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# What determines crime rates? An empirical test of integrated economic and sociological theories of criminal behavior



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## ABSTRACT

Research on crime has by no means reached a definitive conclusion on which factors are related to crime rates. We contribute to the crime literature by providing an integrated empirical model of economic and sociological theories of criminal behavior and by using a very comprehensive set of economic, social as well as demographic explanatory variables. We use panel data techniques to estimate this integrated crime model for property and violent crime using the entire population of all 100 counties in North Carolina for the years 2001–2005. Both fields contribute to the explanatory power of the integrated model. Our results support the economic explanation of crime with respect to the deterrent effect of the probabilities of arrest and imprisonment concerns, as well as the time allocation model of criminal activities. In contrast, the integrated model seems to reject the impact of the severity of punishment on crime levels. With respect to the sociological theories of crime, we find most support for the social disorganization theory and for the routine activity theory. Finally, we find differences between property and violent crimes, mostly explained by the sociological models.

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## 1. Introduction

Sociologists and economists alike have a long standing research interest in which factors are associated with crime rates. Traditionally, sociologists have sought to explain crime levels through the exploration of the influence of social structures and institutions. For instance, sociologists connect crime to social subcultures or social disorganization. In order to understand the dynamics of crime deterrence, some sociological research uses a person's predisposition as determinant and focuses on the unique

individual motivations for engaging in illegal activities (Lilly, Cullen, & Ball, 2002). As this type of research often involves data at the individual level, it is not used in sociological research focusing on higher levels such as work on county or country level. When looking to these macro levels, the predominantly used theories are the social disorganization, routine activity theory, structural strain and deprivation theories (Miethe, Hughes, & McDowall, 1991).

Economists approach this policy question from a completely different perspective and focus on efficiency grounds by looking at costs and benefits and determining the optimal amount of enforcement. "During the last 30 years economists have invaded the [criminological] field using their all-embracing model of individual rational behavior, where a criminal act is preferred and chosen if the total pay-off, including that of sanctions and other costs, is higher than that of legal alternatives." (Eide, 2000,

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p. 345). The economic analysis of crime goes back to the seminal article of [Becker \(1968\)](#), in which he sought to explain crime through an economics lens in search of the most efficient way to combat crime. [Becker \(1968\)](#) showed that the probability of arrest and the severity of punishment had a strong deterring effect on crime. The stream of research that used Becker's work as a template became known as the economic approach to crime. Later [Ehrlich \(1973\)](#) expanded this model by showing that opportunity costs to engage in illegal activities are also determinants of criminal behavior. In his model Ehrlich not only took into account the cost of punishments, but he also incorporated the potential returns of illegitimate versus legitimate activities. In this, the presence of job opportunities and job compensation levels became important. Ehrlich and many subsequent scholars in effect no longer tried to uncover the optimal levels of punishment but rather focused on the question whether punishment in itself had a deterring effect on crime ([Ehrlich, 1996; Pratt & Cullen, 2005](#)).

Both the economic and the sociological explanations of crime have been developed separately from each other. Albeit there have been some previous integration attempts ([Gibbs, 1975; Tittle, 1995](#)), the number of comparative tests remains very small. [Saridakis and Spengler \(2012, p. 173\)](#) therefore suggest that further research should start expanding current economic models to better explain criminal behavior in two directions: “[a] For example, violent crime may be better explained in the context of sociological and criminological theories of crime and therefore, theoretical integration may help better understand violent behavior. [...] [b] The availability of more informative macro panel data may also provide further insights.” We take up both calls for extending the current literature by using a comprehensive set of explanatory variables and by integrating economic and sociological theories of criminal behavior.

We contribute to the literature in four ways. First, we construct a new, rich database containing data from all 100 counties in the state of North Carolina for the period 2001–2005 and collect data on 22 explanatory variables. This new informative panel data set is much richer than existing empirical economic studies, which typically use less than half the amount of explanatory variables we use. For instance, [Saridakis and Spengler \(2012\)](#) only use four variables, while [Entorf and Winker \(2008\)](#) use eight variables and [Buonanno and Montolio \(2008\)](#) use 10 variables. Because of the longitudinal nature of the dataset and the measurement model employed we will be able to control for unobserved heterogeneity, a methodological issue often neglected in earlier research.

Second, we use a detailed set of deterrence variables. Confronted with concerns about the empirical validation of the deterrence hypothesis ([Cornwell & Trumbull, 1994](#)), later economic empirical studies focused on adding socioeconomic and demographic variables. While this literature has its merit in enriching the economic models, they often ignored data on deterrence variables ([Altindag, 2012; Ochsen, 2010](#)) or simplified the full set of deterrence variables to only one variable ([Entorf & Spengler, 2000](#)). We use data on arrest rate (clear-up rate), conviction rate, imprisonment rate, as well as data on the severity of punishment

(fines, sentence length, forfeitures, life imprisonment, capital imprisonment) to fully capture the effect of deterrence on crime.

Third, several empirical studies add socioeconomic and demographic variables to their econometric model in an attempt to add more real-life explanatory power to the model, but do so on an ad-hoc basis without clear link to a good theoretical basis ([Buonanno & Montolio, 2008](#)). We explicitly embed all our variables into a clear conceptual framework.

Fourth, having a rich macro panel data set combined with linking our explanatory variables to both economic and social sciences' theories allows us to better understand the factors related to criminal behavior. Our article contributes to the current literature by conducting a thorough comparative test of economic and sociological explanations to crime. By using an integrated empirical model incorporating variables from both disciplines, we can test which theoretical models relate to which types of crimes. Besides economic models ([Becker, 1968; Ehrlich, 1973](#)), we will include variables drawn from routine activity theory ([Cohen & Felson, 1979](#)), social disorganization theory ([Shaw & McKay, 1942](#)), strain theory ([Merton, 1938](#)), deprivation theory ([Blau and Blau, 1982; Bonger, 1969; Lilly et al., 2002](#)), social support theory ([Cullen, 1994](#)), and subcultural theory ([Gastil, 1971](#)). Gaining insight in the economic and sociological drivers of crime levels in an integrated model is of the utmost importance for policy-makers.

Our main findings show that both the economic and the sociological fields contribute to the explanatory power of the integrated model. Our results support the economic explanation of crime with respect to the deterrent effect of the probabilities of arrest and imprisonment, as well as the time allocation model of criminal activities. In contrast, the integrated model seems to reject the impact of the severity of punishment in explaining crime levels. With respect to the sociological theories of crime, we find most support for the social disorganization theory and for the routine activity theory.

This article is organized as follows. First, we provide an overview of the two fields of crime research as well as their respective theoretical framings. Next our dataset, measures and analytical model are presented. This will be followed by a presentation of the results, and their implication for criminal policy.

## 2. Economic approach to crime

### 2.1. Deterrence

In the economic approach to investigating crime, deterrence probabilities are of significant importance. Although [Becker \(1968\)](#) aimed to find the optimal level of crime deterrence measures in terms of government involvement, he was the first to introduce the influence of the probabilities of arrest and punishment as a determinant factor in explaining crime.<sup>1</sup> Moreover, he included variables

<sup>1</sup> Strictly speaking Cesare Beccaria already introduced this idea in 1764.

measuring public expenditures on police and courts. What he showed in his essay was that the “anticipation of conviction and punishment reduces the loss from offenses and thus increases social welfare by discouraging some offenders” (Becker, 1968, p. 204). In the basic economic crime model, the expected utility (EU) from committing a crime is defined as (Wolpin, 1978):

$$EU = P_a P_{c/a} P_{p/c} U(Y - F_p) + P_a P_{c/a} (1 - P_{p/c}) U(Y - F_f) + P_a (1 - P_{c/a}) U(Y) + (1 - P_a) U(Y) \quad (1)$$

where  $P_a$  is the probability of arrest,  $P_{c/a}$  the probability of conviction conditional upon arrest,  $P_{p/c}$  the probability of imprisonment conditional upon conviction,  $Y$  the expected benefit from the crime,  $F_p$  the severity of prison sentence,  $F_f$  the severity of a non-prison sentence (typically a fine) and  $U(\cdot)$  the utility operator. The model illustrates that solely focusing on the arrest rate ignores other important aspects of the cost function to criminals.

