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Time Preferences and Criminal Behavior

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ABSTRACT

Time Preferences and Criminal Behavior

One main motive behind lengthy prison terms for serious crime is to deter potential offenders from engaging in crime. Yet, economic theory predicts that the scope for punishment as acting as a deterrent depends on how much individuals discount future events when balancing the immediate utility of the crime and the costs of a potential future punishment. If criminals have short time horizons, then it is hard to imagine punishment acting as a key deterrent. This paper provides the first empirical investigation of the link between time preferences and criminal behavior. Our study is made possible by access to a unique Swedish longitudinal dataset that links individual measures of time preferences collected at age 13 to various crime indicators from administrative registers spanning over 18 years. Our results show that high discount rates significantly predict criminal involvement. The magnitude of the relationship is substantial and corresponds to roughly one third of the association between intelligence and crime. Although high discount rates significantly predict the onset of criminal involvement, it is less strongly correlated with crime at the intensive margin. The link is more pronounced for property crime and among males with low intelligence. We also find that part of the association can be explained by high discount rates being associated with lower human capital accumulation.

JEL Classification: K4, D03, D90

Keywords: time discounting, impatience, intertemporal choice, crime

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1. Introduction

It is widely believed that harsh sentences deter potential offenders from engaging in crime. The concept of deterrence involves two main assumptions: first that specific punishments imposed on offenders will "deter" them from recommitting the crime; the second is that fear of punishment will prevent others from committing similar crimes (Cook 1980). The fundamental idea of deterrence is reflected in the criminal justice systems in most democratic societies, although incarceration typically has several goals, such as incapacitation, punishment, deterrence and rehabilitation.

The deterrent effect of punishment is incorporated in the standard economic model of crime where individuals balance the benefits of engaging in crime against the costs of the potential punishment (e.g. Becker 1968). Stricter sanctions will reduce crime because it lowers the present value of criminal activity (Davis 1988). The effectiveness of sanctions as an instrument to fight crime, however, largely depends on how heavily potential criminals discount future events. This is because the rewards of the crime are savored immediately, but the costs of the potential punishment are borne in the future. As pointed out by Lee and McCrary (2009), if criminals have short time horizons, then it is hard to imagine punishment acting as a key deterrent.[1]

In this paper we empirically investigate whether individual time preferences measured at age 13 predict subsequent criminal involvement from age 15 to age 31. High time preferences are often assumed to cause criminal behavior but empirical research on this topic is scarce. Nagin and Pogarsky (2004) measure discount rates among adolescents (grades 7-12) and ask them one year later whether they were involved in criminal activities during that year. They find that respondents with

[1] In the leading contemporary theory of crime, the ability to exercise self-control in the face of opportunity is hypothesized to explain a major part of all criminal behavior (Gottfredson and Hirschi 1990). Although the concept of self-control seems related to that of time discounting it is not clearly defined in the literature. It has therefore proven difficult to empirically test the theory. Self-control is assumed to be coalesced with a number of interrelated individual characteristics such as impulsiveness, lack of persistence and inability to delay gratification (e.g. Piquero et al. 2010). Some studies have used behavioral markers such as the length of time one can squeeze a hand grip, keeping within lines while drawing a maze or various betting behaviors. Other studies use self-reported measures, for example, self-reported inability to avoid thinking about white bears when instructed to do so or reports by parents or teachers. Tittle, Ward and Grasmick (2003) summarize the different measures used.

high discount rates were more involved in criminal activities. The results in Lee and McCrary (2009) and Jacob, Lefgren, and Moretti (2007) provide suggestive evidence that offenders may have short time horizons. Lee and McCrary use register based longitudinal data on felony arrests in Florida and show that the sharp increase in criminal sanctions at age 18 leads to relatively small declines in the probability of offending. A small response in behavior is consistent with offenders discounting future events heavily. Jacob, Lefgren and Moretti (2007) examine whether crime is serially correlated by taking advantage of exogenous shocks on local crime driven by weather shifts. Their results show that weeks with above average crime rates are followed by weeks with below average crime rates. The results are consistent with offenders having short time horizons and that the income effect is substantial: individuals engage more in crime in the next period to make up for the lack of income from criminal activity in the initial period.

Our investigation requires unusually rich data. To properly connect theory to data, it is preferable to uset early measures of time discounting. Ideally, the information on time preferences should be collected before individuals tend to start getting involved in criminal activity to ease complications due to reverse causation. It would further be necessary to link this information to credible indicators of criminal involvement and to follow the individuals for a period that stretches well beyond the peak of the age-crime profile. These restrictions effectively rule out any recently constructed dataset.

