Is Being 'Soft on Crime' the Solution to Rising Crime Rates?
Evidence from Germany

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Abstract: Based on a theoretical framework on informal, custodial and non-custodial sentencing, the paper provides econometric tests on the effectiveness of police, public prosecution and courts. Using a unique dataset covering German states for the period 1977-2001, a comprehensive system of criminal prosecution indicators is derived and subsequently related to the incidence of six major offence categories using panel-econometrics. Empirical evidence suggests that the criminal policy of diversion failed as increasing shares of dismissals by prosecutors and judges enhance crime rates in Germany. Crime is significantly deterred by higher clearance and conviction rates, while the effects of indicators representing type (fine, probation, imprisonment) and severity (length of prison sentence, amount of fine) of punishment are often small and insignificant.

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1. Introduction

There is still a popular belief that criminal cases are ruled on by judges in a trial. When one looks at the facts, it is rather the public prosecutor who tends to play a leading role not only in the investigation but also in the decision process. In both the U.S. and European legal systems the crucial discretionary power of the prosecutor is to determine which case should be disposed of before trial by either dismissal of the charges or by imposing certain obligations on suspects in exchange for laying the file aside. Such practices are known as pre-trial diversion or informal sanctions.

Criminal policy reforms in Germany and other European countries turned to non-custodial and informal sanctions as a response to the rising crime rates of the 1970s (see Weigend 1995, Cherry 2001, Oberwitter and Hoefer 2005, Jehle and Wade 2006, Heinz 2006). The main aspect of these reforms was the emphasis on restricting the use of imprisonment. In particular, short-term custodial sanctions were driven back in favor of probation and non-custodial sentences such as fines. In Germany, in 2005 it was less than every tenth (8.3%) judgment that imposed an unconditional prison sentence. In 1950, this share was still at 39.1% (see Heinz 2006). Besides constraining unconditional prison sentences, the second pillar of criminal policy reforms was to strengthen the role of the public prosecutor in the context of pre-trial diversion, which was likewise considered as 'informal sanctioning'. So prior to judicial decisions, a growing share of cases has already been discharged by the public prosecutor. The portion of crime suspects formally convicted in a court (under general and juvenile penal law) compared to all people sanctioned (informally and formally) steadily declined from 63.7% in 1981 to 45.3% in 2005. The prosecutor accounts for the bulk of all cases, the court is only responsible for 15% of all dismissals (see Heinz, 2006, for quoted figures).

Criminal policy in the U.S. followed a quite different path. Whereas most Western European countries adopted policies of diversion and non-custodial sentences, the U.S. faced the rising crime rates of the 1970s by greater incarceration and practicing 'tough on crime' strategies such as California's 'three strikes and you're out'. As a result, the incarceration rate in the U.S. has increased by more than 220 percent between 1980 and 2000 (Cherry 2001), and reached the unprecedented number of 738 prisoners per 100,000 of the national population in 2006 (US Bureau of Justice Statistics). This rate is more than seven times higher than in Germany (95 per 100,000) and most other European countries (e.g. France 85, Sweden 82, Italy 104, Austria 105, England & Wales 148; see Walmsley 2007).

The policy of increased incarceration leads to much higher expenditures on the criminal justice system in the U.S. compared to Europe. However, the crucial question is whether the savings from smaller imprisonment rates have been offset by higher costs of crime in response to decreasing general deterrence. A first look at German data does not give a clear picture: Whereas theft rates were rising throughout the 1970s and 1980s but started declining ever since the beginning of the 1990s, German violent crime rates show a continuous upward trend and more than doubled since the beginning of the 1970s (GESIS 2007). A look across European borders shows that many European countries have experienced a similar increase in violent crime, in particular among young people. Aebi (2004) and Oberwittler and Hoefer (2005) point at reasons such as poverty, media influences and immigration, but do not see lack of deterrence as a potential factor of rising crime rates.

This paper studies the impact of the 'being soft on crime' strategy, characterized by two different strategies, namely non-custodial sentences and diversion[1], on crime rates in Germany. Germany's 16 states (the German 'Laender') enjoy certain autonomy, in particular in the areas of law, education, social assistance, and police, within a federal system. Thus, different views, traditions, religious roots and political majorities have led to divergent attitudes and political beliefs. This institutional setting makes the German Criminal Law Reform of 1969[2], which introduced the possibility of alternative sanctions into the judicial system and strengthened the discretionary power of public prosecutors, a very interesting starting point for studying different crime policies. Despite a generally binding German penal code, some northern states such as Lower Saxony, Bremen and Schleswig Holstein showed high rates of compliance with the fundamental idea of more lenient sanctioning, whereas in particular the southern states of Bavaria and Baden-Wuerttemberg continued their conservative 'tough on crime' criminal policy and were rather reluctant to adopt the liberal elements of the Criminal Law Reform.

To fully understand the long-lasting impact of the reform, in particular the wide scope given to prosecutors and the vast range of potential custodial and non-custodial sanctions, the entire

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[1] Formally, criminologists refer to 'diversion' as the circumvention of formal sanctioning (or sentencing) of a crime suspect who, based on the circumstances of the case, could be successfully prosecuted but whose case is dropped conditionally or unconditionally for so-called 'reasons of expediency'. Diversion can be applied in all cases concerning offences which are not punishable by a minimum penalty of one year ore more (see Heinz 2006 for details).

