Life is now! Time preferences and crime: Aggregate evidence from the Italian regions

Sergio Beraldo, Raul Caruso, Gilberto Turati, "Life is now! Time preferences and crime: Aggregate evidence from the Italian regions", The Journal of Socio-Economics, Volume 47, December 2013, Pages 73-81, ISSN 1053-5357, Elsevier, http://dx.doi.org/10.1016/j.socec.2013.09.002.

LIFE IS NOW!

TIME PREFERENCES AND CRIME:
AGGREGATE EVIDENCE FROM THE ITALIAN REGIONS

September 2013

Abstract. *This paper tests the relationship between time preferences and crime rates as posited by Davis (1988), whose theoretical analysis suggests that individuals' attitude towards the future significantly affects their propensity to commit crime. Our empirical analysis is based on a panel of Italian regions from 2003 to 2007. Various proxies for time preferences are considered: the consumer credit share out of the total amount of loans to households, the share of obese individuals out of the total population, the rate of marriages out of the total population, and the teenage pregnancy rate. Controlling for a great number of factors suggested by the scientific literature on the determinants of crime, adding to the model also time and regional fixed effects, and clustering standard errors to account for both serial and panel correlations, our results basically provide support to the 'Davis' hypothesis' for property crimes, while for violent crimes there seems to be less evidence that these are higher where people discount the future more heavily. Moreover, there is no evidence of a reverse effect from crime to time preferences at this aggregate level.*

JEL Codes: D99, K42, Z13

Keywords: Time Preferences, Property Crime, Violent Crime, Italian Regions.

1. Introduction

The Ant and the Grasshopper - an Aesopian fable which became very popular just before the French Revolution - remarks the misfortune accruing to the grasshopper from imprudence, having it spent the warm months of the year singing away instead of storing up foods for the incoming winter. The allegory was used to give a bright description of the bourgeois virtues of hard working and saving, those virtues that the rising class - which would have soon taken the power - tried to attribute exclusively to itself. The bourgeois was depicted as l'*honnête homme* who grounds his success on both personal effort and the awareness that much *patience* is needed before the fruits accruing from hard-working and trustworthiness can be reaped.

A long-standing tradition in economics echoes similar arguments. This tradition emphasizes that the socially desirable respect of established ethical codes of conduct is possible only in the presence of *a proper concern for the future*. Such a concern, however, has varied significantly over the centuries and across cultures. Sociologists and anthropologists have in recent times emphasized that the vanishing of the future is actually one of the most distinctive features of modern societies: as uncertainty grows, individuals act as they were condemned to live an everlasting present (e.g. Augé, 2008).

In the eyes of an economist, the reduced concern for the future shows up in the long-term fall in saving rates across countries - a well-established feature of modern industrialized societies - but also in the widespread tendency of the amount of (short-term) debt to raise beyond what can be considered a socially responsible level, as the recent financial crisis has dramatically shown. Possibly, even the recent remarkable increase in corporate scandals may be ultimately due to a reduced concern for the future (coupled with some institutional changes which have considerably

affected the pay-off structure faced by managers and entrepreneurs in modern economies)[1].

In what follows, we test whether there are grounds to argue that a 'life-is-now'-perspective may be detrimental for societies, stimulating undesirable activities like delinquency and crime. Davis (1988) was the first to identify a *theoretical* link between crime and time preferences. In his words, this link finds an easy explanation in the fact that "the fruits of illegal activity…can be savoured *before* the costs of their acquisition must be paid" (Davis, 1988: 383). Hence, *ceteris paribus*, individuals who discount the future more heavily may be more prone to commit crimes.

The goal of this work is to provide a first empirical test to this theoretical prediction considering *aggregate* crime data on Italian regions from 2003 to 2007. As for the proxies for time preferences, we focus on four very different measures, all of which aggregate individual choices guided by idiosyncratic time preferences: *consumer credit*, which represents short-term debt typically used by households to finance their consumption; *obesity,* which is linked to the intake of calories more than it is recommended by the consideration of future health; *marriage*, interpreted as an institution denoting the willingness of individuals to engage in stable relationships; *teenage pregnancy*, capturing the impatience of individuals for having sexual adult experiences. All these variables show clear trends in recent decades. The widespread tendency of both the amount of short-term debt and the number of obese people to increase, as well as the reduction in the willingness to engage in stable relationships, are common features of western industrialized countries, all of which may be (at least partly) related to time preferences.

[1] Beraldo and Turati (2011) discuss several institutional changes that may have shortened the agents' time horizon. There are reasons to believe, for example, that contracts designed to provide professional managers adequate monetary incentives in order to align their objectives with those of the firms' owners may have led managers to maximise short term gains instead of long-term profits.

Controlling for the factors highlighted by the literature on the determinants of crime, adding to the model also time and regional fixed effects, and clustering standard error to account for both serial and panel correlations, our results basically provide support to the 'Davis' hypothesis' for property crimes, while for violent crimes there seems to be less evidence - at the aggregate level - that these are higher where people discount the future more heavily. Moreover, there is no evidence of a reverse effect from crime to time preferences at this aggregate level.

The remainder of the paper is organized as follows. In Section 2 we briefly describe the theoretical model due to Davis (1988). In Section 3 we illustrate our empirical strategy and our data. Results are discussed in Section 4. Section 5 concludes.

2. The theoretical framework: time discounting and attitude to crime

Following Davis (1988), let us consider an individual contemplating illegal activity. If undetected she will get an income U(σ), where σ is the rate at which offences are committed. Suppose that the individual sees the future as split in two sub-periods: in the first sub-period she enjoys the fruits of illegal activity; in the second one she is possibly detected and punished. The individual does not know exactly when detection will occur. However, as soon as she is detected, a fine F must be paid, and - from then on - only an income Y accruing from some legal activity may be earned. Over an infinite time horizon, the expected present value of future income, accruing from both legal and illegal activity can be expressed as:

$$V(\sigma) = \int_0^{\infty} \{U(\sigma)[1 - G(t)] + YG(t) - Fg(t)\} e^{-rt} dt \qquad (1)$$

where $g(.)$ is the probability density function of the time of detection, $G(.)$ is the cumulative of $g(.)$ and r is the individual discount rate, which summarise here the way individuals discount the future.