The early empirical economic literature mainly focused on the deterrence hypothesis and reported strong evidence of a deterring effect of increased probability of apprehension and higher levels of severity of punishment on crime levels, leading Tullock (1974, p. 104) to conclude that “most economists who give serious thought to the problem of crime come immediately to the conclusion that punishment will indeed deter crime.”<sup>2</sup>

After the critique of Cornwell and Trumbull (1994) that the impact of deterrence measures is typically overstated, later econometric studies no longer solely rely on deterrence variables, but have shifted toward socioeconomic and demographic factors, often even neglecting deterrence variables. Nevertheless, in an economic model the full set of deterrence variables should always be included to draw meaningful conclusions on which factors determine crime levels (Donohue & Wolfers, 2009).

## 2.2. Legal versus illegal income opportunities

Ehrlich (1973) expanded Becker’s model by also including economic incentive variables. His reasoning was that not only the costs and benefits of crime matter but also whether people are ‘forced’ into a life of crime due to a lack of legal economic opportunities. When legal opportunities are scarce or insufficient relative to those of crime, people will resort to illegal activities. Put differently, Ehrlich develops a time allocation model where a person allocates part of his time to legal activities and part to illegal activities depending on the expected return of each allocation option. In the time allocation model, criminals are expected to maximize their utility function:

$$EU = P \cdot U[W_0 + G_L(t - t_l) + G_I(t_l) - F(t_l)] + (1 - P) \cdot U[W_0 + G_L(t - t_l) + G_I(t_l)] \quad (2)$$

where  $P$  is the probability of punishment,  $W_0$  is the person’s initial wealth,  $G_L$  is the gain from legitimate activity (Fishback, Johnson, & Kantor, 2010; Mocan & Bali, 2010),  $G_I$

is the gain from illegitimate activity,  $F$  is the level of punishment (Mustard, 2010; Owens, 2011a, 2011b),  $(t - t_l)$  is the time allocated to legitimate activities and  $t_l$  the time to illegitimate activities.

This expanded model of crime capturing the differences in returns from legal and illegal activities has been the basis of much of the subsequent research on crime. Machin and Meghir (2004), for instance, showed that economic incentives in terms of wages have a significant influence on the levels of property crimes in police areas in England and Wales. Following Ehrlich’s model (1973), in many subsequent articles, scholars also included additional ad-hoc explanatory variables (Yearwood & Koinis, 2011).

Besides studies using aggregate data, a few studies make use of alternative data sets constructed through surveys, interviews or by means of experimental studies. For instance, Entorf (2009) conducts a survey of 1,771 inmates in 31 German prisons, combined with selected follow-up interviews to analyze the relationship between labor market opportunities after sentence time and the probability of future recidivism. Foreman-Peck and Moore (2010) test an economic cost-benefit model of gratuitous violence using street interviews combined with experimental questions.

## 2.3. Demographic factors

Drawing on empirical results from the economic geography literature, recent papers also include demographic variables. Geographers indeed found differences in the spatial distribution of crime (Brown, 1982; Freeman, Grogger, & Sonstelie, 1996; Hudson, 2014; Pyle, Hanten, Pearson, Doyle, & Kwofie, 1974; Willis, 1983). For instance, crime seems to be typically higher in urban areas (Hoch, 1973; Myers, 1982), in neighborhoods with high population density (Hoch, 1973) or with more young, male or black population (Donohue & Levitt, 2001; Levitt & Venkatesh, 2001; O’Flaherty & Sethi, 2010).

Although a comprehensive review of previous literature is beyond the scope of this paper, Ehrlich (1996) indicates that in relation to the economic approach to crime analysis, the evidence across this body of literature is at best mixed and far from conclusive.<sup>3</sup>

## 3. Sociological theories on crime

In the social theories on crime, the emphasis is not on the economic costs and benefits of crime. Rather the level of social integration, cultural conflict, social inequality and a breakdown of social control are identified as determinants of crime (Cohen, Kluegel, & Land, 1981).

In *routine activity theory* Cohen and Felson (1979) focus on the circumstances under which offenders commit criminal acts. They argue that a crime requires the convergence of likely offenders, suitable targets and the absence of capable guardians against crime. Of particular importance is the latter as the presence of capable guardianship in terms of increased number of people in a household has the ability

<sup>2</sup> See for instance Cornwell and Trumbull (1994) for an overview of these early empirical studies.

<sup>3</sup> For a review on economic and legal and illegal income opportunities theories of crime, see Ehrlich (1996).

to prevent the occurrence of crime. Unemployment also leads to more people at home, increasing guardianship. Both household size and unemployment are often used as proxies for guardianship to test whether “the dispersion of activities away from households and families increases the opportunity for crime and thus generates higher crime rates” (Cohen & Felson, 1979, p. 588).

Shaw and McKay (1942) argue in their *social disorganization theory* that an effective system of institutional control is often lacking in the prevention of crime. They link crime to the ecological characteristics of communities. They argue that the control system loses its effectiveness as soon as communities are disrupted by low economic status, cultural heterogeneity and high levels of residential mobility. Moreover, frustrations concerning the lack of success and the exacerbation of this feeling when being confronted with those that have obtained a certain level of status (inequality) can also be a source of criminal behavior. This frustration can be caused by various factors, such as belonging to an ethnic minority, heterogeneity or income inequality (Fajnzylber, Lederman, & Loayza, 2002a).

Closely related to this is the *structural strain theory* of Merton (1968) noting that the frustration about the lack of success arises because of the inability to provide legitimate means for reaching the culturally desired goal of economic success. The structural strain this creates, weakens the cultural norms and could result in higher crime levels. In order to capture the structural barriers of unequal opportunities in life, empirical studies use education as a proxy (Buonanno & Leonida, 2009).

Poverty as measure for resource/economic deprivation theory is also included in our analysis. Whether economic inequality or poverty necessitates criminal behavior because they may be necessary in order for people to get by (Bonger, 1969) or that people question the social arrangement they have been handed (Lilly et al., 2002), the hypothesized effect remains the same.

Finally, *subcultural theory* argues that certain subcultures have values and attitudes inducing them to crime (Cohen & Short, 1958). Examples are youth cultures (Blackman, 2005; Downes, 1966) or urban cultures (Fischer, 1975; Wirth, 1938). Empirical studies typically use proxies such as urbanization, county location, population density, the fraction of young population, or the fraction of male population.

A complete review of the findings in the sociological literature for each of these theories is beyond the scope of this article. We refer the reader to Pratt and Cullen (2005) for an excellent meta-analysis. Miethe et al. (1991) indicate that previous studies are largely supportive, however there remains variance between the different theories. Although the results of guardianship theory proves that in most cases it has a deterring effect on crime, the same cannot be said for the target attractiveness argument, which remains less conclusive (Cohen & Cantor, 1981; Cohen et al., 1981; Miethe, Stafford, & Long, 1987; Miethe et al., 1991).

The results for the elements of social disorganization theory such as ethnic heterogeneity, lower economic status, family disruption, weaker social networks, high residential mobility and lower community organization are

often associated with higher crime levels (Bursik & Webb, 1982; Miethe et al., 1991; Sampson & Groves, 1989).

#### 4. Data

We first present the dependent crime variables, before moving to an overview of the independent variables. We include as independent variables proxies for the economic models (deterrence variables, legal versus illegal income variables) as well as sociological variables and demographic control variables for the entire population of all 100 counties in the state of North Carolina for the period 2001–2005. We use North Carolina as it allows us to construct a rich database containing data on 22 explanatory variables, which is much richer than existing empirical economic studies, which typically use less than half the amount of explanatory variables we use (Buonanno & Montolio, 2008; Entorf & Winker, 2008; Saridakis & Spengler, 2012; Widner, Reyes-Loya, & Enomoto, 2011).