[2] According to German criminologists, the 1969 reform was considered the most important change in criminal policy after World War II. The reform, also dubbed the 'Grand Criminal Law Reform" (*Grosse Strafrechtsreform*), came into force in 1975, and is thus fully covered by the panel data set (1977 – 2001) used in this paper. See Busch (2005) and Heinz (2006) for historical details of the reform.

underlying mechanism has to be covered, i.e. the interactions of police, prosecutors and courts have to be taken into account. To cope with the manifold situation of all stages of the prosecution process, theoretical and econometric models need to consider the activities of police, public prosecution and courts and require attention of the probability of being arrested by the police, the probability of being convicted conditional upon arrest, and the probabilities of being imprisoned, being fined or being on probation given conviction. As the Criminal Law Reform entailed changes away from short-term custodial sanctions, also the average length of prison sentences should be focused on when calculating the expected costs of committing a crime. As Mendes and McDonald (2001) and Mustard (2003) argue convincingly, components of general deterrence do not work independently of each other. Rather, all elements operate in combination. Models that do not reflect the interactions of police, public prosecution and courts would fail to translate the economic theory and cause severe omitted variable biases.

In order to overcome this shortcoming, this article is based on a theoretical model that considers diversion strategies and distinguishes between custodial and non-custodial deterrence. The resulting augmented supply of offences is estimated using a newly established and unique database combining information from different sources of official judicial statistics covering the German states for the period 1977–2001. It provides offence and age-specific crime rates of six major offence types and maps the comprehensive system of criminal prosecution, including decisions regarding type (fine, probation, imprisonment) and severity (length of prison sentence and amount of fine) of punishment. To the best knowledge of the authors, so far Wolpin (1978, 1980) and Mustard (2003) are the only authors who applied such a comprehensive set of deterrence variables.[3]

A further innovation is found in the separate assessment of adults and juveniles, for whom the general penal code and juvenile penal code are respectively relevant. Unlike the U.S. law, in Germany turning 18 does not automatically lead to the application of the adult penal law. Young adults (18 to under 21 years of age) might likewise be treated as juveniles (14 to 18

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[3] With the exception of Wolpin (1978, 1980), articles collected in Ehrlich and Liu (2006) that provide econometric tests of the economics of crime model are based on at most two of all three potential stages of deterrence: See, for instance, the papers by Ehrlich (1973, probability of apprehension and imprisonment, time served), Levitt (1997, police only) or Corman and Mocan (2000, police officers, arrest rates). Only papers dealing with capital crimes distinguish between different court decisions (see e.g. Ehrlich, 1975: execution versus time served). Witte (1980) in her detailed empirical model based on individual data of post release activities of former inmates does dispose on the probability of arrest and she approximates probabilities of conviction given arrest and of prison given conviction from past records of the individual.

years old). Whether adolescents were acting '… equal to a juvenile regarding moral and mental development at the time of the act' in the sense of the Act on Juvenile Courts or not again depends on the discretionary margin of prosecutors and judges which varies between German states. Adequate treatment of juveniles and adolescents, in particular of those with a migration background, has been hotly debated in the recent state election campaign in Hesse in January 2008 after the president of cabinet council (*Ministerpraesident*), Roland Koch, called for tightening up the ruling German Juvenile Penal Code. In a recent paper, Lee and McCrary (2005) found evidence that young adults did not respond to the harsher adult law when turning 18, a result that contradicts Levitt's (1998b) findings who showed that there is less crime when adolescents move into the adult system.

Usually, empirical analyses of crime/deterrence take simultaneous account of only a fraction of the items detailed above. This article contributes to different strands of the existing literature:

- First, as elaborated on in detail above, in the tradition of Ehrlich (1973), Wolpin (1978, 1980), Cornwell and Trumbull (1994), Levitt (1998), Corman and Mocan (2000), Fajnzylber et al. (2002), Mustard (2003), Lee and McCrary (2005) and others, the paper provides a comprehensive test of general deterrence based on panel data of all relevant stages of criminal prosecution, namely police, public prosecution, courts and sentencing, including informal sentences, probation and financial fines.

- Second, the German Criminal Law Reform of 1969 and the federal autonomy of the German states provide an interesting natural experiment. Similar to Kessler and Piehl (1998) and Lacasse and Payne (1999), we are able to measure the degree of discretion in the criminal justice system and to study the impact of regional discretion on law enforcement and justice system outcomes. Unlike quoted studies, which analyze explanatory factors such as heterogeneity of social norms, we focus on the relative performance and the competition amongst coexisting criminal justice systems of federal states.

Results presented in this article suggest that the criminal policy of diversion failed as increasing shares of discharges enhance crime rates in Germany, whereas crime is significantly deterred by higher clearance and conviction rates. Harshening the severity of sentences, however, does not provide a suitable strategy for fighting crime. The effects of indicators representing type (fine, probation, imprisonment) and severity (length of prison sentence, size of fine) of punishment are mostly small and insignificant.