Our data originate from a Swedish longitudinal dataset that contains information on children's time preferences collected from a survey held in the year 1966 when the children were 13 years of age. By linking the respondents to administrative registers we are able to follow the 13,606 children who participated in the survey for a period of 18 years. Time preferences are measured through a question where the children were asked to rate the extent to which they prefer SEK 900 (USD 140)

today over SEK 9,000 (USD 1,400) in five years using a five point scale.[2] Our measures of crime originate from two sources: (i) interventions by social authorities due to delinquent behavior of children up to age 18; (ii) the universe of criminal convictions for all individuals between age 15 and 31. Besides details about the type of crime, there is information on crime both at the extensive and intensive margins.

For several reasons, the dataset is ideal for our purposes. First, the survey was administrated relatively early in life before the onset of illegal involvement; yet it was taken sufficiently late so that the respondents are likely to have been able to understand the nature of the question. The fact that the survey was conducted in all schools in the Stockholm metropolitan area implies that all pupils present at school during that particular day took part in the survey, which increases the external validity of our results. Moreover, the use of administrative data means there is no sample attrition. Another key feature of the data set is that it includes information on parental education and income. Being able to adjust for parental socioeconomic background is important since it eases concerns that responses to the survey might reflect differences in the family budget constraint.[3] An additional benefit is that the data include results on a cognitive ability test that was part of the survey. This is essential as previous studies have shown that time preferences and ability interact in the population (Benjamin, Brown and Shapiro 2013; Dohmen et al. 2010).

Our results show that time preferences significantly predict criminal activity. When comparing the size of the relationship to that of the association between intelligence and crime we find that the former is about one third of the size as the latter. We also find that high discount rates predict crime more strongly at the extensive rather than the intensive margin. The link is much stronger for

[2] In 2013 year's price level.
[3] The literature on economic preference parameters typically focuses on the predictive value of preferences. Causal effects are not possible to elicit since - even in the setting of a laboratory where the researcher can control many aspects - one cannot exclude the possibility that other preferences are influenced as well by the experiment.

property crime and among males with low intelligence. We also find that the association can partly be explained by high discount rates being associated with lower rates of human capital acquisition.

Our work is related to two strands of the literature. Most importantly, we add empirical content to theoretical studies concerning the dynamics of criminal behavior. In his seminal paper, Davis (1988) presents a model suggesting that different propensities to commit crime can ultimately be explained by individual attitudes toward the future. Although this is the only theoretical investigation we are aware of that directly focuses on how time discounting affects criminal involvement, a series of relatively recent studies provide structural estimations of other aspects regarding intertemporal decision making among potential criminals, in particular concerning individual joint investments in education, work and crime (e.g. Imai and Krishna 2004; Imrohoroglu, Merlo, and Rupert 2004; Burdett, Lagos, and Wright 2004; Lochner 2004). McCrary (2010) provides an excellent review of these studies. Interestingly, most of them assume a long time horizon for potential offenders, and typically impose annual discount factors close to unity.[4]

We also contribute to the growing literature concerning the predictive value of time preferences for real world outcomes. Several studies have documented that time preferences in the adult population are significantly correlated with field outcomes such as occupational choice (Burks et al. 2009), credit card borrowing (Meier and Sprenger 2010), and smoking (Khwaja, Silverman and Sloan 2007). Sutter et al. (2011) relate risk attitudes and time preferences to health-related behavior and savings decisions in an experimental setting. Their cross-sectional evidence suggests that discount rates among children aged 10 to 18 correlate with their Body Mass Index (BMI), savings as well as spending on alcohol and tobacco. In an intertemporal choice lab experiment, Dohmen et al. (2010) find that patience among adults is significantly associated with higher cognitive ability. With just a few exceptions, the existing evidence on the connection between time preferences and real

[4] The implied annual discount rate in our paper is 58%. Although this number may seem large, it is in line with discount rates used in other experimental and field studies (see Frederick, Loewenstein, and O'Donoghue 2002).

world outcomes is cross-sectional in nature and focuses on the adult population. Golsteyn, Grönqvist, and Lindahl (2014) present one of the first pieces of longitudinal evidence showing a strong negative correlation between high discount rates during childhood and various indicators of human capital, health, and lifetime income. The association is robust when controlling for factors such as family socioeconomic background and ability and persists well into adulthood. They also show that the relationship between time preferences and long-run outcomes operates through early human capital investments.[5]

To the extent that time preferences are malleable, our results potentially have implications for public policy in the sense that early interventions that make individuals more future-oriented may be used as a tool to combat crime. The controversy regarding the understanding of how changeable time preferences are, is not settled. Recent quasi-experimental studies have shown that exogenous traumatic events such as the great tsunami in Sri Lanka (Callen 2011) and the genocide in Burundi (Voors et al. 2012) at least temporarily shifted the time preferences of the survivors. More relevant from a policy perspective is the seminal study by Becker and Mulligan (1997) which posits that people could learn to be more future-oriented. The results in Perez-Arce (2011), which demonstrate that college students in Mexico who were randomly admitted from a pool of applicants were more patient than individuals in the control group, are consistent with the Becker-Mulligan model. Other more policy relevant applications include active decision making and optimal default choices which have been shown to potentially moderate high discount rates (e.g. Carroll et al. 2009).