Let us now consider the probability of being detected within some small interval in the neighbourhood of t, $P(.)$, after having breached the law up to t. Assuming that the chances of being detected depend only on the offence rate at t and on the level of enforcement E, this can be written as:

$$P(\sigma,E)=\frac{g(t)}{1-G(t)} \tag{2}$$

The individual choice problem is that of maximizing (1) subject to (2). This optimal control problem is greatly simplified by the fact that $P(\sigma, E)$ is independent from time. With an infinite time horizon this implies σ to be constant, hence (2) can be written as a linear differential equation which can be substituted into (1). Integrating yields a reformulation of the objective of the agent, which is choosing σ such as to maximize:

$$V(\sigma,E)=\frac{U(\sigma)-Y-P(\sigma,E)F}{r+P(\sigma,E)}+\frac{Y}{r} \tag{3}$$

The numerator of the first term on the right-hand side of (3) represents the expected gains from crime (e.g., Becker, 1968); the denominator is the rate at which these gains are discounted. It is worth noticing that the effective discount rate is composed by the agent's usual time preference plus the probability of being detected. Therefore, the rate at which offences are committed, σ, determines both the expected income from crime and the rate at which such income is discounted.

The first order condition for a maximum, $\partial V(\sigma,E)/\partial\sigma = 0$, imposes that the usual condition of equating marginal costs and benefits must be satisfied in order for the choice of σ to be optimal. Some comparative statics

then reveals that $\partial\sigma / \partial r > 0$: that is, agents with higher discount rates will be more likely to commit crime, or, in other words, the amount of crime committed by different individuals can be explained by their attitudes toward the future. This is the theoretical prediction we aim at testing in the remainder of the paper.

3. The empirical strategy

3.1. An aggregate model of regional crime rates

We test the theoretical prediction briefly presented above by considering Italian regional data over the period 2003-2007. Since we use here aggregate data starting from an individual choice problem, we need to discuss aggregation issues before moving to our empirical analysis (e.g., Blundell and Stoker, 2005; Durlauf et al., 2008 and 2010). A standard representation of the individual expected utility associated with the choice of committing crime, which can be interpreted as a (linear) empirical counterpart of Eq. (3) above, is:

$$u_{it}(\sigma_{it}) = r_{it}\phi\sigma_{it} + X_{it}\gamma\sigma_{it} + Z_{lt}\beta\sigma_{it} + \xi_{lt}\sigma_{it} + \varepsilon_{it}\sigma_{it} \qquad (4)$$

where $\sigma = \{0, 1\}$ is an indicator for having (1) or not (0) committed crime; r is the individual discount rate; X and Z are, respectively, individual (index i) and region (index l) specific observable variables emphasized by the scientific literature on the determinants of crime; ξ and ε are individual and region specific unobservables; finally, ϕ, γ, and β are (unknown) parameters describing preferences. Following Durlauf et al. (2008), we make the following assumptions to restrict the nature of unobserved heterogeneity:

$$\text{A.1.} \quad E[\varepsilon_{it}(1) - \varepsilon_{it}(0)] = 0$$

A.2. $\left[\xi_{lt}(1)-\xi_{lt}(0)\right]$ is independent of $\left[\varepsilon_{it}(1)-\varepsilon_{it}(0)\right]$

A.3. $\left[\varepsilon_{it}(1)-\varepsilon_{it}(0)\right]$ is independent of *r*, *X* and *Z*.

The *i*-th individual will commit crime if and only if [u_{it}(1)-u_{it}(0)] is (strictly) positive, which implies:

$$r_{it}\phi + X_{it}\gamma + Z_{lt}\beta + \left[\xi_{lt}(1)-\xi_{lt}(0)\right] + \left[\varepsilon_{it}(1)-\varepsilon_{it}(0)\right] > 0 \qquad (5)$$

or:

$$r_{it}\phi + X_{it}\gamma + Z_{lt}\beta + \left[\xi_{lt}(1)-\xi_{lt}(0)\right] > \left[\varepsilon_{it}(0)-\varepsilon_{it}(1)\right] \qquad (6)$$

Eq. (6) makes clear that, conditional on *r*, *X*, *Z*, and $\left[\xi_{lt}(1)-\xi_{lt}(0)\right]$, individual choices are stochastic. Let us denote by A_{it} the cumulative distribution function of $\left[\varepsilon_{it}(0)-\varepsilon_{it}(1)\right]$; the probability to commit a crime can then be written as:

$$\Pr\left(\sigma_{it}=1 \mid r_{it}, X_{it}, Z_{lt}, \xi_{lt}(1)-\xi_{lt}(0)\right) = A_{it}\left(r_{it}\phi + X_{it}\gamma + Z_{lt}\beta + \xi_{lt}(1)-\xi_{lt}(0)\right) \qquad (7)$$

This (conditional) probability to commit crime at the individual level can then be aggregated to obtain the (expected) regional specific crime rate Δ_{lt}:

$$E\left(\Delta_{lt} \mid F_{r_{it}}, F_{X_{it}}, Z_{lt}, \xi_{lt}(1)-\xi_{lt}(0)\right) = \int A_{it}\left(r\phi + X\gamma + Z_{lt}\beta + \xi_{lt}(1)-\xi_{lt}(0)\right) dF_X \qquad (8)$$

where F_r and F_X are the empirical distribution functions in the l-th region of the discount rates and the individual controls *X*. Further assuming that the probability density function of $\left[\varepsilon_{it}(0)-\varepsilon_{it}(1)\right]$:

A.4. dA_{it} follows a uniform distribution

we can derive the following linear regression model, which is our estimating equation to be tested below:

$$\Delta_{lt} = \bar{r}_{lt}\phi + \overline{X}_{lt}\gamma + Z_{lt}\beta + \xi_{lt}(1) - \xi_{lt}(0) + \vartheta_{lt} \qquad (9)$$

where $\bar{r}_{lt}$ and $\overline{X}_{lt}$ are the empirical means of the discount rates and the variables in X within the l-th region, and ϑ_{lt} is the difference between realized and expected crime rates.