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This paper is organized as follows. In Section 2 a model of diversion, custodial and non-custodial sentencing is provided that analyses expected effects on crime in the conventional framework of economics of crime. Section 3 highlights descriptive evidence of trends and tendencies of crime as well as of prevailing heterogeneity of sentencing practices at the disaggregate state level in Germany. In Section 4 econometric results are presented. Section 5 concludes.

2. Theoretical Considerations: Diversion, Custodial and Non-Custodial Sentences in a Model of Crime

In this chapter, we extend standard models of general deterrence (Becker 1968) by considering custodial and non-custodial sentences. The approach combines Wolpin's (1978) idea of mapping the cascade police/public prosecution/court /sentencing decisions with a model of time allocation. Ehrlich (1973) introduced the framework of time allocation into the economics of crime. He considers an individual who allocates his fixed amount of time between legal and illegal income-generating activities. Under certain assumptions his main results are that a) given risk aversion, an increase in legal income opportunities reduces the incentive to participate in illegal activity, and b) increasing either the probability of detection and conviction or the punishment if convicted reduces the participation in illegal activities. Many authors (see, among others, Block and Heineke 1975, Witte 1980, Zhang 1997, Grogger 1998, and Funk 2004) have applied and extended the model, but also questioned some of Ehrlich's general results. Block and Heineke (1975), in particular, attacked Ehrlich's findings by showing that if the time allocated to legal and illegal activity is introduced into the utility function any comparative static result would be impossible without further assumptions.

The following framework draws heavily upon the theoretical work of Ehrlich, Block and Heineke and Wolpin. We consider an individual who maximizes his expected utility E(U) by allocating available time T to legal (t_ℓ) and illegal (t_i) activities, w.r.t. $t_\ell + t_i < T$ (non-binding time constraint). The individual's utility and well-being emerges from her time allocated to legal work resulting in legal income $L(t_\ell)$, and from his time spent on illegal activities rewarded by $G(t_i)$. Illegal activities are detected and punished with exogenously given probability p. We can decompose $p \equiv p_{cl} p_{ac|cl} p_{cv|ac}$, where $p_{cl} =$ probability of detection,

$p_{ac|cl}$ = probability of trial if detected and $p_{cv|ac}$ = probability of conviction if brought to court, i.e. p combines the discretionary work of police, it captures incentives from varying diversion policies (through decisions of public prosecution), and it covers the fact of a conviction (conditional on indictment), but does not include the sentence itself. This decomposition is of great importance for the econometric model (see below), where the respective individual roles of police, public prosecutors and judges need to be identified separately.[4] In the present theoretical model, we restrain from splitting up the decision process into further ramifications such that it suffices to consider the overall effect of p.[5]

As outlined in the Introduction, the main focus of this article is to contrast 'tough' (unconditional) prison sentences on the one hand, and more lenient sentencing practices, such as probation and fines, here covered as 'non-custodial sentences', as well as diversion on the other hand. Following this intention, we assume that the convicted offender expects the cost of a prison sentence $F(t_i)$ with conditional probability $p_{s|c}$ and non-custodial sentences with probability $(1 - p_{s|c})$. Additionally, in case of the juvenile penal code, non-custodial sentencing would imply educational and correctional measures (see Sections 3 and 4). In the case of non-custodial sentences, offenders can still work in the legal sector, but their income after conviction, $L^b(t_\ell)$, will fall below $L(t_\ell)$ as a consequence of the criminal record. This situation contrasts with the case of diversion: Despite previous detection, crime suspects are protected from any stigmatizing effect such that their potential legal and illegal earnings coincide with that of undetected criminals or legally working full-time employees individuals who all earn $L(t_\ell)$ and $G(t_i)$. This situation arises with probability $(1 - p)$.

Summing up, three different situations need to be considered. First, in case of non-detection, pre-trial diversion or court's dismissal, individual utility would be

(2.1) $$U\left[A + L(t_\ell) + G(t_i) \right],$$

emerging with probability (*1-p*). If detected, brought to court and convicted, either utility

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[4] In the econometric model, p will be decomposed into p_{cl} (measured as clearance rate) and $p_{ac|cl} p_{cv|ac}$ ('sentencing rate'). The reason why we construct a product instead of using all variables separately is the rather small variance of the share of acquittals, $p_{cv|ac}$ at the court level.

[5] The presented model could be extended by separate treatment of all three different stages $p \equiv p_{cl} p_{ac|cl} p_{cv|ac}$ of general deterrence, but expected effects of p are identical to that of all factors underlying p unless standard assumptions (e.g. with respect to different legal or illegal payoffs at subsequent stages) would be changed.

(2.2) $\quad U\left[A + L^b\left(t_\ell\right) + G\left(t_i\right)\right]$

occurs in case of non-custodial sentences with probability $p(1 - p_{s|c})$, or

(2.3) $\quad U\left[A + G\left(t_i\right) - F\left(t_i\right)\right]$

would apply with probability $pp_{s|c}$, where U is individual's utility function, and

$L\left(t_\ell\right) \quad = \quad$ legal income,

$L^b\left(t_\ell\right) \quad = \quad$ legal income after previous conviction (adjusted for non-custodial

$\qquad\qquad\qquad$ sentences such as fines), with $L\left(t_\ell\right) > L^b\left(t_\ell\right) > 0$,

$G\left(t_i\right) \quad = \quad$ illegal gain,

$F\left(t_i\right) \quad = \quad$ cost function (monetary equivalent) of prison sentence,

$A \qquad = \quad$ initial wealth.

