 after childbirth.

The social multiplier (SM(ρ); see Glaeser, Sacerdote, and Scheinkman 2003) that measures how many additional crimes within a peer group a single crime stimulates is then the total effect of the focal father fathering a boy rather than a girl on the father's own crime and that of all his peers, relative to the direct effect on the focal father himself, f_1 . As we show in appendix B, this can be written as follows:

$$SM(\rho) = \frac{1}{1 - \gamma_{\rho}}.$$
 (6)

C. Estimates of Structural Parameters and the Multiplier

Table 10 reports the model estimates based on crime convictions accumulated over 5 years after childbirth, with the 90% confidence intervals in brackets underneath. Results in column 1 assume spillovers to be the same in high- and low-density neighborhoods (i.e., s = 0). The estimate

	Spillovers Constant across Population Density (1)	Spillovers Allowed to Vary across Population Density (2)
$f_{\rm l}$, child-gender shock	121	129
γ , spillover parameter	.804 [.550; .908]	.835 [.745; .897]
s, difference of spillovers in low- and high-density neighborhoods		140 [157 : 094]
Social multiplier	5.1	[
Social multiplier, high population density		6.1
Social multiplier, low population density		3.3

TABLE 10		
MODEL ESTIMATES OF	CHILD-GENDER SHOCK AND	Spillover Parameter

SOURCE.—Our own calculations based on data from Statistics Denmark.

NOTE.—Column 1 corresponds to the case in which spillover intensity does not vary across population density (i.e., having s = 0). Column 2 corresponds to the case with heterogeneity in spillover intensity across neighborhood population density. The scale parameter *s* captures the differences in spillover intensity between high- and low-density neighborhoods (defined by the median population density); hence, γ_{ρ} in low-density neighborhoods is estimated to be 0.835-0.140 = 0.695. The table also shows the implied social multiplier SM(ρ) = $1/(1 - \gamma_{\rho})$. We estimate 90% nonparametric confidence intervals are empirical bootstrap confidence intervals from 1,000 bootstrap samples clustered at neighborhood by year of childbirth level.

of the direct effect of child gender on fathers' crime f_1 shows that fathering a boy versus a girl results in 0.12 fewer crime convictions over the first 5 years after childbirth. The parameter γ is estimated to be 0.80, which corresponds to a social multiplier of 5. Based on these estimates, equation (5a) implies that the total effect on father's crime of giving birth to a boy versus a girl is about 10% larger than the direct effect f_1 , due to spillovers back from peers to the father.

Results in column 2 allow the spillover parameter to vary by population density, which is estimated to be 0.84 in high-density (above-median-density) neighborhoods and 0.7 (0.84–0.14) in low-density neighborhoods, with the difference being statistically significant. This suggests that strategic complementarities between individuals are stronger in neighborhoods that are more densely populated. The heterogeneity in the estimates of γ_{ρ} across neighborhoods of different population density translates directly into heterogeneity in estimates of the social multiplier. The last two rows of table 10 show that the social multiplier is estimated to be 3.3 in low-density neighborhoods but 6.1 in high-density neighborhoods.³¹ This implies that

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³¹ The estimates in table 10 are within the range of the social multipliers identified in Glaeser, Sacerdote, and Scheinkman (2003), which are between 1.4 and 8.2 across various outcomes, group sizes, and identification strategies.

one crime of a focal father induces about three crimes in low-density neighborhoods but nearly twice as many crimes in high-density neighborhoods.

Our finding that social multipliers are substantially higher in highdensity neighborhoods is important for targeting of crime prevention policies, something that we explore in the next section. It also adds causal evidence to the prediction in Calvó-Armengol and Zenou (2004) that social multipliers increase as network connections become tighter. Moreover, if social multipliers in crime are larger in more densely populated neighborhoods, then this may help in explaining the differences in crime rates between cities and rural areas, as studied in Glaeser, Sacerdote, and Scheinkman (1996) and Glaeser and Sacerdote (1998).