As for region specific crime rates Δ_{lt}, we consider both (reported) *property crime* and *violent crime* as measured by the Italian National Institute of Statistics (ISTAT). In particular, the property crime rate is the number of property crimes (like thefts, robberies, frauds and burglaries) per 1,000 inhabitants. The violent crime rate is the number of violent crimes (like rapes, homicides, kidnappings and injuries) per 10,000 inhabitants. Main descriptive statistics for these variables are in the Appendix. Over our five years period, the average property crime rate is 22 per 1,000 inhabitants, while the violent crime rate is about 16 per 10,000 inhabitants. Both variables show a clear increasing trend: from 20 to 23 per 1,000 inhabitants for property crimes, and from 11 to 18 per 10,000 inhabitants for violent crimes. Both variables also show a clear geographical variability: property crimes are 28 per 1,000 people in the North-Western part of the country, and drop to 15 per 1,000 in the South; violent crimes are instead 17.8 per 10,000 inhabitants in the North-West, and 13.8 in North-Eastern regions. From table 1, it emerges a positive and statistically significant linear correlation between the two types of crime (r = 0.3669; p-value=0.0002).

Before moving further it is worth noticing that – as the previous discussion make clear – we need a number of assumptions for model in Eq. (9) to be an adequate representation of the aggregate behaviour of

individuals located in different regions. For instance, as highlighted by Durlauf et al. (2008), there is no reason for the orthogonality assumptions to hold. Hence, this means that most (if not all) estimated coefficients will be biased, and one cannot make a correct *causal* inference. Moreover, as we discuss below, this problem is exacerbated here by the fact that we can measure *only imprecisely* the average discount rate. We do our best to account for both unobserved heterogeneity at the regional as well as year level considering regional and year fixed effects in all our specifications, and to account for serial and panel correlation. However, our estimates below must cautiously be interpreted as the search for robust *ceteris paribus* correlations.

3.2. Proxying time preferences

Time preferences are usually measured at the individual level via experiments or surveys, proposing individuals a number of alternative choices, and asking for preferences of having a (discounted) amount of money now or the whole amount some time later in the future (see, e.g., recent contributions by Andreoni and Sprenger, 2012; Meier and Sprenger, 2011a, b). Varying both the discount rate for computing the present value and the time interval, researchers are able to elicit individual time preferences, and separate these from risk attitudes. But here we consider *aggregate* crime data, and the main challenge for our analysis is to find proxies for the time preferences at this aggregate level.

We consider four different proxies, all of which are certainly *related* to individual time preferences, but can only capture *loosely* the discount rate at the aggregate level: (i) the *consumer credit share* as the ratio between the amount of consumer credit and the total amount of loans to households; (ii) the share of obese people (*obesity rate*); (iii) the *marriage rate* as the number of marriages per 1000 individuals; (iv) the *teenage pregnancy rate* as the share of children born from teenage mothers. All these proxies aggregate

choice variables at the individual level which are shown by the literature to be influenced by idiosyncratic time preferences (the demand of a short term loan, the intake of excess calories, the decision to get married, the choice of having unprotected sex), but are also clearly influenced by other variables (for instance, loan supply in the case of consumer credit). More precisely, considering Eq. (9), instead of having a direct measure for the empirical mean of the discount rates $\bar{r}_{lt}$, we do have empirical means of four different choice variables Ψ for which the (individual) discount rate plays a crucial role, i.e. $\overline{\Psi(r_{lt})}$. We now briefly discuss each of these variables in turn.

Consumer credit share. The consumer credit share is probably the most intuitive of such proxies for time preferences. It measures consumer credit standardized by the total amount of loans supplied to households. Consumer credit is a typical form of short-term debt, whereas total loans include, for instance, mortgages, that are typical long-term debts. According to the definition provided by the Bank of Italy in its official statistics, 'consumer credit' includes only short-term debts commonly financing the purchase of consumer goods, like - for instance - holidays or small appliances. At the individual level, the higher the discount rate - hence the lower the utility attached to future consumption - the higher the willingness to ask for short-term loans to increase current consumption. Considering US data on credit card borrowing, Meier and Sprenger (2011a) shows that present-biased individuals (i.e., individuals who show a particular desire for immediate consumption) are indeed more indebted, hence providing evidence of a strong correlation between time preferences and consumer credit[2]. At the aggregate level, then, a higher share of consumer credit is informative of a larger share of individuals with a higher discount rate.

[2] Unfortunately, no studies are available on Italian data. However, descriptive evidence taken from the 2004 Bank of Italy Survey on Household, Income and Wealth (SHIW) provide further support to the correlation between time preferences and consumer credit. See Beraldo et al. (2012) for additional details on this point

Of course, the (realized) share of consumer credit does not depend *only* on the time preferences of individuals. On the demand side, considering European data, Magri et al. (2011) show that this type of short-term debt is primarily used both by larger households with youngest and well educated heads, and by poorer households. Delinquencies (i.e., problems in repaying consumer credit) are more frequent among poor households, and more common for the unemployed relative to other positions. This means that we need to control – in our analysis – also for the age structure of the population, the share of poor households, and the unemployment rate. Yet, these variables are also relevant as explanatory variables for the crime rates. On the supply side, as the realized consumer credit share depends also on the credit availability at the regional level, we also augment our model with controls like the number of bank branches and year fixed effects, to account for the likely impact of the general economic situation.