Equations (2.1) to (2.3) provide standard assumptions in models of economics of crime, except for the explicit consideration of legal income with and without previous conviction. It should be reminded that the idea of the German *Criminal Law Reform* was to avoid any criminal record, or, if conviction still seemed justified, to avoid imprisonment. The rationale behind this legal norm is that offenders, in particular young offenders, should not lose their future legal income opportunities, because this would increase the risk of recidivism. Moreover, if convicted, any term behind bars would accumulate criminal capital (see evidence for this hypothesis by Bayer, Hjalmarsson and Pozen 2007, and Chen and Shapiro 2003) and should be the *ultima ratio* of penal law (covered by equation (2.3)). Non-custodial sentences prevent negative experiences behind bars and enable convicted offenders to work in the legal sector, although previous records and fines cause an income gap such that expected payoffs are below those without conviction (see equation (2.2)). The difference $L\left(t_\ell\right) - L^b\left(t_\ell\right)$ can be interpreted as the stigma effect from previous convictions (Rasmussen 1996, Funk 2004), and the result of fines.

Individuals maximise expected utility, i.e

(2.4) $\quad E\left(U\right) = p\left\{(1 - p_{s|c})\, U\left[A + L^b\left(t_\ell\right) + G\left(t_i\right)\right] + p_{s|c}\, U\left[A + G\left(t_i\right) - F\left(t_i\right)\right]\right\}$
$$+ \left(1 - p\right) U\left[A + L\left(t_\ell\right) + G\left(t_i\right)\right],$$

subject to the given time constraint. Unambiguous first-order conditions (see Appendix) require some further assumptions:

I.	$U'' < 0$	risk aversion,
II.	$G''(t_i) < 0$	decreasing marginal return to illegal activity,
III.	$F''(t_i) > 0$	neoclassic functional form of sentencing costs,
IV.	$F'(t_i) > G'(t_i)$	'evil of punishment' > 'gain from offence'.[6]

Under these conditions, first-order conditions of an interior maximum provide the following results:

$$(2.5) \qquad \frac{\partial t_i}{\partial p} < 0 \,, \quad \frac{\partial t_i}{\partial p_{s|c}} < 0 \,, \quad \frac{\partial t_i}{\partial (1 - p_{s|c})} > 0 \,, \quad \frac{\partial t_i}{\partial F} < 0 \,, \quad \frac{\partial t_i}{\partial \left(L(t_\ell) - L^b(t_\ell) \right)} < 0 \,.$$

Thus, in addition to classical results confirming the crime reducing effects of probability (*p*) and severity (*F*) of punishment, our results highlight the crime rising effect of non-custodial sentences, i.e. increasing incentives to allocate time to illegal activities, when courts change their judgment preferences towards probation and financial punishments. Since p includes the probability of trial if detected, $p_{ac|cl}$, p is also driven by diversion. Hence the model predicts that more time is devoted to illegal activity when diversion is intensified through a rising share of crime suspects dismissed by public prosecutors (i.e. by falling indictment rates $p_{ac|cl}$).

Finally, the higher the stigma from a previous conviction, the higher is the effect of deterrence:[7]

$$(2.6) \qquad \frac{\partial t_i / \partial p}{\partial \left(L(t_\ell) - L^b(t_\ell) \right)} > 0 \,.$$

This effect is also called 'dynamic deterrence' in the literature because the threat of future income losses due to stigma would deter crime today (see Imai and Krishna, 2004).

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[6] This condition can be justified by Bentham's (1781) 'Principles of Morals and Legislation'. According to Rule 1 of his 'Of the Proportion between Punishments and Offences' *The value of the punishment must not be less in any case than what is sufficient to outweigh that of the profit of the offence* (p.141). Moreover, Rule 7 states *To enable the value of the punishment to outweigh that of the profit of the offence, it must be increased, in point of magnitude, in proportion as it falls short in point of certainty* (p.143/144).

[7] Funk (2004), however, shows that while stigma deters unconvicted individuals from committing crimes, it may have undesirable side effects because it simultaneously enhances recidivism of a convicted and already stigmatized offender.

Summing up, derived signs are consistent with expected effects of rational choice theory. However, as was stated by Block and Heineke (1975), the signing of variables is not merely a theoretical question but demands econometric tests. They are going to be provided in Section 4 of this article.