D. Crime Prevention Policies

The resources that a social planner devotes to lowering crime ultimately rest on a comparison of the costs associated with these and the benefits through crime reductions, including those induced by social interaction as measured by the social multipliers that we establish above. One way to quantify such costs (and potential benefits) of crime reductions in monetary terms is to use estimates of individuals' willingness to pay to eliminate one crime, as computed by Cohen and Piquero (2009). When we weight Cohen and Piquero's costs across crime types by the pattern observed in our sample (see table A1), we obtain estimates of the average costs per one crime conviction for a young father of approximately \$18,000. Taking account of the social multiplier increases the total costs per crime to \$59,000 in low-density neighborhoods, but to \$109,000 in high-density neighborhoods due to the larger spillovers in criminal behavior between peers.³² Thus, the potential benefits of reducing crime committed by individuals such as the young fathers in our sample are far larger than what the primary effects suggest, particularly so in high-density neighborhoods.

To further illustrate the potential cost effectiveness of crime prevention programs that target individuals highly prone to criminal activity at an early stage, we use our estimates from table 10 (col. 2) to proxy the costs of crime until age 24 for males with characteristics that are readily observable to policy makers and authorities.³³ Figure 8 shows the estimated total costs of crime for a young man according to his background and whether he lives in a low- or high-density neighborhood. The figure illustrates substantial costs of crime and thus potential benefits from directed crime prevention. Most of the potential benefits accruing through eliminating

³² We monetize costs of social multipliers as SM(ρ) × \$17,949.

³³ We estimate the total costs of crime until age 24 for each group in fig. 8 as the average number of crime convictions of males until age 24 in each group, multiplied with costs per crime of \$17,949 and the social multiplier $SM(\rho)$.



FIG. 8.—Monetizing spillover effects; total costs of crime. The figure shows the costs of all crimes committed by males from age 15 to 24, by different subpopulations, scaling crime costs by the estimated social multiplier across neighborhoods with different population density. Average number of convictions for crimes committed from age 15 to 24 has been estimated using full population register data for all the subpopulations in question. The figure shows estimates for neighborhoods (NBHs) with below and above median population density. The costs per crime are estimated using "average willingness to pay for a crime reduction" (Cohen and Piquero 2009). We weight the individual costs for each specific type of crime using offense shares from table A1 to estimate the average costs per crime observed in the data (\$17,949). Source: Our own calculations based on data from Statistics Denmark.

criminal activity of a focal individual are due to further reductions in crime through the social interaction channel. The largest total potential benefit (reduction in costs) is achieved by preventing criminal activity until age 24 of males who live in high-density areas and in a crime-aggravating context, such as having violent criminals in their nearest family.

VI. Discussion and Conclusion

This paper uses a novel identification strategy to provide new evidence on behavioral (endogenous) social effects in crime, by exploiting exogenous variation in the criminal behavior of one focal individual, induced by the gender of his first child, and measuring the effect this has on other members of his social network. Based on this design, we present strong evidence for peers responding to changes in one focal individual's criminal activity. By illustrating that a child-gender-induced reduction in criminal activity likewise leads to a reduction in victimization rates, we further corroborate the findings on spillovers of crime to peers in the neighborhood.

Overall, our findings not only add support to the existence of spillovers in criminal behavior; our design also allows us to conclude that these spillovers are due to behavioral (endogenous) social interactions, and that this mechanism is considerably stronger in high-density (urban) areas.

Our findings have important implications for the optimal approaches to crime prevention, as the cost-benefit considerations of such policies ranging from "kingpin strategies" against organized crime to the promotion of positive role models for adolescents all depend on the existence and magnitude of social multipliers. By using our estimates to recover the parameters of a structural model of crime interaction, we show that spillovers in crime increase not only the effects of an exogenous shock to a focal individual's crime (through feedback from his peers); they also generate crime multipliers that differ by population density. We illustrate that the benefits from programs and policies that reduce crime at an early stage of a young person's life, targeted at individuals with easily observable individual and circumstantial characteristics, are far larger than suggested by the primary effects alone, in particular in high-density neighborhoods where strategic complementarities in crime are found to be stronger.

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