[5] Only two additional studies provide longitudinal evidence; however the measures employed cannot directly be interpreted as reflecting intertemporal decision making. Cadena and Keys (2011) proxy for time preference using the assessment of the interviewer in the National Longitudinal Survey of Youth whether (s)he perceived the respondent as restless. The results suggest that individuals classified as restless between age 15 and 27 had lower educational attainment and reduced labor supply. Moffitt et al. (2011) measure self-control by a composite that among other things incorporates parental-teacher ratings of children's aggression, hyperactivity, and impulsivity, with self-reports of attention problems and observational ratings of restlessness and stamina, for a cohort of around 1,000 New-Zealand children. They follow the children from age 3 to 32 and find substantial positive effects of the composite on health and wealth. This paper is particularly interesting since it also studies crime. The results show that low values of the self-control index strongly predict criminal convictions.

The rest of the paper is organized as follows. In section 2 we describe our data. Section 3 presents the results from our empirical analysis. Section 4 provides concluding comments.

2. Data and measurement[6]

The data used in this study is a longitudinal data set called the Stockholm Birth Cohort (SBC). The data set is a matching of two longitudinal data sets, the Stockholm Metropolitan Study (SMS) and the Swedish Work and Mortality Database (SWMD). For the purpose of this study we only use the SMS part of the SBC, which consists of all children born 1953 in the Stockholm metropolitan area.

The data include information from a school study that was conducted in 1966 when the cohort members were 13 years old. During one school day, pupils at practically all schools in the county filled out two questionnaires, including the question which we use to elicit time preferences, and took a spatial cognitive ability test which we use to measure cognitive ability. An important aspect of the survey is that it took place at school which gave it a mandatory character. As a result, the non-response rate is only 9 percent (the percentage of pupils absent on that particular school day). The low non-response rate in combination with the fact that the survey was given to all students in the county is likely to increase the external validity of our study. This is an advantage compared to laboratory based studies in which the participants probably are self-selected on the basis of their discount rate. Impatient individuals could for example be less likely to sign up for participation in a laboratory experiment.[7] On the other hand, laboratory based studies benefit from the use of real payments, while our type of study relies on a hypothetical question about time preferences and it is not obvious that stated choices perfectly correspond to choices made in real life.

[6] The description of the data is partly based on Golsteyn, Grönqvist and Lindahl (2014). We also use data from the Stockholm Birth Cohort but we link these data to register data on crime, which is different from the register data used by them. More details about the Stockholm Birth Cohort data can be found in Stenberg and Vågerö (2006).
[7] Related to this, von Gaudecker, van Soest and Wengström (2011) find that people in a laboratory have substantially lower risk preferences than subjects drawn from the (Dutch) population and that the heterogeneity among subjects in the laboratory is much lower than that in the population wide sample. However they also show that self-selection into the experiments did much less harm than sampling from a narrowly defined distribution, such as a student population.

The children answered the following question: "If you had to choose between SEK 900 [USD 138] now versus SEK 9,000 [USD 1,380] in five years, which would you choose?"[8] The set of possible answers was: "Certainly SEK 900 now" (1), "Probably SEK 900 now" (2), "Cannot choose" (3), "Probably SEK 9000 in five years" (4), "Certainly SEK 9000 in five years" (5). Since the answers do not necessarily map into a monotonic scale we present the coefficients on separate dummy variables for each answer category. By current standards, our measure is a relatively rough measure of time preferences. For instance, we cannot distinguish exponential and hyperbolic discount rates. Future research may link more precise measures to criminal behavior. It will take many years however before a link between precisely measured time preferences at age 13 and criminal behavior until age 31 will become available.

Figure 1 shows the distribution of the answers. In spite of the very high implied annual discount rate of 58%, 13% of the children state that they prefer SEK 900 today over SEK 9,000 in five years. Around half of these children (6% of the total sample) report that they certainly prefer the SEK 900 today. The discount rate is well in line with discount rates used in other experimental and field studies (see e.g. Frederick, Loewenstein and O'Donoghue 2002, who give an overview of the wide variation in time preferences reported in various articles).