3. Data and Descriptive Evidence

3.1 Crime Trends in Germany, 1963 - 2005

Germany is a federal republic consisting of 16 states (*Laender*), five of which represent East Germany, i.e. the former German Democratic Republic (GDR). General trends and tendencies have to rely on official statistics of recorded crime, collected by the Federal Criminal Police Office (*Bundeskriminalamt*), as Germany neither participates in the regular International Crime Victim Survey (ICVS) nor performs any periodical national crime victim survey. Notwithstanding well-known limitations of official crime statistics, in the following long-run trends are presented which focus on theft and violent crimes (mainly assaults). Figure 1 shows the long-run development of theft rates (serious theft and petty theft) in Germany. West German crime rates increased from 1,638 cases per 100,000 inhabitants in 1963 to 4,860 in 1992 and fell thereafter to 3,287 in 2005. East German rates started at a much higher level (6,591 in 1993), but are converging towards western rates ever since then.[8]

[Figure1, Figure 2 about here]

With the exception of a slight decline at the beginning of the 1980s, Figure 2 reveals a steady upward trend of violent crimes.[9] A closer look at the data shows that robbery and assault rates are the driving forces behind this trend, whereas murder/manslaughter and rape stay relatively stable over time. Contrary to popular beliefs, violent crime rates in the East are not higher than in the West, there rather is divergence with stable crime levels in the East but strongly rising rates in the 1990s reaching 267 cases per 100,000 in Western Germany in 2005.

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[8] There are no reliable crime statistics for the first three years after the fall of the Berlin Wall in 1990.

[9] Violent crime is measured as the sum of murder, manslaughter, rape, robbery, and assault, of which assault accounts for 69.5% and robbery for 25.5% in 2005. Note that robbery is registered as violent crime by official statistics, though its motivation suggests classifying it among property crimes (as we do in Section 4).

3.2. Criminal Prosecution in Germany: Data and General Tendencies

In order to quantitatively operationalize the criminal prosecution process, data from two sources of official statistics is drawn upon – police crime statistics (PCS) and criminal prosecution statistics (*StVStat*). Information was acquired for six 'classic' categories of crime (murder and manslaughter, rape and indecent assault, robbery, aggravated assault, serious theft, petty theft) for each of the former West German states for the period from 1977 - 2001.

The criminal prosecution process should be covered as comprehensively as possible. To accomplish this goal, two issues require further attention. First, it must be borne in mind that the general penal code and the juvenile penal code differ fundamentally with respect to their provisions for the type of sanction and intensity of invasiveness. Second, when inspecting long-run efficiency of police, prosecutors and courts, demographic changes of the criminal population have to be taken into account.[10]

The juvenile penal code makes frequent use of two forms of punishment not provided for in the general penal code, corrective penalties (educational aid and supervision, issuing of instructions) and disciplinary measures (mandatory labor service, juvenile detention). Furthermore, sentences pronounced according to the juvenile penal code are principally less severe, this being reflected in the fact that, for example, the longest sentence is only half as long as that provided for by the general penal code and that no juvenile sentence (not even for murder) exceeds 10 years. In the context of these differences, it seems reasonable to develop separate systems of prosecution indicators for adults and juveniles and to then correlate them within the context of separate estimation models with suitable, i.e. age-specific,[11] incidences of crime. Accordingly, one model refers to persons aged 14 to 17 years. The latter are sentenced exclusively according to the juvenile penal code. The other model is conceived for

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[10] Note that in Germany the ratio of the young population under 20 years of age to the population between 20 to under 65 years decreased from 0.53 in 1970 to 0.33 in 2005, whereas during the same time period the ratio of the population elder than 65 years to the active population aged 20 to 64 years increased from 0.25 to 0.32 (Source: Statistisches Bundesamt 2006). Thus, ignoring the decreasing share of crime-prone aged people would lead to a downward bias of crime rates of the active and, in particular, of the young population.

[11] Age-specific crime rates are not available and have to be approximated under the assumption that the (unknown) age distribution of criminals is similar to the (known) age distribution of suspects. The approximation is conducted according to the formula, $O_{cast} = CASES_{cst} \times (SP_{cast} / SP_{cst}) \times (1 / PS_{ast}) \times 100.000$, where CASES represents the number of cases recorded by police, SP the number of crime suspects, and PS the size of population. The indices identify the offence group (c), the age group (a), the federal state (s) and the year (t).

persons aged 21 to 59 years, who are exclusively subject to the general penal code.[12] Adolescents (persons aged 18 to 20 years) are excluded from the empirical analysis as it is at the discretion of the judge whether they are sentenced according to *either* the juvenile penal code *or* the general penal code, a circumstance which prevents econometric testing of any penal system for this age group. Table 1 (see below) reveals that at the end of the period under investigation (1998-2001) only about one tenth of all convicted violent adolescents were sentenced under the adult penal law. This rate was still 29.7% in 1977/81 for aggravated assault, which highlights the still ongoing realization of the ideas of German Criminal Law Reform in 1969, according to which young offenders should not be punished but rather educated.

As a rule, the criminal prosecution process begins with investigative police work following the registration of a criminal offence, and ends, if successful, with the crime being solved. The initial indicator of the prosecution system is, therefore, the *clearance rate* (Table 1, column (1)), which links the number of crimes registered to the number of cases solved and thus is based solely on data from the PCS. As regards the clearance rate, no age-specific differentiation is possible since, in the case of crimes which are registered but not solved, it cannot be ascertained by whom the crime was committed. For the sake of simplicity it is assumed that the (unknown) clearance rates for both juveniles and adults correspond to the general clearance rate and thus they are equally high. Table 1 presents general tendencies of two important and characteristic types of crime in Germany, namely serious theft and aggravated assault. It reveals high and quite stable clearance rates for assault (about 85%), and much smaller rates for serious theft which declined from 19.3% in 1977-81 down to 13.3% in 1998-2001.