##### 4.1. Crime level variables

The empirical measures we use in our analysis were obtained from various sources. In terms of crime statistics we use the ratios of violent crime and property crime rates to county population as measure for the level of crime in each county.<sup>4</sup> These dependent variables are denoted as  $CR_{VIOL}$  and  $CR_{PROP}$  respectively, and were obtained from the FBI's Uniform Crime Reports for the years 2001–2005. These were downloaded from the National Archive of Criminal Justice Data Website (U.S. Department of Justice 2001–2005). In line with earlier studies (Buonanno & Montolio, 2008) we distinguish between violent crimes (such as murder, manslaughter, rape, assault) and crimes against property (such as burglary, larceny, robbery, motor vehicle theft) as the factors driving each type of crime are potentially expected to differ.

##### 4.2. Deterrence variables

The proxy probability of arrest,  $P_a$ , is the ratio of arrests to offenses. The probabilities denoted  $P_{c/a}$  and  $P_{p/c}$ , are the ratios of convictions to arrests and the proportion of total convictions resulting in prison sentences. The measures for  $P_{c/a}$  and  $P_{p/c}$  were taken from the North Carolina Department of Correction.

Besides the probability of punishment, the economic theory of crime also predicts the level of punishment to be important. Therefore we include the average prison sentence length in months, termed sanction severity and denoted by  $S$  in our model as another explanatory variable. Alongside the measure for average sentence time, we also include the number of life imprisonment ( $S_{LIFE}$ ) and death sentences ( $S_{DEATH}$ ) relative to the number of total

<sup>4</sup> Although we focus on those prime categories of serious crimes, our study does not include certain types of crimes such as tax evasion (Cebula, 1997) or securities fraud (Engelen, 2004).

convictions as variables for violent crimes. Both numbers were taken for the North Carolina Department from Correction. Following [Cherry \(2001\)](#), we include a measure for fines and forfeitures in our model for property crimes. First, we include a measure for the number of total fines related to index crime in a county (*Fines*). Second, we add the value of property recovered in a county ( $V_{recovered}$ ). [Bowles, Faure, and Garoupa \(2000\)](#) stress the importance of the removal of illegal gains as a deterrent effect. For each county, data were obtained from the North Carolina Courts Annual Report of the Administrative Offices of the Courts.

The final deterrence measure replicated from [Cornwell and Trumbull \(1994\)](#) is the number of police officers per capita (*Police*). This variable is used to measure the county's ability to detect crime and was obtained from the FBI's police agency employee counts. Recent studies show that higher police levels impact negatively on crime ([Lin, 2009](#); [Vollaard & Koning, 2009](#)).

Besides using these standard measures for investigating the deterring effects of punishment on crime, we also include additional variables in our analysis.

#### 4.3. Legal versus illegal opportunity variables

The operationalization of the return difference between legal and illegal opportunities is not straightforward. Some authors, such as [Cornwell and Trumbull \(1994\)](#) use the average level of wages across various industries as a proxy for the opportunities in the legal sector, while [Entorf and Spengler \(2000\)](#) and [Widner et al. \(2011\)](#) use the real GDP per capita as a proxy. However, the average level of wages across various industries or GDP per capita does not represent a likely composition of possible legal opportunities. When looking at legal opportunities as economic incentives, [Machin and Meghir \(2004\)](#) use the 25th percentile real hourly wage level. They argue that only changes in these low paid jobs will influence the level of crime in a given county. As the low-paid jobs will start to pay even less, people could switch to more lucrative illegal activities. As we do not have access to data on the 25th percentile real hourly wage level, we chose a comparable proxy, being the poverty level, along a similar line of reasoning as [Machin and Meghir](#). *Poverty* is defined as the percentage of people whose monetary income before taxes is below a threshold level set by the U.S. Census Bureau each year. These people, we assume, will currently have limited legal opportunities as they live below the poverty line. Higher levels of poverty represent fewer opportunities in the legal sectors and hence will lead to more crime.

#### 4.4. Sociological variables

In terms of sociological variables we follow the major social theories discussed above. From routine activity theory we include *Unemployment* and *Household size*. The unemployment data were drawn for the Local Area Unemployment Statistics Program. From social disorganization theory we include the ethnic *Minority* and *Heterogeneity*, as well as *Median income*. Ethnic heterogeneity was

constructed following [Hipp, Bauer, Curran, & Bollen \(2004\)](#). They use a Herfindahl index of four ethnic groups:

$$1 - \sum_{j=1}^{j=k} G_j^2 \quad (3)$$

where  $G_j$  represents the proportion of the population of ethnic group  $j$  out of  $k$  ethnic groups. Subtracting it from 1 makes it a level of heterogeneity rather than homogeneity. Data for household size, median income, minority and ethnic heterogeneity were obtained from the U.S. Census Bureau.

*Educational expenditure* was introduced as proxy for structural strain theory. We argue that higher levels of expenditure increase the possibility for achieving culturally aspired goals and will hence lead to a lower crime level. This data was obtained from the North Carolina Educational Services Annual Report.

#### 4.5. Demographic control variables

We also include certain demographic variables as controls that have shown to exhibit some explanatory power in previous studies. A dummy variable was created indicating those counties that are *Urban*, which included the metropolitan statistical areas (MSA) and have a population over 50,000 citizens, and those that are *Rural*. We calculated the *Density* of each county by dividing county population by total county area. These data were obtained from the U.S. Census Bureau. Cultural influences are captured by including dummies for western (*West*), eastern (*East*) and central counties (*Central*). Finally, as crime rates seem to differ across ages, we include the variable *Young male* which is the proportion of the county population that is male and between the ages of 15 and 24. Information was obtained from the U.S. Census Bureau. [Table 1](#) provides descriptive statistics of the dependent and independent variables, while [Table 2](#) summarizes the hypothesized signs of each variable for the economic and sociological theories.

### 5. Econometric modeling

The assumptions underlying the economic model of crime are the same as any other economic model. Individuals will try to maximize their utility and choose that option accordingly. Therefore economic theory predicts that individuals will partake in illegal activities as soon as the maximized expected utility is highest for that option ([Becker, 1968](#); [Ehrlich, 1973](#)). In other words, engaging in illegal activities depends on whether the relative monetary rewards are large enough in the illegal sector and the extent to which a county can influence the probabilities of arrest and conviction. Moreover, sociological theories emphasize that social integration, cultural conflict and social inequality are possible determinants of crime. While we first test pure play economic and social models separately, our ultimate goal is to test an integrated crime model in which variables from both disciplines feature to explain crime levels. The following crime equation is specified in order

**Table 1**  
Descriptive statistics for dependent and independent variables.

Variable	Description	Observations	Mean	Std dev
$CR_{VIOL}$	The ratio of violent crime to county population	478	.008	.009
$CR_{PROP}$	The ratio of property crime to county population	481	.076	.063
$P_a$	The probability of arrests to offenses	475	.21	.23
$P_{c/a}$	The probability of convictions to arrests	462	.23	.11
$P_{p/c}$	The probability of convictions resulting in prison sentences	466	.36	.16
$Fines$	Total fines related to index crime in a county	479	193.27	186.87
$V_{recovered}$	The value of property recovered in a county	495	25.62	14.22
$S$	Average prison sentence length in months in a county	500	25.87	8.54
$S_{LIFE}$	The ratio of life imprisonment to the number of total convictions	500	.003	.006
$S_{DEATH}$	The ratio of death sentences to the number of total convictions	500	.0003	.002
$Police$	The number of police per capita in a county	495	.0015	.0007
$Poverty$	The ratio of families who money income before taxes is below a set threshold level	500	.15	.04
$Minority$	The ratio of the county population that is minority or is nonwhite	500	.26	.18
$Unemployment$	The ratio of the county population that is unemployed	500	.06	.02
$Education\ expenditure$	The average education level in a county	499	7233.80	1181.44
$Median\ income$	Median household income in a county	500	35.70	6.25
$Household\ size$	The average number of people living in a housing unit	500	2.15	.32
$Heterogeneity$	Represents the different ethnic groups in a county	500	.33	.17
$Vocational\ programs$	The total number of graduated inmates for a program of vocational education	294	.002	.004
$Life\ programs$	The total number of graduated inmates for other programs	294	.0006	.002
$Density$	The ratio of county population to county total area	500	174.67	216.73
$West$	The probability of dummy variable equal to 1 for the countries in the west region	500	.24	.43
$Central$	The probability of dummy variable equal to 1 for the countries in the central region	500	.35	.48
$Urban$	The probability of dummy variable equal to 1 if a county is included in the MSAs and have a population over 50,000 citizens	500	.49	.50
$Young\ male$	The ratio of the county population that is male and between the ages of 15 and 24	500	.07	.02