Obesity rate. The second proxy for time preferences is the share of obese people out of the total population. Following international standards, obese people are defined according to their Body Mass Index (i.e., BMI $\geq$ 30). As suggested for instance by Borghans and Golsteyn (2006), the link between BMI and the individual discount rate can be traced by considering the immediate gratification of eating and the future effects of over-eating, both in terms of physical appearance and – most importantly – in terms of reduced health. Again, the higher the discount rate, the lower the utility attached to future health, hence the higher the food intake in the current period, which is likely to increase BMI[3]. At the aggregate level, then, a higher share of obese people is informative of a larger share of individuals with a higher discount rate.

As before for consumer credit, the available empirical evidence highlights an association between BMI and some measures of time preferences at the

[3] A similar explanation has been provided about smokers. Yamane et al. (2013) show that smokers are more impatient than non-smokers.

individual level, although time preferences alone are not able to give a complete account of the sharp increase in the number of obese people observed in many countries (e.g., Borghans and Golsteyn, 2006; Daly et al., 2009). Education is likely to play a role, as well as poverty, age, marital status, and regional cultural factors. We do then take into account also these additional covariates in our empirical exercise below. Notice that obesity has been already studied in relationship with crime, with mixed results. For instance, Price (2009) finds that obesity increases crime, whereas Kalist and Siahaan (2013) find likelihood of being arrested to be lower for obese people.

Marriage rate. The third proxy for time preferences is the marriage rate, defined as the number of marriages per 1,000 individuals. Our claim is that time preferences may be expected to influence also the decision to get married; in particular, more patient individuals should be more likely to enter in long term relationships. Indeed, Compton (2009) discusses the correlation between heterogeneity in time preferences and marriage stability, finding some evidence to support the idea that more patient individuals are less likely to divorce. Grounding on this finding, we should expect a negative correlation between marriage rates and crime: *ceteris paribus*, the higher the discount rate, the lower the utility attached to the future, hence the willingness to enter long term relationships.

However, such prediction is not unchallenged. Historical decline in marriage rates across industrialized countries and the change in marriage customs have been extensively discussed, for example, by Akerlof (1998) and Stevenson and Wolfers (2007). In particular Akerlof (1998) also examines the impact of these changes on society at large, arguing that the observed widespread delay in settling down is likely to cause more crime and more substance abuses with adverse effects upon the subsequent generations, establishing a direct link between marriage customs and crime. Yet, this

implies the need to control for the share of single in our empirical analysis below.

Teenage Pregnancy Rate. The fourth proxy for time preferences is the number of children per 1,000 newborn from a mother who is less than 18 years old. Also for this proxy, there is evidence of a link with time preferences. For instance, Chesson et al. (2006) find that risky sexual-behaviour-indicators (such as 'having sex before age 16' and 'pregnancy status') are significantly associated with high discount rates. As before, we then expect a positive correlation between the share of teenage mothers and crime: *ceteris paribus*, the higher the discount rate, the lower the utility attached to the future, hence the higher the willingness to adopt risky sexual behaviours. Also in this case, other variables may be responsible for teenage pregnancy, like the level of education or regional cultural factors. We account for all these in what follows.

Descriptive evidence. Main descriptive statistics for all the four proxies are in the Appendix. Consumer credit as a share of total loans is 36 per cent over the five years period, and it trends upward from 35 to 39.6 per cent. Regional differences are also clear: the share is the highest in the Italian *Mezzogiorno* (about 47 per cent), and lowest in the North-Eastern part of the country (about 23 per cent). Obese are 9.9 per cent out of the whole population, but their share is slowly rising, from 9.2 to 10.2 per cent. Regional variability points to the highest share in the South (almost 11 per cent) and to the lowest in the North-Western area (8.5 per cent). As for the marriage rate, the national average is 4.17 per 1,000 people, but the trend is decreasing in this case, from 4.38 to 3.99 per 1,000. Also regional variation goes in the opposite direction with respect to the previous two proxies: the highest share is registered for the *Mezzogiorno*, while the lowest for the North-East (4.5 vs 3.7 per 1,000, respectively). Finally, the share of teenage mothers is 37 per 1,000 newborn in Italy, with a reducing trend from more

than 39 to about 35. As for the first two proxies, Southern regions record by far the highest share (56 per 1,000 newborn), while North-Western regions show the lowest one (22.5). To sum up, taken at face value, all but one of our proxies (the share of teenage pregnancy) suggest that the aggregate discount rate has effectively increased in Italian regions in recent years. Moreover, all but one of our proxies (the marriage rate) suggest that the Italian *Mezzogiorno* represents the area of the country where the aggregate discount rate is the highest.

Interestingly, the four proxies are all negatively associated with the property crime rate and all positively associated with the violent crime rate, with most of the correlations that are also statistically significant. Furthermore, the four proxies are all positively (and significantly) correlated among themselves, with the strongest (linear) association between the marriage rate and the share of teenage pregnancy. Clearly enough, this suggests that – at least in some part of the country – the decision to get married is not only influenced by time preferences, but it takes shape in the presence of a unplanned pregnancy. We will account for cultural differences in the empirical analysis below, both by considering regional fixed effects and by differentiating the impact of our time preferences proxies across country macro-areas.

[TABLE 1 ABOUT HERE]

3.3. Additional controls for crime and time preferences proxies

As covariates, we consider a number of variables that the economic literature on crime deems to be important. Descriptive statistics, sources, and definitions of all these covariates are in the Appendix.