Although the Swedish murder rate is one of the lowest among all developed countries, other types of crimes are relatively more frequent. Farrington, Langan and Tonry (2004) show that the Swedish crime rate in 1980 is comparable to other countries such as England and Wales and the United States for many types of crimes including assaults. This is also the conclusion that can be drawn from more recent statistics on crime rates in the EU countries. Details about convictions are incorporated from the Swedish National Crime Register (Person- och belastningsregistret, PBR), which is administered by the Swedish National Police Board (Rikspolisstyrelsen). It contains data on the number of crimes reported to the police that have been connected to the cohort member. The

[8] Note that these amounts are presented in current prices.

reports are based on convictions in criminal trials. There is also information from the Child Welfare Committee (CWC) data (Socialregisteruppgifter) for children under age 18. The CWC also received information concerning criminal behavior from schools, parents, neighbors, and shopkeepers. In most cases, it was not required by law to report these crimes to the police, unless a serious crime was involved. The fact that we have information on crime from another source than criminal convictions is advantageous since there is a risk that individuals with high discount rates may be more likely to be convicted for a crime conditional on actually having committed the crime. Although we believe that this risk is likely to be small, analyzing CWC data provides a reality check of our estimates. This means that we have access to all offenses and juvenile delinquencies for every individual between age 13 to 31 (year 1966 to 1984) that either led to a criminal conviction or to the involvement of the CWC. We follow the standard procedure in the literature and focus on the types of crimes that account for most of the social costs of crime: violent crime and property crime. The former includes crimes of physical violence or threats of violence and the latter theft and receiving stolen goods. We also examine whether an individual committed any type of crime.

It is worth mentioning that all crimes that were reported to the police and committed by persons under age 18 were reported by the police to the CWC. Thus, there is some overlap between criminal convictions and those variables concerning juvenile delinquency reported in the CWC data. The CWC records are more accurate for children under age 15 because the police were not allowed to file records against them unless in unusually serious cases. They are, however, required to report each crime to the CWC which keeps track of them. We study both crime at the intensive and the extensive margins. Since there are a few number of individuals with extremely many crimes committed during this period and we wish to avoid the risk that these outliers may bias our estimator we assign 32 crimes to all observations with more than 32 reported crimes.[9]

[9] 99 percent of the population has fewer than 32 reported crimes. The maximum number of crimes recorded for one person is 256.

The dataset contains several other variables of interest to us. We use a spatial cognitive ability test as a measure of cognitive ability. The test, which was also taken at age 13, consists of 40 figures which are unfolded and need to be folded mentally. Similar to the Raven Progressive Matrices test, this spatial cognitive ability test measures fluid intelligence which is often considered to be a purer measure of intelligence than tests of crystallized intelligence, such as regular IQ tests or achievement tests. Scores on crystallized intelligence tests are in part determined by intelligence but also partly by personality traits (see e.g. Borghans et al. 2012).[10]

The dataset also contains a rich set of information on individual traits and family/social background. Most importantly, there is information on each parent's highest completed level of education (four levels) and each parent's income in 1963 (i.e. three years prior to the survey). We control for these variables in the regressions along with information on each parent's year of birth and the month of birth of the cohort member.

The original SBC data set matched with administrative registers consists of 13,606 observations.[11] An overwhelming majority of all crime is committed by males. Our main analysis therefore focuses on males, but we present our baseline results also for females in appendix. After selecting out observations with missing values on the time preferences variable, we are left with 6,749 males. Table A.1 gives the descriptive statistics of the variables included in our analysis.

3. Results

This section presents the results from our empirical analysis of the link between time preferences and criminal behavior. We first present our findings for the main sample and then proceed to subgroup

[10] Note that IQ as measured by standard IQ tests would give an average of 100 (and SD 15). Our measure of IQ, the spatial ability test, is not a standard IQ test and therefore the average is different from 100.

[11] 15,118 children were born in 1953 in Stockholm county. But not all children still lived in Stockholm at the time of the school survey (around 1%) and around 9% did not participate in the school survey due to absence from school, which leaves us with 13,606 observations.

and sensitivity analyses. The tables show the coefficients on dummies for all answer categories of the question on time preferences. The reference group is individuals who with certainty prefer the immediate reward. Each column represents a separate regression. All regressions are estimated by ordinary least squares and control for month of birth, the educational level of each parent (three levels), cognitive ability, each parent's income (linearly) and each parent's year of birth (linearly). We only present estimates for our main variable of interest (i.e. time preferences). The estimates of the control variables are available upon request.

Table 1 shows our baseline results. The table presents estimates for our two measures of crime: criminal convictions (age 15-31) and CWD interventions. For each measure we show results for crime both at the intensive and extensive margins. Note however that crime at the intensive margin in the CWD data for the outcome *Any crime* refers to the number of decisions by the CWD for delinquent behavior, and does not refer to the number of offenses. Each decision may involve several crimes. For property crime and violent crime, however, we observe the number of crimes and not the number of decisions.