[Table 1 about here]

When a crime is solved by the police, i.e. when a suspect is, or suspects are, detected, it then becomes the task of the public prosecutor's office to legally and factually evaluate the accusation and to reach a final decision regarding the investigative procedure. Essentially, the latter can result in the case being dropped owing to the uncertain probability of sentencing, in diversion or in an indictment (BMI and BMJ, 2001, pp. 344, 347). In the case of an indictment the suspect is subject to sentencing by a court. In Table 1, column (2), the share of

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[12] As already pointed out above, the intention is to adjust for demographic changes and to focus on persons in the 'criminally active' age group (according to BKA, 2004, in 2003 only 6.3% of suspects were 60 years or older, while 21 and 22-year-olds made up 6.4% of all suspects).

cases passed on to court is referred to as the *indictment rate*. The large drop in criminal proceedings reflects the highly influential discretionary power of the public prosecutor. During the last period of investigation, 1998 – 2001, only 35.4% of suspects of serious theft and 30.4% of assaults were brought to court. Both rates fell throughout the period of investigation, in particular during the 1980s. They came down from 46.5% to 35.4% for theft (average rates of the period 19771981 compared to the period 1998/2001) and from 35.1 to 30.4% for assault. Put differently, in the most recent period of the sample, almost 70% of police clear-ups are discharged by public prosecutors through the channel of pre-trial diversion.

The trial can result in acquittal, in the proceedings being dismissed or end in a conviction. In contrast to the indictment rate, the proportion of trials resulting in a conviction, i.e. the *conviction rate*, remained rather stable, as can be seen from the examples of theft and assault in Table 1, column (3). The ratio of acquittals and dismissals based on trials in case of serious assault, however, significantly exceeds that of serious theft (37% versus 17%, on average).

Considering the variations and interactions of both indictment and conviction rate, of course, suggests drawing on the product of both variables, henceforth defined as the *sentencing rate,* whereby its operationalization can be conducted separately for adults and juveniles, owing to the availability of age-specific data on suspects in the PCS and on convicted persons in the StVStat.[13] Thus the econometric analysis below will make use of the sentencing rate rather than considering separate indictment and conviction rates, having in mind that the variance of the sentencing rate is mainly driven by public prosecution activities over time and across states (see also below).

In as far as a sentence is passed, the judge's verdict can, according to the adult penal code, take the form of either a non-suspended prison sentence, a suspended prison sentence – i.e. one which is suspended on probation – or a fine. The attendant indicators are the *imprisonment rate*, *probation rate* and *fine rate* (Table 1, columns (4) to (6)). The juvenile penal code also provides for non-suspended and suspended prison sentences. Additionally, two alternative punitive means, *disciplinary measures* and *corrective measures,* are available. For the various forms of punishment the severity of the penalty is measured by the length of

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[13] The fact that the computation of the sentencing rate (and of all subsequent indicators) necessitates the (painstaking) match of information from the PCS with that of StVStat is evidently the reason why studies on crime and deterrence in Germany (see Curti 1999, Büttner and Spengler 2002, Entorf and Spengler 2000, 2002, Entorf and Winker 2008) are almost without exception restricted to information from the PCS.

the non-suspended prison sentence handed down and by the number of per-diem fines, respectively. The prosecution indicators developed here (besides the other variables used in the empirical analysis) will subsequently be related to the incidence of crime using panel-econometric procedures.

Table 1 reveals unclear trends of the imprisonment rate. Proportions were low and stable at about 10% for aggravated assault and decreasing for serious theft from 41.1% down to 31.6% during the 1980s and early 1990s, indicating that incarceration was driven back in favor of probation and financial fines, as suggested by the reform of 1969. However, from 1998 on imprisonment (from 10.4% up to 14.7%) and probation rates (from 29.2% up to 49.7%) for aggravated assault rose sharply, while the fine rate dropped from 60.4% down to 35.5%. This somewhat more punitive behavior from the late 1990s on is the result of a 1998 reform of the reform of 1969 (see Busch, 2005, for the history of all reforms since the Grand Criminal Law Reform of 1969). This reform (*6th Strafrechtsreformgesetz*) is the legislative outcome of preceding discussions on the inconsistency of existing sentences and degrees of penalties with the *Werteordnung* (value system) of the German Constitution. The debate was raised because sentences for violent crimes appeared to be unjustifiably lenient compared to sentences for property crimes. As a consequence, in a reform of the Grand Reform new (more severe) maximum and minimum penalties were introduced for many violent crimes (for example: the minimum/ maximum penalty for aggravated assault was 3 months/ 5 years before the reform, and it is 6 months/ 10 years after the reform).