We measure *current economic opportunities* by including lagged *GDP per capita* and two different measures of the unemployment rate, such as the

long-term unemployment rate and the *youth unemployment rate*[4]. GDP has been proved to be significantly related to crime in the Italian case (e.g., Caruso, 2011; Scorcu and Cellini, 1998; Marselli, 1997). However, its impact on crime is not perfectly predictable. On the one hand, taking income per capita as a measure of economic opportunities, one can expect that where GDP is higher, the tendency to commit crime should be lower. On the other hand, where GDP per capita is higher, opportunities for crime are higher (especially so for property crime). We also control for the *share of immigrants* out of the total population, which is correlated with - according to Bianchi et al. (2012) - with the incidence of property crimes.

With regard to unemployment, some theoretical studies predict a positive association between crime and unemployment, as the latter is considered a variable reliably capturing the 'opportunity cost' associated to crime (e.g., Freeman, 1999; Ehrlich, 1996, 1973). This hypothesis has found robust empirical evidence for property crime (e.g., Neumayer, 2005; Levitt, 2001; Britt, 1997; Reilly and Witt, 1996; Allen, 1996; Chiricos, 1987; Phillips and Votey, 1981; Sjoquist, 1973). On the contrary there is a strand of literature which interprets the level of unemployment as an indicator of 'social inactivity', and posits a negative relationship between crime and unemployment (e.g., Cantor and Land, 1985). According to this 'opportunity perspective', as unemployed are engaged in a reduced number of social interactions, their 'opportunities' for delinquency are reduced[5]. Evidence is available only for violent crime (e.g., Cotte Poveda, 2011; Saridakis 2004; Levitt, 2001; Entorf and Spengler, 2000, Britt, 1997). Since unemployment is likely to proxy also for income distribution (e.g., Brandolini et al., 2004), a

[4] Also for unemployment, we consider the one year lagged values of both rates, following the empirical strategy discussed in Allen (1996) and Levitt (2001). According to Carmichael and Ward (2001) and Fougère et al. (2009), youth unemployment is expected to increase crime. Caruso and Schneider (2011) emphasize the frustration and the political violence emerging in the presence of growing rates of youth unemployment.

[5] The direct role of social interactions on crime is discussed, for instance, by Glaeser et al. (1996) and Zenou (2003). The evidence that social interactions impact more on certain types of crime is consistent with the literature on the 'opportunity perspective'.

further control in this direction is the *relative poverty index*. When considering the relationship between poverty and crime, we simply refer to the line of reasoning expounded above with respect to unemployment and current economic opportunities. Then, with regard to property crime we expect a positive correlation with crime rates whereas we may also expect a negative association with violent crime. The latter, in particular, is drawn from Mehlum et al. (2006).

Following Caruso (2009) we also control for *future economic opportunities* captured by means of two variables: *(gross) investments in manufacturing* and *patent intensity* (per 1,000,000 inhabitants). We then control also for the *number of bank branches at the regional level* which is also likely to interact with the share of consumer credit.

A number of studies highlight a negative correlation between *education* and crime, as education is expected to increase the returns of legitimate work and business, hence the opportunity costs of committing crime (e.g., Groot and van den Brink, 2010; Dills et al., 2008; Lochner and Moretti, 2004; Soares, 2004; Gould et al., 2002; Miron, 2001; Grogger, 1998). Then, we consider two measures for education: the *share of the population between 25 and 64 years old holding a high school diploma*, and the *share of the population between 20 and 24 years old holding a high school diploma*[6]. In fact, education can also indirectly affect crime via time preferences, since it impacts on the ability of individuals to figure out future scenarios (e.g., Borghans et al., 2008).

Eventually, we also consider regional *public expenditure in security*. Controlling for this variable is directly suggested by the model presented in Section 2: the probability of being detected is clearly affected by the amount of resources available to the Authorities to enforce legal rules, and – in turn - it affects the effective discount rate of each agent (see Eq. 3 above).

[6] Notice that the two variables capture different cohorts of individuals. For the former, diploma was less likely and can really be thought as a signal for patience. On the contrary, for the latter, diploma is much more common, and those more patient would further improve their education enrolling in a university course.

However, one of the recurring issues raised in the literature is that any measure of deterrence might be really co-determined with crime. This can explain why, in the empirical literature, different measures of deterrence are not statistically significant or, quite frequently, even positively related to crime (e.g., Benson et al., 1994*a*,*b*; Cameron, 1988; Devine et al., 1988; Cloninger and Sartorius, 1979; Corman et al., 1987). To mitigate the problem of reverse causality, we consider the one-year lagged spending in security.

Another recurring question in the literature on crime is whether the *age structure* influences the level of crime. Results are not fully conclusive even if a positive association between younger males and violent crimes seems to emerge (see, among others, McCall et al., 2013; Phillips, 2006; Marvell and Carlisle, 1991; Steffensmeier et al, 1989). We then control for the *share of males 15-24 years old* and the *share of males 25-34 years old* out of the total population. We also control for marital status, in particular for being single, considering the *share of single households* (per 100 households), since this affects both the propensity to commit crimes and some of our proxies for time preferences (e.g., the marriage rate). Finally, we also control for *'social capital'*, which began to be investigated in recent literature (Akçomac and ter Weel, 2012; Loureiro et al.,2009; Lederman et al., 2002; Rosenfeld et al. 2001). As for Italy, Buonanno et al. (2009) study whether social capital reduces crime, considering provincial level variations in associational networks. They find that a standard deviation increase in association density is related, for example, with a reduction in car thefts by 13 percentage points. Here we sum up social capital considering another commonly adopted measure, namely the *ratio of volunteers in not-for-profit organizations out of the population*. Also in this case, to mitigate the reverse causality issue, we lagged the variable one year. We expect a negative correlation with crime rates.