Note: Data were collected from the FBI's Uniform Crime Reports, the National Archive of Criminal Justice Data Website, the North Carolina Department of Correction, the North Carolina Courts Annual Report of the Administrative Offices of the Courts, the North Carolina Educational Services Annual Report, and the U.S. Census Bureau for the years 2001 until 2005.

to test panel data on the counties of North Carolina<sup>5</sup>:

$$CR_{jt} = P'_{it}\beta + X'_{it}\gamma + S'_{it}\delta + D'_{it}\theta + \alpha_i + \varepsilon_{it};$$

with  $i = 1, \dots, N; t = 1, \dots, T$  (4)

where  $CR_{it}$  is the crime rate (for property and violent crimes, respectively),  $P'_{it}$  is the set of deterrent variables,  $X'_{it}$  contains the variables controlling for the relative return to legal opportunities,  $S'_{it}$  is the set of social variables and  $D'_{it}$  contains the set of demographic control variables. To capture the unobserved county-specific characteristics that may be correlated with the set of deterrent, social-demographic and legal opportunities  $\alpha_i$  is introduced. The error term  $\varepsilon_{it}$  is assumed to be independent to other variables of interest with a zero mean and constant variance.

Before presenting our results, we will discuss the underlying assumptions of the different models. In our dataset

the same counties are followed over the period 2001–2005. The crucial reason to use panel data is that it partly solves 'the omitted variable bias' (Verbeek, 2004). Unobserved county aspects might be correlated with the independent variables and therefore the estimators would be biased (Fajnzylber, Lederman, & Loayza, 2002b). This requires estimating the model with Fixed Effects, Random Effects, or Alternative Instrumental Variables (Halaby, 2004). For the (pooled) OLS model does not correct for unobserved heterogeneity in the unit of observation (county level), while the other models allow the intercept term to vary across counties and over time (Andres, 2002). Therefore the (pooled) OLS model is only a good estimator if there is no unit specific (county) component in the error term. However, several researchers point to the importance of unobserved county specific (social, economic or demographic) effects (Greenberg & Kessler, 1982).

Nowadays one of the standard approaches to handle this kind of estimation problem is to use fixed or random effects models. Using the fixed effects model allows to correct for unobserved specific effects that differ between counties but are stable over time. The random effects model is used

<sup>5</sup> We only present the regression equation for the integrated model as this is our final objective.

**Table 2**  
Overview of economic and sociological crime model variables with hypothesized sign.

Economic models		Sociological models	
<b>1. Deterrence variables</b>		<b>a. Routine activity theory</b>	
$P_a$ (prob. arrest)	–	HOUSEHOLD SIZE	–
$P_{c/a}$ (prob. conv.)	–	UNEMPLOYMENT	–
$P_{p/c}$ (prob. prison)	–	<b>b. Social disorganization theory</b>	
FINE	–	MINORITY	+
$V_{recovered}$	–	HETEROGENEITY	+
$S$ (length)	–	MEDIAN INCOME	–
$S_{LIFE}$	–	<b>c. Strain theory</b>	
$S_{DEATH}$	–	EDUCATION EXPENDITURE	–
POLICE	–	UNEMPLOYMENT	+
<b>2. Legal versus illegal returns</b>		<b>d. Deprivation theory</b>	
Poverty	+	Poverty	+
<b>3. Economic geography</b>		<b>e. Subcultural theory</b>	
URBAN	+	URBAN	+
DENSITY	+	DENSITY	+
YOUNG MALE	+	YOUNG MALE	+
COUNTY LOCATION	?	COUNTY LOCATION	?

Note:  $P_a$  is the probability of arrests to offenses,  $P_{c/a}$  is the probability of convictions to arrests,  $P_{p/c}$  is the probability of convictions resulting in prison sentences, FINES are the total fines related to index crime in a county,  $V_{recovered}$  is the value of property recovered in a county,  $S$  is the average prison sentence length in months in a county,  $S_{LIFE}$  is the ratio of life imprisonment to the number of total convictions,  $S_{DEATH}$  is the ratio of death sentences to the number of total convictions, POLICE is the number of police per capita in a county, POVERTY is the ratio of families who money income before taxes is below a set threshold level, UNEMPLOYMENT is the ratio of the county population that is unemployed, HOUSEHOLD SIZE is the average number of people living in a housing unit, MINORITY is the ratio of the county population that is minority or is nonwhite, HETEROGENEITY represents the different ethnic groups in a county, MEDIAN INCOME is the median household income in a county, EDUCATION EXPENDITURE is the average education level in a county, URBAN is a dummy variable equal to 1 if a county is included in the SMSAs and have a population over 50,000 citizens, DENSITY is the ratio of county population to county total area, COUNTY LOCATION are dummy variables for counties belonging to different regions, YOUNG MALE is the ratio of the county population that is male and between the ages of 15 and 24. Data were collected from the FBI's Uniform Crime Reports, the National Archive of Criminal Justice Data Website, the North Carolina Department of Correction, the North Carolina Courts Annual Report of the Administrative Offices of the Courts, the North Carolina Educational Services Annual Report, and the U.S. Census Bureau for the years 2001 until 2005.

when some unobserved specific effects may be constant over the time, while in the meantime others may be fixed between counties but change over time. Researchers use the fixed effects model as common practice, because it seems logical to think of fixed unobserved county specific parameter that can be estimated (Cherry, 2001). Hausman (1978) developed a formal test to choose between the fixed and random effects estimates. When the differences are small, if  $\alpha_i$  and the explanatory variables are uncorrelated, then both estimators are consistent. When this is the case, the random effects model is the most appropriate and efficient estimation model.

In our empirical analysis the Hausman test does not reject the assumption that  $\alpha_i$  and explanatory variables are uncorrelated ( $\chi^2(22) = 17.64, p = .73$ ). Therefore the most appropriate regression model is the random effects. Tables 3 and 4 present the results for the estimated crime models for property and violent crimes, respectively. We estimate three different models for property and violent crime each, to compare in detail the social and economic

explanations to different crimes. In all regressions, the deterrence coefficients are estimated as elasticities, except the variables  $S_{LIFE}$  and  $S_{DEATH}$ .

## 6. Results

Measures for each of the two theoretical perspectives were used to predict their impact on the levels of property and violent crime. From the economic model of crime, higher proportions of arrests, convictions and imprisonment, increased sentence severity, the presence of life and death sentences, the size of the police force as well as the improved possibilities for legal opportunities should be associated with lower levels of each type of crime. For the sociological perspective measures from various theories were used. From the social disorganization perspective, lower levels of population heterogeneity and the absence of minority groups should lead to lower levels of crime. From the routine activity literature follows the premise that higher levels of household size and unemployment increase guardianship and thus reduce the possibility of illegal behavior. From structural strain theory education expenditure per pupil was used as a proxy for the possibility of realizing culturally aspired goals.