We can see in Panel A that individual time preferences significantly predict criminal involvement at the extensive margin. Individuals who are more certain that they prefer to delay the reward are less likely to be convicted for a crime. The magnitude of the relationship appears to be substantial. Individuals who certainly prefer to delay the reward are 32 percent (.093/.291) less likely to be convicted for any type of crime. To better understand the effect size we standardized the variable to mean zero unit standard deviation and re-estimated the model. It turns out that the coefficient is about one third as large as for that of our standardized measure of intelligence. The association between intelligence and crime is well documented in the literature. It appears that the statistical association between time preferences and crime is weaker for violent crime, although the magnitude of the relationship is about the same when regarding the coefficient in relation to the mean of the dependent variable. For property crime the statistical significance is much stronger. Turning to

CWD data we find similar results: strong associations between time preferences and any crime as well as for property crime. However, none of the coefficients for violent crime are statistically significant.[12]

For all outcomes it is evident that the individuals in the reference group clearly stand out as being more likely to engage in crime. The coefficients on the other possible answers to the question tend to be of similar size. In other words, time preferences seem to matter for crime only for individuals with very high discount rates.[13] It is possible that there is a non-linear relationship between time preferences and crime. Individuals in our sample who state that they prefer the immediate reward have an annual discount rate of 58 percent. This number is well in line with other studies trying to estimate the individual discount rate (e.g. Frederick et al. 2002). Individuals who state that they absolutely certainly prefer the immediate reward are likely to have discount rates that exceed 58 percent. If the link between time preferences and crime only appears for extremely high discount rates, then this could potentially explain our findings. It seems not implausible that criminals have discount rates that substantially diverge from that of the overall population.

In Panel B we can see that the link between time preferences and crime at the intensive margin appears to be much weaker. For all outcomes, many of the coefficients are not statistically significant. Moreover, when interpreted in relation to sample mean the effect sizes are in general much lower. It therefore appears as if time preferences do a better job predicting the onset of criminal involvement rather than the frequency of its occurrence. Put differently, being very impatient may induce some individuals to commit crime but after having gotten involved in crime, time preferences

[12] In relation to this, Nagin and Pogarsky (2004) report evidence from a sample of adolescents grades 7-12 that time preferences are not related to violent crimes. However, poor impulse control is related to violent crimes.
[13] One explanation for this may be that crime is an activity for which someone has to be very impatient. Golsteyn, Grönqvist and Lindahl (2014) report that women in this highest time preference group are more likely to become teenage mothers.

matter less. One reason could be that factors such as reduced stigma outweigh the importance of time preferences after having developed a criminal lifestyle.

Table 2 presents results from sensitivity checks and an exercise where we try to probe deeper into the underlying mechanisms. The baseline estimates are those in Panel A of Table 1 using criminal convictions as outcome. As parental socioeconomic background has previously been shown to be causally linked to criminal behavior (Meghir, Palme and Schnabel 2011) we have included controls for parental education and income in our main analysis. One potential concern is also that children from poor socioeconomic background may be more likely to state that they prefer a smaller amount immediately. Therefore, we also show estimates from regressions excluding those background variables. It is clear that the coefficients are not sensitive to dropping controls for parental education and income. Essentially all coefficients are invariant to dropping these controls. In Table 2, we also examine how sensitive the results are to dropping controls for intelligence. Dohmen et al. (2010) show laboratory based experimental evidence that time preferences and cognitive ability interact. Moreover, intelligence is one of the most well-known correlates of criminal involvement (e.g. Wright and Boisvert 2009). Again, we only find modest changes in the coefficients when dropping controls for intelligence.

One of the potential pathways through which time preferences could be linked to crime is through educational investments. Golsteyn, Grönqvist and Lindahl (2014) find that high discount rates are strongly associated with lower educational attainment. Many studies have also documented that education is linked to crime (e.g. Hjalmarsson, Holmlund and Lindquist 2011; Lochner and Moretti 2004; Machin, Marie and Vujic 2011). To investigate this, we add educational attainment to the vector of control variables. Some caution is warranted when interpreting the results from this exercise because education is not a pre-determined variable. Table 2 shows that controlling for years of schooling tends to reduce the coefficients. In most cases, the estimates are about 40 percent lower. This provides suggestive evidence that time preferences are associated to crime through its link to

human capital investments. Still, the results show that a non-trivial part of the correlation between time preferences and crime remains even after conditioning on educational attainment.

Table 3 presents results from an analysis where we focus on the link between time preferences and crime in different segments of the population. The dependent variable is the probability of being convicted for a given type of crime between age 15 and 31. We start by stratifying the sample according to parental education. No clear picture emerges from this exercise however. We can see that the correlation between time preferences and any crime is much stronger for individuals with parents who only have compulsory education relative to individuals that have at least one parent with more than compulsory education. For property crime, however, the opposite story holds: the link is stronger for individuals with highly educated parents.

The picture becomes clearer when instead dividing the sample by cognitive ability. We can see that time preferences predict future criminal involvement more strongly for individuals with below average intelligence compared to individuals with at least mean intelligence scores. For the latter group, most point estimates are substantially smaller and in many cases also not statistically significant. Put differently, being less future-oriented increases the risk of crime more for less intelligent persons.