4. Results

4.1. Time preferences and crime

We experiment with four different models for each of our proxies, entering all variables in logarithms. We included in all models regional and year fixed effects to control for unobserved heterogeneity across regions and time periods that cannot be captured by our covariates. We also account for serial and panel correlations by clustering standard errors for each region and each year, using the methodology proposed by Cameron et al. (2011). Results are in Table 2 for both property and violent crime[7]. For both types of crime we first estimated a very simple model including our proxies for time preferences, together with all the controls that the established literature indicates as important determinants of crime. We then interacted our time preferences proxies with macro-area dummies and a measure of resource distribution in each region. We are interested in coefficient ϕ from Eq. (9); it captures the robust correlation between crime and our time preferences proxies. In the baseline model I, only the share of children born from teenage mothers is strongly and significantly associated with property crime among the proxies for time preferences. The other proxies do not appear to be significantly correlated with crime rates. However, according to descriptive statistics, there is a large variability across regions. Therefore, correlations could vary considerably across macro-areas. In order to capture such territorial asymmetries, we then introduce interactions between our measures of time preferences and territorial dummies.

Introducing interactions shows more significant coefficients, although not all with the expected sign (model II). While coefficients for teenage

[7] The complete tables are not included here for brevity but are available upon request from the authors. Notice that most coefficients of the additional controls are insignificant, likely because of the inclusion of time and regional fixed effects. However, when significant, covariates coefficients show the expected signs. In particular, significant coefficients emerge consistently only for the share of males 15-24 years old in the property crime equation and for the number of banks in the violent crime equation.

mothers are positive and significant in Southern regions for both types of crime, and coefficient for obese people in Northern regions for violent crime is also positive and significant as expected, results for consumer credit share and the marriage rate are more puzzling. In particular, the consumer credit share appears to be negatively associated with both violent and property crime in Northern regions. Albeit contrary to expectations, this result can be explained by the fact that Northern regions exhibit the highest income in Italy. And a negative association with crime in such case would likely capture the negative impact of current economic opportunities. To put it differently, as noted above, in richer regions consumer credit may also be expected to be a tool to facilitate consumption. This would enhance welfare of individuals and households so indirectly decreasing incentives to commit crime. Clearly opposite to expectations is also the positive and significant association between marriage rate and violent crime in Northern regions. Again, however, this result is not surprising if we consider that the mechanism envisioned in Akerlof (1998) may take place in richer regions. Moreover, since figures on violent crime include also violence between partners (especially against women), it is reasonable to say that family violence increases with the number of marriages. In this respect, Karadole (2012) and ISTAT (2007) had shown that in Italy violence perpetrated against women by husbands is higher in Northern regions.

To capture the potential interactions between time preferences and economic opportunities that can affect our results, in model III we introduced an additional covariate interacting time preferences and the poverty rate. In fact, coefficient for this interaction term with poverty comes up as significant and negative in three models: the impact of time preferences on crime is lower where the share of poor households is higher. Moreover, with the important exception of the share of children born from teenage mothers, almost all coefficients for time preferences turn to be insignificant. A potential explanation is that - in the presence of a high share of poor households - the negative effect on crime reflects much more

the 'opportunity perspective' discussed above than the role of time preferences. Notice, however, that time preferences still play a role also in this specification. First, consumer credit share coefficient is now positive (as expected) and significant in Southern regions for property crime. More importantly, almost all interactions for teenage mothers are positive and significant for both types of crime, with coefficient magnitude increasing when moving from North to South, hence counterbalancing the negative impact of the interaction with poverty.

Eventually, in order to evaluate some asymmetries within Northern regions, we further divide these in North-Eastern and North-Western regions (Model IV). Results further confirm our hypotheses, with all significant coefficients now taking the expected sign. Moreover, coefficient for the interaction term between time preferences and poverty is now insignificant in all models, suggesting that it is the *within-North* variability the likely source of the unexpected results discussed above. In particular, for property crime, positive and significant coefficients now emerge for consumer credit share, obese people and teenage mothers in both North-Eastern and Southern regions, while a negative and significant association emerge for the marriage rate in North-Western regions. As for violent crime, a positive and significant association still emerge in both North-Eastern and Southern regions for teenage mothers again.

[TABLE 2 ABOUT HERE]

4.2 From crime to time preferences?

In the previous section we analysed the relationship between crime and time preferences by hypothesizing that time preferences may significantly be associated with crime rates. However, a growing literature explains the formation of time preferences in the light of some specific violent and risky events. In particular, Chao et al. (2009) show that mortality risk is a crucial

determinant of time preferences in a country, South-Africa, where the prevalence of HIV/AIDS is high. Along this line, Lahav et al. (2011) and Shavit et al. (2013) analyse in depth time preferences of soldiers in Israel. Soldiers face a high mortality risk as compared to university students and teenagers. In fact, the authors show that - among these categories of young adults - soldiers show the highest discount rates, concluding that a violent and risky environment affect time preferences.

With this in mind, therefore, while studying the relationship between crime and time preferences it could be maintained that exposure to crime and other risks make individuals more impatient. To test whether or not this is valid also in our aggregate framework, we estimate a model where the one year lagged crime rates are both used as regressors – together with all the other covariates discussed before – in a model for time preferences proxies. Results are in Table 3.[8] Coefficients for these variables are never significant, suggesting that there seems to be no evidence for an impact of a violent environment on time preferences proxies at this aggregate level.