Summing up, the major issue of the sentencing practice is the tendency towards lower indictment rates (see Table 1, column 2) and higher rates of probation[14] (see Table 1, column 5). Both trends are in line with the idea of the German Criminal Law Reform of 1969 and confirm general observations on the increasing importance of diversion and sentences suspended on probation found elsewhere (see, in particular, Heinz 2006).

3.3. *Heterogeneity of Criminal Policy at the State Level*

Identification of deterrent effects by means of multivariate panel econometrics is only possible when both the explanatory and the dependent variables display a sufficiently strong

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[14] The share of sentences on probation in the sum of both conditional and unconditional imprisonment increased from 48.2% in 1977/81 to 53.9% in 1997/2001 for theft and even from 67.4% to 77.1% for aggravated assault.

variation. In Figures 3 to 5 federal-state-specific time series for serious theft by adults are presented for purposes of exemplification.[15] Largely congruent temporal developments (a rise in serious theft up to the mid-1990s, followed by a decrease) can be identified for three groups of states in Figure 3. The first group consists of so-called city-states, Bremen (Bre) and Hamburg (Ham), with crime rates many times as high as these in the non-city states.[16] The second one is made up of Baden-Wurttemberg (BaW), Bavaria (Bav), Rhineland-Palatinate (RhP) and Saarland (Saa). These states exhibit a below-average occurrence of crime in comparison with the Federation (the former West German states except Berlin). All remaining states, i.e Hesse (Hes), Lower Saxony (LoS), North Rhine-Westphalia (NoW) and Schleswig-Holstein (SHo), can be allocated to a third group, which lies above the federal average.

[Figures 3 to 5 about here]

Figures 4 and 5 reveal the heterogeneous development of deterrence indicators at the state level. For reasons of layout and space, the presentation is limited to Bavaria, Bremen and Schleswig-Holstein as representatives of the state-groups specified above. Fig. 4 shows that, in the federal comparison, Bavaria has the highest clearance-rate, the latter finally lying considerably above the federal average which decreased over time. The temporal variation is to be seen most clearly in the case of Bremen, where the clearance-rate fell from 16% in 1980 to the present figure of 6%. As can be gathered from Figure 5, crime suspects in Bavaria are convicted and sentenced with above-average frequency (at least in recent years). Moreover, Bavaria is proving to be largely resistant to the long-term federal trend towards diversion. Despite the federally binding penal code, Bavaria also follows a harsher course concerning type and severity of sentence, non-suspended prison sentences for adults being markedly more frequent than in the federal average, notwithstanding recent years, and of a longer duration.

Among the non-city states, Schleswig-Holstein can be considered a representative of a more lenient criminal policy. The state's administration of justice repeatedly avowed its persuasion that alternative sentencing practices and diversion are effective measures that prevent crime through avoidance of formal convictions.[17] The different notions of adequate strategies for fighting crime in both states can be seen by significantly higher imprisonment rates in Bavaria

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[15] Serious theft was selected because it is a crime category clearly related to material gain and is, therefore, especially compatible with the economic theory of crime and is, moreover, the crime category with the highest incidence.

[16] Berlin, which also belongs to the group of city-states, is excluded from the (descriptive and multivariate) analysis because of the structural upheavals connected with German Reunification.

[17] In 1990, the state passed a bill that renewed and extended the idea of the federal reform of 1969.

and in particular by the strongly divergent length of imprisonment throughout the 1990s, indicating strong compliance with the Criminal Law Reform of 1969 in Schleswig-Holstein and less or no compliance in Bavaria.

Table 2 focuses on the discrepancies between the two states. As regards the role of the public prosecutor, the most remarkable differences can be detected for assault and theft. Whereas sentencing rates for assault were about the same in both states and even higher for theft in Schleswig-Holstein than in Bavaria before 1990, the recent period shows a strongly reverted picture: The probability of 'sentencing' (i.e. conviction of a crime suspect) dropped from 19.4% to 14.2% for aggravated assault (Bavaria: increase from 19.5% to 19.7%), from 46.4% to 26.4% for petty theft (Bavaria: increase from 37.% to 38.1%) and from 43.5% to 27% for serious theft (Bavaria: decrease from 35.9% to 31.6%). During the period 1991-2001, all average sentencing rates of the Bavarian justice exceeded those of Schleswig-Holstein. While these differences are mainly caused by the discretionary power of public prosecutors, also judges act according to respective state-specific judiciary norms. With the exception of murder, Bavarian courts impose unconditional prison sentences more often than courts in the northern state Schleswig-Holstein, where judges have the strong propensity to divert defendants from custody. Some of these contrasts are quite remarkable. In Bavaria, for instance, robbers receive a prison term in 64.2 cases out of 100 convictions in Bavaria, but in Schleswig Holstein this is becomes evident in 48 cases.

[Table 2 about here]

Given precedent probabilities of sentencing and imprisonment, it is not surprising that also expected values of the expected length of imprisonment differ substantially. In Table 2, the expected duration is defined as the product of the clearance rate, sentencing rate, imprisonment rate and the average (realized) length of the prison sentence. In Bavaria offenders of all types of crime have to expect longer prison terms than in Schleswig-Holstein. After 1990, albeit at a low level, most expected durations in Bavarian prisons are more than twice the Schleswig-Holstein value. Given that all crimes were reported to the police, in Schleswig-Holstein robbers would take the risk of 2.4 months in custody (compared to 4.9 months in Bavaria), committing rape and sexual assault would imply the risk of 3.1 months (5.7 months in Bavaria), aggravated assault would cause just 6 days in prison (12 days in Bavaria), and the expected prison sentences for serious theft and petty theft were 4 days and 0.6 days (12 days and 2.4 days), respectively.