The final subgroups we look at have been stratified according to whether or not the father has previous criminal records. For individuals with convicted fathers there seems to be a big difference between those who responded that they certainly prefer the immediate reward to those who probably prefer the immediate reward. We can further see that while there are no statistically significant coefficients on time preferences when studying violent crime among individuals with non-criminal fathers, time preferences strongly predict criminal involvement for individuals with convicted fathers. It is difficult to draw any strong conclusions from these results as relatively few individuals have convicted fathers.

4. Concluding remarks

This paper provides the first assessment of the link between time preferences and criminal behavior. Drawing on a unique database that contains measures of time preferences collected from a school based survey at age 13 and longitudinal information on criminal involvement from administrative registers, we document that time preferences significantly predict crime. The magnitude of the relationship appears sizable and corresponds to about one third of the size of the relationship between intelligence and crime. We also show that high discount rates predict crime more strongly at the extensive rather than the intensive margin. The link is much stronger for property crime and among males with low intelligence. Our results further suggest that the association partly can be explained by high discount rates being associated with lower rates of human capital acquisition.

Our results are consistent with the predictions of the standard economic model of crime where individuals decide on whether or not to engage in crime depending on the immediate benefits from the crime and the costs from a potential future punishment. The model has been used to motivate the use of stricter sanctions as a way to deter potential criminals to engage in crime. Our results potentially have other policy implications in the sense that early interventions that make individuals more future-oriented may be used as a tool to combat crime. The results in the literature regarding the malleability of time preferences are however not yet settled. Still, the results in Becker and Mulligan (1997) and Perez-Arce (2011) do provide some support for the argument that educational investments may be one way to moderate high discount rates. This is interesting also because many studies have documented that increased education can be used as a way to combat crime (e.g. Lochner and Moretti 2004). One reason for this could be that education makes individuals more future oriented.

Our measure of time preferences cannot identify individuals with hyperbolic time preferences. It is possible that our results at least partly are driven by individuals with very high short-run time preferences but with discount factors closer to the population average time preferences

in the longer-run (see Lee and McCrary 2005). Future studies on this topic should therefore focus on collecting exponential and hyperbolic measures of time preferences and link these measures to administrative crime data. Still, it will take many years to collect such data in early adolescence with links to crime rates later in life.

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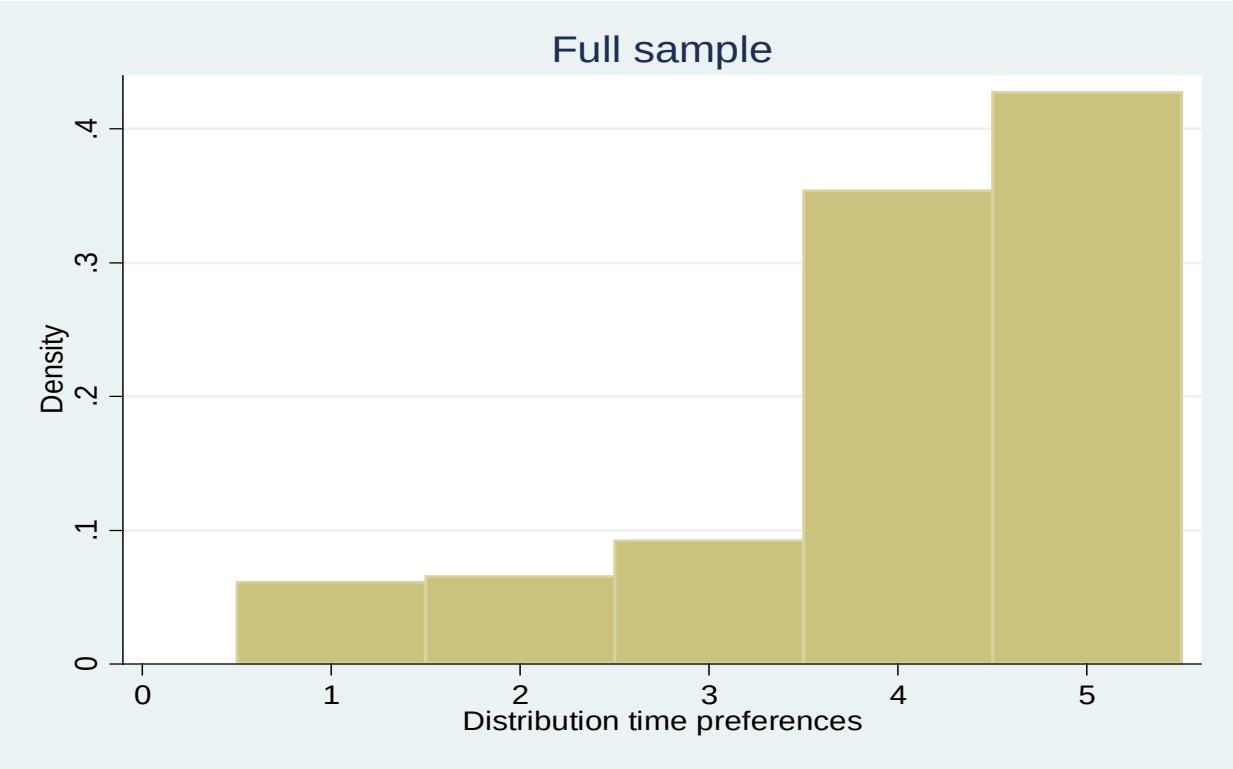
Figure 1 Distribution of time preferences