[TABLE 3 ABOUT HERE]

5. Concluding remarks

In this paper we proposed an empirical test on the relationship at the aggregate level between time preferences and crime considering Italian regions observed over the period 2003-2007. The theoretical hypothesis is drawn by Davis (1988) and can be summarised as follows: individuals who discount the future more heavily may be more prone to commit crimes. As a consequence, where people are more impatient and discount the future more

[8] Also in this case the complete tables are available upon requests from the authors.

heavily, property and violent crimes are supposed to be higher. We test this hypothesis by considering both property and violent crimes. We proxy time preferences at the aggregate level using four very different proxies, all of which are choice variables affected at the individual level by idiosyncratic discount rates: 1) the consumer credit share, which is the amount of short-term debt to finance current consumption; 2) the prevalence of obese people according to their body mass index, which is related to the consideration of future health; 3) the marriage rate, interpreted as the willingness of individuals to engage in stable and long-term relationships; 4) the share of children born from teenage mothers, which tells about the preference for unprotected sexual adult experiences.

Controlling for variables drawn from the established literature on crime, as well as considering time and regional fixed effects, besides serial and panel correlations, our results basically provide support to the Davis hypothesis, at least for property crime, while they are not fully conclusive for violent crime. In particular, for property crime, we find a positive and significant correlation between criminal behaviour and consumer credit share, obese people and teenage mothers in both North-Eastern and Southern regions, while a negative and significant association emerge for the marriage rate in North-Western regions. As for violent crime, a positive and significant association still emerge in both North-Eastern and Southern regions for teenage mothers only. Moreover, following a line of research emphasizing the role of violence in influencing individual discount rates, we also check whether a violent environment influences time preferences, but find no evidence at this aggregate level.

Needless to say, we are aware that this work has several limitations, which are related to the nature and the number of observations, the time length and – more importantly – the (aggregate) proxies of time preferences. Extending the work to address these points would be part of a new research agenda on these issues. Still, some implications can be drawn from our results. In fact, if time preferences are associated with crime rates,

evidently it becomes important to understand how these preferences are shaped. Some scholars suggest that time preferences depend upon cognitive (unobserved) abilities and/or other biological characteristics. Dohmen et al. (2010) suggest for example that cognitive ability and impatience are negatively correlated. One may therefore think that individuals with reduced cognitive ability are more prone to commit crime. Daly et al. (2009) find that discount rates correlate positively with systolic blood pressure. Supporters of this vision would advocate that hypertensive individuals are more prone – *ceteris paribus* - to engage in antisocial activities. In general, these ideas are not new and would imply that the propensity to commit crime would be *biologically* determined, an hypothesis very close to the one first advanced by the Italian anthropologist Cesare Lombroso, and eventually rejected on scientific grounds.

An alternative hypothesis is that time preferences are *socially* determined. In other words, they are mostly determined by social processes related to the cultural transmission of values and norms. In this sense, our analysis at a regional level might properly catch the 'average' time preferences in a given *social context*. How society influences time preferences is then a key challenge for future research, and the crucial question really becomes how time preferences can be influenced (or not) by means of adequate policies. Empirical results discussed here suggest that policies contributing to give more importance to the future are likely to be important. In this sense, policies emphasizing the importance of saving, of future health, of stable relationships, are likely to go in the right direction to bring back the sense of future, to challenge the 'life-is-now' perspective, and to improve social life via the association with criminal behaviour.

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TABLES

Table 1. Correlations

	Property crime	Violent crime	Consumer credit share	Marriage rate	Obesity rate	Teenage Pregnancy rate
Property crime	1.000					
Violent crime	.3669***	1.000				
	(.000)					
Consumer credit share	-.4922***	.1964**	1.000			
	(.000)	(.050)				
Marriage rate	-.1053	.3428***	.5143***	1.000		
	(.297)	(.000)	(.000)			
Obesity	-.4457***	.0596	.4865***	.2099**	1.000	
	(.000)	(.556)	(.000)	(.036)		
Teenage Pregnancy rate	-.2008**	.3238***	.4827***	.6372***	.2932	1.000
	(.045)	(.001)	(.000)	(.000)	(.003)	

P-values in parentheses. Sig. Lev.: *** p<0.01, ** p<0.05, * p<0.1

Table 2. Time preferences and crime

Regressors	Dep. Var.: Property Crime				Dep. Var.: Violent Crime			
	Consumer Credit Share	**Obesity rate**	**Marriage rate**	**Teenage pregnancy rate**	**Consumer Credit Share**	**Obesity rate**	**Marriage rate**	**Teenage pregnancy rate**
Model I								
Time preferences	-0.189	0.069	0.235	**0.095*** **	-0.149	-0.138	0.279	0.102
	(0.142)	(0.106)	(0.432)	**(0.030)**	(0.187)	(0.197)	(0.654)	(0.138)
Model II								
Time pref x Northern Italy	**-0.368*** **	0.412	0.152	0.121	**-0.362***	**0.502***	**1.211***	-0.013
	(0.133)	(0.351)	(0.700)	(0.080)	**(0.201)**	**(0.279)**	**(0.674)**	(0.160)
Time pref x Centeral Italy	-0.065	-0.117	-0.179	0.025	-0.075	-0.342	-0.791	0.048
	(0.194)	(0.135)	(0.384)	(0.065)	(0.160)	(0.287)	(0.573)	(0.219)
Time pref x Southern Italy	0.379	0.023	0.451	**0.115***	0.806	-0.319	0.265	**0.212***
	(0.264)	(0.260)	(0.497)	**(0.061)**	(0.656)	(0.226)	(0.525)	**(0.120)**
Model III								
Time pref x Northern Italy	-0.143	0.592	0.821	**0.507** **	-0.253	0.396	2.409	**0.579** **
	(0.169)	(0.423)	(1.033)	**(0.255)**	(0.276)	(1.186)	(1.734)	**(0.235)**
Time pref x Central Italy	0.197	0.084	0.528	0.418	0.051	-0.460	0.472	**0.650** **
	(0.222)	(0.471)	(0.928)	(0.265)	(0.335)	(1.327)	(1.399)	**(0.316)**
Time pref x Southern Italy	**0.879** **	0.322	1.477	**0.733*** **	1.047	-0.494	2.102	**1.159*** **
	(0.415)	(0.584)	(1.453)	**(0.279)**	(0.737)	(1.783)	(2.220)	**(0.383)**
Time pref x Poverty	**-0.121***	-0.100	-0.349	**-0.199***	-0.058	0.059	-0.624	**-0.305*** **
	(0.071)	(0.206)	(0.473)	**(0.107)**	(0.123)	(0.617)	(0.782)	**(0.114)**
Model IV								
Time pref x North Western regions	0.122	0.569	**-1.530** **	0.498	-0.028	0.449	2.174	0.451
	(0.310)	(0.453)	**(0.694)**	(0.352)	(0.210)	(1.166)	(1.809)	(0.351)
Time pref x North-Eastern regions	-0.263	**0.797***	0.916	**0.513** **	-0.355	-0.071	2.418	**0.664*** **
	(0.284)	**(0.421)**	(0.842)	**(0.234)**	(0.218)	(1.164)	(1.703)	**(0.253)**
Time pref x Central Italy	0.124	0.124	0.130	0.413	-0.010	-0.550	0.433	0.581
	(0.268)	(0.401)	(0.684)	(0.322)	(0.339)	(1.338)	(1.439)	(0.364)
Time pref x Southern Italy	**0.850** **	0.350	0.925	**0.724***	1.023	-0.558	2.047	**1.034***
	(0.386)	(0.555)	(1.184)	**(0.380)**	(0.726)	(1.750)	(2.176)	**(0.548)**
Time pref x Poverty	-0.104	-0.110	-0.185	-0.196	-0.044	0.080	-0.607	-0.265
	(0.074)	(0.188)	(0.420)	(0.139)	(0.130)	(0.615)	(0.780)	(0.162)