### 6.1. Economic crime model results

The deterrence variables in Model 2 in both Tables 3 and 4 show that the probability of arrest and the probability of imprisonment both have a strong deterring effect on the prevalence of property as well as violent crime. This is clearly in line with the predictions of the Becker model. Similarly, higher levels of poverty increase the levels of both types of crime supporting the argument that lower levels of legal opportunities for obtaining income will result in increased crime levels. This result offers strong support for the time allocation model of Ehrlich (1973). A somewhat puzzling result appears when looking at the probability of conviction for violent crimes. The variable appears with a positive sign in contrast to predictions of the deterrence model. One would expect a higher conviction rate to be associated with lower crime levels. For the remainder of the deterrence variables no significant relationship was found in relation to both types of crime. It appears that the severity of punishment has no impact on criminals. Both the amount of fines and the possibility to remove illegal gains for property crimes as the length of prison sentences for violent crimes appear not to have any effect on crime levels. This confirms the studies of Farrington, Langan, and Wikstrom (1994) and Langan and Farrington (1998) who find significant negative correlations between crime rates and the certainty of punishment, but no significant correlation with the severity of punishment. Other studies find a deterrent effect of the severity of punishment, but the deterrent effect of the certainty of punishment is typically much stronger (Grogger, 1991; Willis, 1983; Witte, 1980). More recent studies lack data on the severity of punishment (Buonanno & Montolio, 2008; Entorf & Spengler, 2000) making it difficult to relate our results to those empirical studies. Finally, the magnitude of the police force did not

**Table 3**  
Model estimation results of property crime.

	Sociological model (1)	Economic model (2)	Integrated model (3)
<b>A. Economic variables</b>			
$P_a$		-.19** (.05)	-.19** (.05)
$P_{c/a}$		-.03 (.04)	.15 (.15)
$P_{p/c}$		-.25** (.05)	-.12 (.07)
Fines		-.00 (.00)	-.00 (.00)
$V_{recovered}$		-.02 (.02)	.005 (.03)
$S$		-.08 (.06)	-.03 (.07)
Police		3.11 (10.63)	4.35 (12.89)
Poverty		.02** (.00)	.02 (.01)
<b>B. Social variables</b>			
Minority	.15 (.22)		.10 (.25)
Unemployment	.68 (.92)		-.06 (1.10)
Median income	-.01 (.00)		.00 (.01)
Education expenditure	.00 (.00)		-.00 (.00)
Household size	-.16 <sup>†</sup> (.07)		-.10 (.08)
Heterogeneity	.67 <sup>†</sup> (.27)		1.11** (.31)
<b>c. Demographic variables</b>			
Density	-.0007** (.00)	-.0008** (.00)	-.0008** (.00)
West	-.02 (.07)	-.20** (.05)	.03 (.08)
Central	-.03 (.05)	-.09 (.05)	-.05 (.06)
Urban	-.20** (.05)	-.22** (.04)	-.22** (.05)
Young male	-6.80* (3.23)	-6.61 (3.16)	-3.78 (3.77)
Constant	3.51 (.40)	2.06 (.16)	1.71 (.48)
Year dummies included	Yes	Yes	Yes
Number of observations	479	431	431
Adjusted R-sq. overall	.70	.65	.75

*Note:* Standard errors are in parentheses and are adjusted for serial correlation and heteroscedasticity. The dependent variable is  $CR_{PROP}$ , the ratio of property crime to county population. The independent variables are:  $P_a$  is the probability of arrests to offenses,  $P_{c/a}$  is the probability of convictions to arrests,  $P_{p/c}$  is the probability of convictions resulting in prison sentences,  $Fines$  are the total fines related to index crime in a county,  $V_{recovered}$  is the value of property recovered in a county,  $S$  is the average prison sentence length in months in a county,  $Police$  is the number of police per capita in a county,  $Poverty$  is the ratio of families who money income before taxes is below a set threshold level,  $Minority$  is the ratio of the county population that is minority or is nonwhite,  $Unemployment$  is the ratio of the county population that is unemployed,  $Median income$  is the median household income in a county,  $Education expenditure$  is the average education level in a county,  $Household size$  is the average number of people living in a housing unit,  $Heterogeneity$  represents the different ethnic groups in a county,  $Density$  is the ratio of county population to county total area,  $West$  is a dummy variable equal to 1 for the counties in the west region,  $Central$  is a dummy variable equal to 1 for the counties in the central region,  $Urban$  is a dummy variable equal to 1 if a county is included in the SMSAs and have a population over 50,000 citizens,  $Young male$  is the ratio of the county population that is male and between the ages of 15 and 24. Data were collected from the FBI's Uniform Crime Reports, the National Archive of Criminal Justice Data Website, the North Carolina Department of Correction, the North Carolina Courts Annual Report of the Administrative Offices of the Courts, the North Carolina Educational Services Annual Report, and the U.S. Census Bureau for the years 2001 until 2005.

Bold highlights statistical significance.

\* Significant level:  $p < .05$ .

\*\* Significant level:  $p < .01$ .



**Table 4**  
Model estimation results of violent crime.

	Sociological model (1)	Economic model (2)	Integrated model (3)
<b>A. Economic variables</b>			
$P_a$		<b>-.16**</b> (.06)	<b>-.16**</b> (.06)
$P_{c/a}$		<b>.12*</b> (.07)	.14 (.14)
$P_{p/c}$		<b>-.16*</b> (.06)	<b>-.18**</b> (.06)
S		-.01 (.07)	-.01 (.07)
$S_{LIFE}$		-1.60 (1.28)	-1.66 (1.27)
$S_{DEATH}$		-2.24 (3.54)	-2.20 (3.52)
Police		-.89 (13.00)	3.07 (13.01)
Poverty		<b>.02</b> (.00)	-.00 (.01)
<b>B. Social variables</b>			
Minority	-.04 (.26)		.08 (.25)
Unemployment	.47 (1.17)		.18 (1.11)
Median income	-.00 (.00)		-.00 (.01.)
Education expenditure	-.05 (.05)		-.01 (.00)
Household size	-.09 (.09)		-.08 (-.08)
Heterogeneity	<b>1.20**</b> (.32)		<b>1.09**</b> (.31)
<b>C. Control variables</b>			
Density	<b>-.0007**</b> (.00)	<b>-.0006**</b> (.00)	<b>-.0007**</b> (.00)
West	.05 (.08)	<b>-.25**</b> (.06)	.01 (.09)
Central	-.07 (.06)	-.13 (.06)	-.06 (.06)
Urban	<b>-.24**</b> (.05)	-.23 (.05)	<b>-.22**</b> (.05)
Young male	-6.30 (3.90)	-.33 (3.87)	-2.69 (3.78)
Constant	2.31 (.53)	.50 (.21)	1.67 (.51)
Year dummies included	Yes	Yes	Yes
Number of observations	476	435	435
Adjusted R-sq. overall	.62	.58	.64

Note: Standard errors are in parentheses and are adjusted for serial correlation and heteroscedasticity. The dependent variable is  $CR_{VIOL}$ , the ratio of violent crime to county population. The independent variables are:  $P_a$  is the probability of arrests to offenses,  $P_{c/a}$  is the probability of convictions to arrests,  $P_{p/c}$  is the probability of convictions resulting in prison sentences, S is the average prison sentence length in months in a county,  $S_{LIFE}$  is the ratio of life imprisonment to the number of total convictions,  $S_{DEATH}$  is the ratio of death sentences to the number of total convictions, *Police* is the number of police per capita in a county, *Poverty* is the ratio of families who money income before taxes is below a set threshold level, *Minority* is the ratio of the county population that is minority or is nonwhite, *Unemployment* is the ratio of the county population that is unemployed, *Median income* is the median household income in a county, *Education expenditure* is the average education level in a county, *Household size* is the average number of people living in a housing unit, *Heterogeneity* represents the different ethnic groups in a county, *Density* is the ratio of county population to county total area, *West* is a dummy variable equal to 1 for the counties in the west region, *Central* is a dummy variable equal to 1 for the counties in the central region, *Urban* is a dummy variable equal to 1 if a county is included in the SMSAs and have a population over 50,000 citizens, *Young male* is the ratio of the county population that is male and between the ages of 15 and 24. Data were collected from the FBI's Uniform Crime Reports, the National Archive of Criminal Justice Data Website, the North Carolina Department of Correction, the North Carolina Courts Annual Report of the Administrative Offices of the Courts, the North Carolina Educational Services Annual Report, and the U.S. Census Bureau for the years 2001 until 2005.