Notes: Figure 1 shows the distribution of answers to the question: "If you had to choose between SEK 900 [USD 138] now versus SEK 9,000 [USD 1,380] in five years, which would you choose?". Categories (1) to (5) represents respondents stating: "Certainly SEK 900 now" (1), "Probably SEK 900 now" (2), "Cannot choose" (3), "Probably SEK 9,000 in five years" (4), "Certainly SEK 9,000 in five years" (5). The amounts are presented in current prices. The sample consists of all children born in Stockholm county in the year 1953. The survey was administrated in to children aged 13.

Table 1 The link between time preferences and crime

	Criminal convictions (age 15-31)			Child Welfare Committee (age -18)		
	Any crime	Violent crime	Property crime	Any crime	Violent crime	Property crime
A. Extensive margin						
Timing of reward:						
Certainly immediate	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Probably immediate	-.104***	-.035*	-.078***	-.100***	-.021	-.089***
	(.034)	(.020)	(.027)	(.030)	(.018)	.025
Indifferent	-.072**	-.034*	-.058**	-.045	-.010	-.045*
	(.032)	(.019)	(.027)	(.030)	(.018)	(.026)
Probably delay	-.094***	-.033**	-.067***	-.051**	-.015	-.046**
	(.025)	(.015)	(.021)	(.023)	(.014)	(.021)
Certainly delay	-.093***	-.021	-.067***	-.049**	-.010	-.049**
	(.025)	(.015)	(.021)	(.023)	(.014)	(.020)
Sample mean	.291	.066	.145	.213	.058	.143
B. Intensive margin						
Timing of reward:						
Certainly immediate	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Probably delay	-.957**	-.120	-.307	-.154**	-.467***	-.027
	(.438)	(.074)	(.189)	(.067)	(.142)	(.054)
Indifferent	-.742*	-.149**	-.218	-.048	-.174	-.008
	(.421)	(.068)	(.183)	(.070)	(.149)	(.052)
Probably delay	-.657*	-.085	-.210	-.071	-.239**	-.034
	(.351)	(.065)	(.148)	(.051)	(.115)	(.040)
Certainly delay	-.563	-.067	-.184	-.061	-.252**	-.024
	(.347)	(.065)	(.146)	(.050)	(.113)	(.039)
Sample mean	1.926	.156	.666	.371	.146	.735

Notes: The table shows the coefficients on dummies set to unity if the child at age 13 probably prefers SEK 900 (USD 138) today versus SEK 9,000 (USD 1380) in five years, is indifferent, or either probably or certainly prefers SEK 9,000 in five years. The amounts are presented in current prices. All regressions are estimated by OLS. Each column represents a separate regression. The sample consists of male children born in Stockholm county in 1953 (6,749 observations). Any crime in CWD data refers to a decision by the CWD for delinquent behavior (each decision may involve multiple offenses) while Property crime and Violent crime refers to the number of crimes in each category. All regressions control for dummies for month of birth, intelligence, educational level (3 levels) of the parent, each parent's income (linearly) and each parent's year of birth (linearly). *** = significant at the 1 % level, ** = significant at the 5 % level, * = significant at the 10 percent level.

Table 2 Robustness and mechanisms

	Baseline (left corner of Panel A in Table 1)			Dropping controls for parental SES		
	Any crime	Violent crime	Property crime	Any crime	Violent crime	Property crime
Timing of reward:						
Certainly immediate	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Probably immediate	-.104***	-.035*	-.078***	-.102***	-.035*	-.079***
	(.034)	(.020)	(.027)	(.034)	(.020)	(.027)
Indifferent	-.072**	-.034*	-.058**	-.071**	-.034*	-.057**
	(.032)	(.019)	(.027)	(.032)	(.019)	(.027)
Probably delay	-.094***	-.033**	-.067***	-.101***	-.036**	-.071***
	(.025)	(.015)	(.021)	(.025)	(.015)	(.021)
Certainly delay	-.093***	-.021	-.067***	-.098***	-.024	-.071***
	(.025)	(.015)	(.021)	(.025)	(.015)	(.021)
	Dropping controls for intelligence			Baseline + controlling for educational attainment		
	Any crime	Violent crime	Property crime	Any crime	Violent crime	Property crime
Timing of reward:						
Certainly immediate	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Probably delay	-.112***	-.039**	-.087***	-.063*	-.031	-.051*
	(.034)	(.020)	(.027)	(.034)	(.020)	(.028)
Indifferent	-.080**	-.038**	-.063**	-.029	-.025	-.027
	(.033)	(.019)	(.027)	(.033)	(.020)	(.027)
Probably delay	-.122***	-.045***	-.087***	-.056**	-.025	-.036*
	(.026)	(.016)	(.022)	(.026)	(.016)	(.022)
Certainly delay	-.116***	-.032**	-.084***	-.052**	-.015	-.038*
	(.025)	(.015)	(.021)	(.025)	(.016)	(.021)