Two-ways Clustered Standard Errors in parentheses. Sig. Lev.: *** p<0.01, ** p<0.05, * p<0.1
Controls included in all models: lagged GDP per capita, long term unemployment, youth unemployment, investment in manufacturing, patents, education, lagged spending for security, volunteers, foreigners, poor households, male 15-24 yrs. old, male 25-34 yrs. old, single households, regional and year Fixed Effects

Table 3. From crime to time preferences

	Dep. Var. (time preferences)			
Regressors	**Consumer Credit Share**	**Obesity rate**	**Marriage rate**	**Teenage pregnancy rate**
Lagged Property Crime (t-1)	-0.097	-0.006	0.109	0.610
	(0.102)	(0.189)	(0.092)	(0.539)
Lagged Violent Crime (t-1)	-0.005	-0.069	0.099	0.050
	(0.148)	(0.203)	(0.086)	(0.541)

Two-ways Clustered Standard Errors in parentheses. Sig. Lev.: *** p<0.01, ** p<0.05, * p<0.1
Controls included in all models: lagged GDP per capita, long term unemployment, youth unemployment, investment in manufacturing, patents, education, lagged spending for security, volunteers, foreigners, poor households, male 15-24 yrs. old, male 25-34 yrs. old, single households, regional and year Fixed Effects

APPENDIX

Table A1. Variables definitions and descriptive statistics

	Definition	Mean	St. Dev.	Min	Max
Property Crime rate*	Number of property crime (thefts, robberies and burglaries.) per 1,000 inhabitants	21.970	8.350	6.15	40.43
Violent Crime rate*	Number of violent crime (rapes, homicides, kidnappings, injuries and lesions)per 10,000 of inhabitants.	16.025	5.939	6.2	40.1
Consumer Credit Share**	Ratio between the amount of consumer credit and the total amount of loans to households.	.365	.104	.14	.59
Obesity rate*	Share of obese people out of the total population (Body Mass Index ≥ 30)	9.901	1.410	6.57	13.24
Marriage rate*	Number of marriages per 1.000 individuals	4.171	.541	3.2	5.76
Teenage pregnancy rate*	Share of children born from teenage mothers	37.074	27.035	7.921	131.408
Youth Unemployment (t-1)*	Proportion of the youth labour force (persons aged between 15-24) that is unemployed.	22.483	11.962	7.2	46.5
Long- term Unemployment (t-1)*	Proportion of labor force out of work and looking for work for 12 months or more	42.122	13. 418	11.9	61.9
Poverty*	Relative Poverty Index	12.308	8.403	2.5	30.8
Foreigners*	Share of immigrants out of the total population	3.581	2.095	.596	7.595
High School (20-24)*	Ratio of individuals holding a high school diploma aged 20-24 out of total population	75.333	6.162	56.7	84.4
High School (25-64)*	Ratio of individuals holding a high school diploma aged 25-64 out of total population	49.983	5.752	37.4	61.4
Male 15-24*	Share of males, 15-24 years old out of the total population	5.315	.928	3.890	7.075
Male 25-34*	Share of males, 25-34 years old out of the total population	7.209	.424	5.618	8.106
Single*	Share of single households (per 100 households)	13.665	2.585	9.633	16.9
GDP per capita (t-1) *	Gross Domestic Product per capita (1,000 euro)	23.791	5.877	14.773	34.531
Investments in Manufacturing (t-1)*	Gross Investments in Manufacturing	2692.876	3229.187	46.22	14708.09
Patent Intensity (t-1)	Patents registered at EPO per 1,000,000 inhabitants	59.896	52.591	.3	187.4
Banks**	Number of bank branches	1571.868	1420.056	96	6344
Social Capital (t-1)*	Ratio of volunteers out of the total population	1.808	1.832	.415	9.451
Security*(t-1)	Public expenditure in security	1222.729	970.554	65.82	3889.07

Sources: * Italian National Institute of Statistics (ISTAT); ** Bank of Italy.