Bold highlights statistical significance.

\* Significant level:  $p < .05$ .

\*\* Significant level:  $p < .01$ .

seem to have a deterrent effect.<sup>6</sup> This finding is similar to Altindag (2012), but opposite to earlier results of Cornwell and Trumbull (1994) and Lin (2009).

### 6.2. Sociological crime model results

In terms of the sociological variables included in our analysis, most show signs in the hypothesized direction albeit most of them lack significance (Table 2). When looking at Model 1 in Tables 3 and 4 we see that only household size and heterogeneity are significant in the property crime model. Household size is in congruence with routine activity theory, showing that the presence of more supervision at the family level will lead to less opportunity to commit crimes. Cultural heterogeneity, as social disorganization theory supposes, would lead to higher levels of crime as this would weaken the structural bonds within a community. Our results support this hypothesis for both property and violent crime. Our results reject the strain theory for both crime types as neither education nor unemployment turn out to be significant in the sociological model. Earlier studies reported mixed results on both variables. Ochsen (2010) finds no impact of education on theft, but a negative effect on assault, while Buonanno and Montolio (2008) find a negative impact of education on property crimes, but not on violent crimes. Entorf and Spengler (2000) report a positive impact of unemployment on crime levels, while Saridakis and Spengler (2012) find a positive impact only for property crimes, but not for violent crimes.

### 6.3. Integrated model results

When both social and economic predictors of crime are introduced alongside each other, we see that the adjusted *R*-squared is highest for the integrated model as compared to the models that test either the social or economic variables. In the integrated property crime model (Model 3 in Table 3) we see the strong deterrent effect of the arrest rate. The higher the probability of apprehension for a property crime, the lower is the crime level. This again confirms the classic Becker economic crime model. The probability of imprisonment loses its significance in the integrated model of property crime. Severity of punishment (fines, prison length and recovery of criminal proceeds) remains insignificant in the integrated model. Again, higher poverty levels are associated with higher crime levels. The integrated model thus confirms that relative higher returns in the illegal market induce persons to move from the legal to the illegal segment. An alternative explanation is offered by the deprivation theory, but leads to similar results. The integrated model confirms the insignificance of most sociological crime variables, with the exception of heterogeneity. The variable household size loses its significance in the integrated model. Overall, the results of the property crime model confirm the deterrent effect of the economic model as well as the time allocation model, but finds only weak support for the sociological explanations

of property crimes. We only find partial support for the social disorganization theory, but no confirmation of the routine activity theory or of the strain theory. Only the impact of the poverty variable seems to be in accordance with deprivation theory.

The deterrence hypothesis of the economic theory of crime is strongly supported by the integrated violent crime model (Model 3 in Table 4). Both the probability of arrest and the probability of imprisonment have a clear and convincing negative effect on violent crime levels. Interestingly, the puzzling positive effect of the probability of conviction disappears in the integrated model and loses its significance. Severity of punishment has no effect on violent crime levels in the integrated model. Nor the length of sentences, nor life imprisonment, nor capital punishment has any effect on crime levels. This contributes to the old debate on the (lack of) deterrent effect of capital punishment (Cover & Thistle, 1988; Dezhbakhsh, Rubin, & Shepherd, 2003; Ehrlich, 1975; Passell & Taylor, 1977).

In contrast to property crimes, the variable poverty loses its significance. This is not surprisingly as violent crimes do not fit the time allocation model well. The integrated violent crime mirrors the results of the property model with respect to the sociological variables. Only heterogeneity is significant offering partial support for the social disorganization model and no support for the other sociological models.

Finally, in terms of demographic control variables density and urban are significant in both the integrated property and violent crime models, but have a surprising negative effect on crime rates. Although this is in contrast with some early economic geography studies, recent papers find similar results to ours. Ackerman and Murray (2004) find that many smaller communities have more serious crime problems than larger cities, while Wheaton (2006) finds that urban areas can exhibit less crime due to displacement effects. We do not find any effect of young males on crimes rates, confirming results of Buonanno and Montolio (2008), but contrasting findings of Entorf and Winker (2008).

### 6.4. Extensions, robustness checks and limitations

In order to assess the generalizability of our findings, we conducted one extension and two robustness tests presented in Tables 5 and 6, while we also discuss potential limitations of the results.

First, we introduce two new variables capturing the effect of preventing former inmates from relapsing into old habits, the effectiveness of vocational (*Vocational programs*) and other programs (*Life programs*). Both variables can serve as proxies for social support theory.<sup>7</sup> Differences in levels of social support, at the community or at the state level, are said to influence the crime rate, although there is some disagreement whether a state or county is capable of being supportive. According to Witte (1983) these programs could help convicts to regain a sense of direction in

<sup>6</sup> There is a possible endogeneity problem with including this variable. We will discuss this issue in detail in Section 6.4.

<sup>7</sup> We only introduce this theory in the robustness section as including the rehabilitation programs reduces the sample size to about 260.

**Table 5**  
Additional tests – integrated model estimations with (a) vocational and life programs and (b) wages instead of poverty.

	(a) With vocational and life programs		(b) With wages instead of poverty	
	Property crime (1)	Violent crime (2)	Property crime (3)	Violent crime (2)
<b>A. Economic variables</b>				
$P_a$	-.17** (.05)	-.14** (.06)	-.18** (.05)	-.14** (.05)
$P_{c/a}$	.09 (.09)	.07 (.04)	-.02 (.04)	.07 (.04)
$P_{p/c}$	-.20** (.07)	-.22 (.14)	-.30** (.07)	-.25** (.06)
Fines	-.00 (.00)		.00 (.00)	
$V_{recovered}$	.01 (.03)		-.00 (.03)	
$S$	-.05 (.07)	-.00 (.06)	-.11 (.07)	-.15* (.07)
$S_{LIFE}$		1.26 (1.37)		1.12 (1.19)
$S_{DEATH}$		-3.82 (4.89)		-5.20 (4.50)
Police	-33.37 (36.82)	2.35 (36.20)	7.16 (28.73)	-48.21 (44.46)
Poverty	.02* (.01)	.01* (.00)		
<b>B. Social variables</b>				
Minority	.14 (.32)	.03 (.32)	.23 (.22)	.16 (.34)
Unemployment	-.61 (1.15)	-.45 (1.20)	.89 (1.05)	1.50 (1.18)
Median income	.00 (.00)	.00 (.00)	-.01 (.01)	.00 (.01)
Education expenditure	-.00 (.00)	-.01 (.00)	.00 (.00)	-.00 (.00)
Household size	-.18 (.11)	-.14 (.10)	-.16** (.07)	-.17 (.11)
Heterogeneity	.79* (.44)	.79* (.40)	.77** (.27)	1.10* (.45)
Vocational programs	-2.64 (4.25)	-8.54* (4.20)		6.28 (4.00)
Life programs	.25 (3.60)	2.20 (3.73)		-5.63 (3.45)
<b>C. Control variables</b>				
Density	-.0007** (.00)	-.0007** (.00)	-.0009** (.00)	-.0007** (.00)
West	-.05 (.12)	-.06 (.11)	-.01 (.00)	-.01 (.12)
Central	-.03 (.07)	-.05 (.07)	-.04 (.05)	-.05 (.07)
Urban	-.12** (.05)	-.12** (.05)	-.18** (.04)	-.09 (.05)
Young male	5.15 (6.76)	7.75 (6.60)	-6.17 (3.39)	-4.68 (7.32)
Constant	1.11 (.63)	1.06 (.62)	3.10 (.40)	1.86 (.66)
Wages included	No	No	Yes	Yes
Year dummies included	Yes	Yes	Yes	Yes
Number of observations	263	261	374	229
Adjusted R-sq. overall	.64	.69	.67	.68