Notes: The table shows the coefficients on dummies set to unity if the child at age 13 probably prefers SEK 900 (USD 138) today versus SEK 9,000 (USD 1380) in five years, is indifferent, or either probably or certainly prefers SEK 9,000 in five years. The amounts are presented in current prices. All regressions are estimated by OLS. Each column represents a separate regression where the dependent variable is a dummy set to unity for the individual having been reported to the police for a crime at least once between age 15 and 31. The sample consists of male children born in Stockholm county in 1953 (6,749 observations). All regressions control for dummies for month of birth, intelligence, educational level (3 levels) of the parent, each parent's income (linearly) and each parent's year of birth (linearly). *** = significant at the 1 % level, ** = significant at the 5 % level, * = significant at the 10 percent level.

Table 3 Subgroup analysis

	Parents at most compulsory school			At least one parent higher education		
	Any crime	Violent crime	Property crime	Any crime	Violent crime	Property crime
Timing of reward:						
Certainly immediate	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Probably immediate	-.157***	-.000	-.069	-.054	-.077	-.133**
	(.056)	(.033)	(.045)	(.086)	(.056)	(.067)
Indifferent	-.087	.023	-.044	.058	-.127***	-.062
	(.057)	(.034)	(.046)	(.088)	(.046)	(.074)
Probably delay	-.166***	-.017	-.059	-.075	-.100**	-.121**
	(.043)	(.024)	(.035)	(.063)	(.046)	(.056)
Certainly delay	-.149***	-.009	-.047	-.057	-.071	-.099*
	(.042)	(.024)	(.035)	(.061)	(.046)	(.056)
Sample mean	.302	.069	.150	.216	.044	.098
	Below average intelligence			At least average intelligence		
	Any crime	Violent crime	Property crime	Any crime	Violent crime	Property crime
Timing of reward:						
Certainly immediate	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Probably delay	-.115**	-.038	-.105**	-.093**	-.030	-.049
	(.050)	(.033)	(.042)	(.045)	(.022)	(.035)
Indifferent	-.062	-.054**	-.099**	-.081*	-.016	-.013
	(.047)	(.030)	(.040)	(.044)	(.023)	(.036)
Probably delay	-.101***	-.052*	-.087***	-.085**	-.015	-.041
	(.038)	(.025)	(.033)	(.034)	(.018)	(.027)
Certainly delay	-.090**	-.029	-.082***	-.091***	-.012	-.046*
	(.036)	(.025)	(.033)	(.033)	(.018)	(.027)
Sample mean	.350	.093	.185	.325	.048	.118

Table 3 continued

	Father previously convicted			Father no previous convictions		
	Any crime	Violent crime	Property crime	Any crime	Violent crime	Property crime
Timing of reward:						
Certainly immediate	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Probably immediate	-.337***	-.171***	-.168**	-.066*	-.013	-.064**
	(.083)	(.061)	(.070)	(.036)	(.020)	(.029)
Indifferent	.011	-.098	.058	-.080**	-.020	-.071***
	(.093)	(.066)	(.085)	(.034)	(.019)	(.028)
Probably delay	-.104	-.124**	-.015	-.089***	-.018	-.070***
	(.071)	(.054)	(.061)	(.027)	(.015)	(.023)
Certainly delay	-.072	-.036	-.008	-.092***	-.016	-.072***
	(.069)	(.054)	(.060)	(.026)	(.015)	(.022)
Sample mean	.421	.137	.251	.274	.057	.132

Notes: The table shows the coefficients on dummies set to unity if the child at age 13 probably prefers SEK 900 (USD 138) today versus SEK 9,000 (USD 1380) in five years, is indifferent, or either probably or certainly prefers SEK 9,000 in five years. The amounts are presented in current prices. All regressions are estimated by OLS. Each column represents a separate regression where the dependent variable is a dummy set to unity for the individual having been reported to the police for a crime at least once between age 15 and 31. The sample consists of male children born in Stockholm county in 1953 (6,749 observations). All regressions control for dummies for month of birth, intelligence, educational level (3 levels) of the parent, each parent's income (linearly) and each parent's year of birth (linearly). *** = significant at the 1 % level, ** = significant at the 5 % level, * = significant at the 10 percent level.