Note: Standard errors are in parentheses and are adjusted for serial correlation and heteroscedasticity. The dependent variable is  $CR_{PROP}$ , the ratio of property crime to county population, respectively  $CR_{VIOL}$ , the ratio of violent crime to county population. The independent variables are:  $P_a$  is the probability of arrests to offenses,  $P_{c/a}$  is the probability of convictions to arrests,  $P_{p/c}$  is the probability of convictions resulting in prison sentences,  $Fines$  are the total fines related to index crime in a county,  $V_{recovered}$  is the value of property recovered in a county,  $S$  is the average prison sentence length in months in a county,  $S_{LIFE}$  is the ratio of life imprisonment to the number of total convictions,  $S_{DEATH}$  is the ratio of death sentences to the number of total convictions,  $Police$  is the number of police per capita in a county,  $Poverty$  is the ratio of families who money income before taxes is below a set threshold level,  $Minority$  is the ratio of the county population that is minority or is nonwhite,  $Unemployment$  is the ratio of the county population that is unemployed,  $Median income$  is the median household income in a county,  $Education expenditure$  is the average education level in a county,  $Household size$  is the average number of people living in a housing unit,  $Heterogeneity$  represents the different ethnic groups in a county,  $Vocational programs$  are the total number of graduated inmates for a program of vocational education,  $Life programs$  are the total number of graduated inmates for other programs,  $Density$  is the ratio of county population to county total area,  $West$  is a dummy variable equal to 1 for the counties in the west region,  $Central$  is a dummy variable equal to 1 for the counties in the central region,  $Urban$  is a dummy variable equal to 1 if a county is included in the SMSAs and have a population over 50,000 citizens,  $Young male$  is the ratio of the county population that is male and between the ages of 15 and 24. Data were collected from the FBI's Uniform Crime Reports, the National Archive of Criminal Justice Data Website, the North Carolina Department of Correction, the North Carolina Courts Annual Report of the Administrative Offices of the Courts, the North Carolina Educational Services Annual Report, and the U.S. Census Bureau for the years 2001 until 2005.

Bold highlights statistical significance.

\* Significant level:  $p < .05$ .

\*\* Significant level:  $p < .01$ .

their lives and would make reentry into society easier. In order to capture the influence of state sponsored programs, we therefore have included two types of rehabilitation programs in the regression analysis. The total number of graduated inmates for each program was obtained from the Educational Services Annual Report (North Carolina Department of Correction, 2000–2004). Models 1 and 2 in Table 5 present the estimation results of the integrated

**Table 6**  
Integrated 2SLS random effect model estimation controlling for endogeneity.

	Property crime (1)	Violent crime (2)
<b>A. Economic variables</b>		
$P_a$	-.19** (.05)	-.14** (.06)
$P_{c/a}$	-.02 (.04)	.07 (.04)
$P_{p/c}$	-.19** (.05)	-.22** (.07)
Fines	.00 (.00)	
$V_{recovered}$	-.00 (.02)	
$S$	-.08 (.06)	-.00 (.07)
$S_{LIFE}$		1.25 (1.38)
$S_{DEATH}$		-3.88 (4.91)
Police	4.95 (10.60)	4.10 (36.23)
Poverty	-.02* (.01)	.02 (.01)
<b>B. Social variables</b>		
Minority	.15 (.20)	.03 (.31)
Unemployment	.83 (.90)	-.44 (1.20)
Median income	-.01** (.00)	.00 (.01)
Education expenditure	-.00 (.00)	-.01 (.02)
Household size	-.17* (.06)	-.14 (.11)
Heterogeneity	.67* (.25)	.79* (.40)
Vocational programs		-8.46* (4.21)
Life programs		2.18 (3.75)
<b>C. Control variables</b>		
Density	-.0007** (.00)	-.0007** (.00)
West	-.07 (.07)	-.07 (.12)
Central	-.04 (.05)	-.05 (.07)
Urban	-.19** (.04)	-.12* (.05)
Young male	-6.18 (3.60)	7.59 (6.56)
Constant	3.53 (.40)	1.07 (.61)
Wages included	No	No
Year dummies included	Yes	Yes

Table 6 (Continued)

	Property crime (1)	Violent crime (2)
Number of observations	431	261
Adjusted R-sq. overall	.70	.69

Note: Standard errors are in parentheses and are adjusted for serial correlation and heteroscedasticity. The dependent variable is  $CR_{PROP}$ , the ratio of property crime to county population, respectively  $CR_{VIOL}$ , the ratio of violent crime to county population. The independent variables are:  $P_a$  is the probability of arrests to offenses,  $P_{c/a}$  is the probability of convictions to arrests,  $P_{p/c}$  is the probability of convictions resulting in prison sentences,  $Fines$  are the total fines related to index crime in a county,  $V_{recovered}$  is the value of property recovered in a county,  $S$  is the average prison sentence length in months in a county,  $S_{LIFE}$  is the ratio of life imprisonment to the number of total convictions,  $S_{DEATH}$  is the ratio of death sentences to the number of total convictions,  $Police$  is the number of police per capita in a county,  $Poverty$  is the ratio of families who money income before taxes is below a set threshold level,  $Minority$  is the ratio of the county population that is minority or is nonwhite,  $Unemployment$  is the ratio of the county population that is unemployed,  $Median income$  is the median household income in a county,  $Education expenditure$  is the average education level in a county,  $Household size$  is the average number of people living in a housing unit,  $Heterogeneity$  represents the different ethnic groups in a county,  $Vocational programs$  are the total number of graduated inmates for a program of vocational education,  $Life programs$  are the total number of graduated inmates for other programs,  $Density$  is the ratio of county population to county total area,  $West$  is a dummy variable equal to 1 for the counties in the west region,  $Central$  is a dummy variable equal to 1 for the counties in the central region,  $Urban$  is a dummy variable equal to 1 if a county is included in the SMSAs and have a population over 50,000 citizens,  $Young male$  is the ratio of the county population that is male and between the ages of 15 and 24. Data were collected from the FBI's Uniform Crime Reports, the National Archive of Criminal Justice Data Website, the North Carolina Department of Correction, the North Carolina Courts Annual Report of the Administrative Offices of the Courts, the North Carolina Educational Services Annual Report, and the U.S. Census Bureau for the years 2001 until 2005.

Bold highlights statistical significance.

\* Significant level:  $p < .05$ .

\*\* Significant level:  $p < .01$ .

property and violent crime models with both rehabilitation programs. The results are largely in line with our earlier results. Also, admittedly significant only once, vocational rehabilitation programs have a negative effect on the level of violent crime. This in line with the arguments put forth by social support theory.

Second, throughout our paper we used poverty as a proxy to operationalize the relative opportunities in the illegal sector. Some previous research used wages instead of poverty as a proxy. Although we argued above that the poverty level is a better proxy than the average wage level, we check if our results remain robust if we use wages instead of poverty (Cornwell & Trumbull, 1994). Models 3 and 4 in Table 5 show that wages instead of poverty do not significantly affects our results. Again, the results confirm the deterrent effect of the probabilities of arrest and imprisonment and the impact of heterogeneity. The integrated property model also offers support for the guardianship model as the variable household size is now significant. All other sociological variables are again insignificant.

Third, we investigate the possible endogeneity of the variable number of police officers per capita. Like Cornwell

and Trumbull (1994) we worry about the possible endogeneity of the number of police officers per capita. If the crime rate increases, the local government might increase the number of police officers, and consequently crime rate will fall. In this context a 2SLS random effects model might be more appropriate (Cebula, 2012). As instrument we use per capita tax revenue to check for this possibility. The argument for using this instrument is that counties with residents who have greater preferences for law enforcement will express their preferences by voting for higher taxes to fund larger police forces (instrument relevance). We assume that tax revenue is not correlated with the error term (instrument exogeneity). The results of the 2SLS random effects model in Table 6 show large similarities compared to the random effects model.<sup>8</sup>

Fourth, the latter robustness check also brings us to the first potential limitation of our results. An important caveat of our results is the possible endogeneity of policy choices. For instance, if high crime locations also have the strongest police presence (as is the case with hot-spots policing strategies), then a simple regression will suggest that stronger deterrence measures increase rather than decrease crime, even if this is the opposite of the true causal effect.<sup>9</sup> We recognize this problem and try to address it by using local tax revenues as an instrument. One might argue that this approach is not 100% satisfactory as this instrument is potentially too endogenous and might depend on the level of crime. In the literature there is a lot of debate about instruments that are on one hand strong predictors of the endogenous variables and are on the other hand themselves exogenous (Baltagi, 2006; Saridakis & Spengler, 2012). The crime literature does not offer such a perfect instrumental variable. While we cannot eliminate completely concerns about endogeneity, we recognize that it might limit our conclusions. In worst case, we can only interpret our results as partial correlations.

Finally, our results are also potentially limited because of the lack of specific data forcing us to use second-best constructs for testing certain theories. For instance, while we included poverty and average wage levels as proxies to test the sociological deprivation theory, a better proxy would be to use income inequality or a related measure of relative deprivation in the equations. Such data were, however, not available for our population. Future work that includes better proxies might therefore be very valuable. In a similar way, we use household size and unemployment as proxies to test the routine activity theory. The percent two-parent versus single-parent families could be a better proxy for bonds to families as well as a measure of the availability of motivated guardians in a county. To the extent that adult males are bonded to family as care givers to children, it would seem plausible that they would be more motivated to control youth.<sup>10</sup> Again, data availability put a limit on the use of this construct.

<sup>8</sup> We formally tested the difference between the OLS and the 2SLS results and the coefficients were not significantly different from each other.

<sup>9</sup> We thank an anonymous reviewer for this valuable suggestion.

<sup>10</sup> We thank an anonymous reviewer for this valuable suggestion.

## 7. Discussion

In his review Ehrlich (1996) argues that even though the empirical literature on the effects of positive and negative incentives is largely in line with the theoretical hypotheses, it would be premature to view it as conclusive. From our study it becomes clear that interpreting this line of empirical work as conclusive would be inappropriate. The rational economic model suggests that a possible criminal would make checks and balances and when crime would come out as the best option, that path would be taken. According to Becker (1968), negative incentives such as the probability of arrest and conviction should have a negative effect on the occurrence of crime. We find strong support in our results that the probability of arrest and the probability of imprisonment have the desired effect of deterring crime. We find this deterrence effect both for property and violent crimes. In sharp contrast the severity of punishment seems to have no influence at all. Later this model was expanded by Ehrlich (1973) who introduced positive incentives to the equation through the use of opportunities in the legal sector. In our results we find that the poverty as a proxy for the lack of opportunities in the legal sector would decrease the occurrence of property crimes, but not violent crime. Through the years various modifications and additions have been made to the model, such as the inclusion of fines and forfeitures (Bowles et al., 2000). Here we find no evidence that these indeed help in reducing property crime levels. Cornwell and Trumbull (1994) added the size of police force, arguing that greater police force would increase the possibility of arrest and subsequently reduce crime levels. Again, we find no evidence to support this hypothesis. In terms of violent crime, we hypothesized that introducing such punishments as life imprisonment and capital punishment would strongly deter crimes of this nature. This did not turn out to be the case, which is in line with arguments of the sociologist camp. Neither capital punishment nor life imprisonment turned out to be significant. Apparently eye for eye logic does not prevent reoccurrence of violent crimes (Maggard, Payne, & Chappell, 2012).

Theories on crime from a sociological perspective move away from the idea that crimes are the result of a cost benefit analysis. These scholars argue that crime is the function of cultural conflict, social inequality and the breakdown of social control. Similar to the economic approach to crime, the results of articles examining crime from this perspective are not wholly conclusive. A similar picture emerges here. Cohen et al. (1981) hypothesized in their routine activity theory that a higher number of people in a household would lead to more stringent monitoring and hence to less crime. This line of thought is indeed found to be significant in the pure sociological model and in the integrated model controlling for endogeneity. Measures of institutional control as described in social disorganization theory by Shaw and McKay (1942) show mixed results. Minority does not have any significant influence, whereas median income is significant for property crimes in the integrated model. Heterogeneity is the only consistent significant variable in the social and integrated models for both property and violent crimes. Merton's (1938) strain

theory argument that belonging to an ethnic minority would lead to frustration about the lack of opportunities to achieve culturally aspired goals is not substantiated by our results. Deprivation theory is only weakly supported as poverty is only significant for property crimes. This might suggest that the economic explanation of the time allocation model is driving these results. Finally, we examine the impact of rehabilitation programs as they could help convicts to regain a sense of direction in their lives and would make reentry into society easier. This reasoning is supported in the analysis of violent crimes. Vocational programs have a negative influence on the level of crime. Life programs on the other hand do not prove to be of any significant influence on either type of crime.

Besides wanting to add to both streams of research through testing preexisting relationships and through adding new variables, we show on the basis of our results that certain variables lose their potency once they are introduced alongside variables which normally are not introduced in a pure economic or social model. Moreover, in all instances these more comprehensive models show better fit with the data as compared to the pure models (compare Models 1, 2, 3 in [Tables 3 and 4](#)).

## 8. Conclusion

At the onset of our article we took up recent research calls for extending the current literature by using a comprehensive set of explanatory variables and by integrating economic and sociological theories of criminal behavior. First, by studying newly gathered data on the entire population of all 100 counties in North Carolina between 2001 and 2005, we were able to provide replication results for different pure sociological and pure economic crime models. Second, by comparing pure economic and pure social models to crime prevention with a more comprehensive model integrating both fields, we were able to comment on the potency of all factors when introduced alongside each other. Our results support the economic explanation of crime as far as the deterrent effect of the probabilities of apprehension and imprisonment concerns, as well as the time allocation model of criminal activities. In contrast, the integrated model clearly rejects the impact of economic models in explaining crime levels through the severity of punishment. This is an important policy finding. With respect to the sociological theories of crime, we find most support for the social disorganization theory and for the routine activity theory.

When we compare the integrated model for property and violent crimes, we find most of the difference between both types of crimes for the sociological models. We do not find any differences between both crime types with respect to the deterrence hypothesis in contrast with [Entorf and Winker \(2008\)](#) and [Saridakis and Spengler \(2012\)](#). The arrest and imprisonment probabilities are of similar deterrent magnitude, while the non-impact of severity of punishment is similar across both types of crimes. Only with respect to the time allocation model, we find that the occurrence of profitable illegal opportunities holds for property crimes (burglary, car theft, and alike), but not for violent crimes (rape, assault). In contrast, we find

important differences in sociological explanation between both crime types. The routine activity theory only holds for property crimes, while the social disorganization theory impact seems stronger for property crimes than for violent crimes. As far as rehabilitation programs concern, we only observe an impact on violent crimes.

Similarly, life and death sentence impact, here non-significant, are very important in terms of policy implications. Instead of focusing on expensive prison sentences, which to a large extent are not significant, government focus should be on rehabilitation, decreasing poverty, and improving social controls. Finally, as most research on crime to date used cross-sectional analysis researchers are not to control for unobserved heterogeneity. This research shows that variables that are often found to be significant in both streams of literature lose much of their potency in the integrated model, possible due to the ability to control for this unobserved heterogeneity in panel data studies. Therefore, we urge future studies using 'higher' level data to employ panel studies. This in itself would require the development of new measures for some theories as census data is not gathered for multiple consecutive years. We also call to include better constructs to test certain theories when measures of omitted constructs become available (percent two-parents versus single-parent families or income inequality). The use of new methods, new variables and new models make the coming years for those studying crime potentially very interesting.

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