[Table 3 about here]

Table 3 summarizes previous findings by way of relating crime rates to indicators of deterrence. The table depicts results from simple panel regressions of crime rates on the probability of being sentenced to imprisonment (without probation) conditional upon detection arrest (i.e. the product of sentencing and imprisonment rates). These preliminary econometric results (without any further explanatory variables except control for state and year effects) give an impression of the *overall (combined)* effect of public prosecutors and courts on crime rates. Almost without exceptions all coefficients have a negative (and significant) sign, as expected from deterrence theory. The only exceptions are rape and aggravated assault for the less efficient and problematic time series evidence in column (1), and for assault in a panel regression with time and state effects (col. (4)). Inspecting most reliable estimations in cols. (4) and (5), which both control for unobserved heterogeneity by either including time and state effects or by taking growth rates of dependent and explanatory variables, strongest effects from harsher conviction and/or sentencing seem to arise for theft and, somewhat surprisingly, because it contradicts the popular view that deterrence does less apply to violence crime, for murder and manslaughter. The next section will show whether these preliminary findings will hold in a more general and statistically more elaborated context. In particular, from Table 3 it seems obvious that deterrence might work, but the causes of its significance cannot be identified. Hence, the question still to be answered is whether diversion decisions by public prosecutors have a stronger impact than court decisions regarding type and severity, or vice versa, or whether both are likewise important.

4. Econometric Evidence

4.1. Econometric Modeling and Methodological Aspects

The econometric model is based on the theoretical framework on informal, custodial and non-custodial sentencing derived in Section 2, eventually leading to an augmented version of the traditional supply of offences (Becker 1968, Ehrlich 1973):

$$(4.1) \qquad O = f\left(\underset{(-)}{p}, \underset{(-)}{p_{s|c}}, \underset{(+)}{(1 - p_{s|c})}, \underset{(-)}{F}, \underbrace{L\left(t_{\ell}\right) - L^{b}\left(t_{\ell}\right)}_{(-)}, X\right),$$

where p is factorized into p_{cl} (clearance rate) and $p_{ac|cl}\, p_{cv|ac}$ (sentencing rate).

Previous descriptive evidence has revealed that criminal prosecution indicators display a high variation both across the federal states and throughout the observation period, and show a

certain (inverse) correlation with the incidences of crime. The crime rate will be subsequently related to all criminal prosecution indicators described above and to further explanatory variables derived from the economic theory of crime. The latter consist of the real per-capita gross domestic product, the unemployment rate and the share of migrants[18], representing legal and illegal income opportunities (cf. Ehrlich, 1973, for theoretical grounding, and, for example, Entorf and Spengler, 2002, for a survey of empirical results). Descriptive statistics of all variables are included in Tables A1 and A2 (Appendix).

Results by Cornwell and Trumbull (1994) reveal that disregarding unobserved heterogeneity would lead to substantial overestimation of deterrence effects. Sources of such biases can be seen, for example, in the basic attitude of the state population towards illegal acts, in the peculiarities of the state prosecution systems which are not accounted for by the prosecution indicators deployed, especially in varying levels of underreporting, or in changes of the measurement of the endogenous variable such as changing definitions of and allocations to crime categories. The panel structure of the used data set implies that unobserved heterogeneity of the federal states can be controlled for in the estimations. In estimation terms, besides applying a (two-way) fixed-effect model (i.e. with state-specific as well as time-specific constants as additional regressors), unobserved heterogeneity is accounted for by means of a framework into which first differences of all variables are incorporated. The fixed-effects model is deployed in two variants. In the first version, the explanatory variables enter the equation with their contemporaneous values, whereas in the second one they are lagged by one period. This procedure takes account of the fact that there is a lack of knowledge as to how quickly changes to the criminal prosecution system and other variables are perceived by potential offenders and relevant to their decision-making.

A total of 36 (6 offence groups x 2 age groups x 3 model specifications) estimations were conducted. The general estimation equation for the fixed-effects model with contemporaneous explanatory variables (Model 1) can be written as follows,

$$(4.2) \qquad \ln(O_{st}) = \beta \ln(O_{s(t-1)}) + \mathbf{X}_{st}\mathbf{\Gamma} + \mu_s + \lambda_t + \varepsilon_{st}$$

where the indices s and t stand for federal states and time, respectively, ln refers to the natural logarithm, O stands for the crime rate, $\mathbf{X}$ represents a $1 \times k$ vector of explanatory variables which, besides containing the criminal prosecution indicators, also depicts the three control

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[18] The German PCS does not distinguish between migrants with and without German citizenship. For this reason 'migrants' cover the share of foreign nationals in the German resident population.

variables mentioned above, and with the variables μ and λ embodying state-specific (fixed-effects) constants and indicator variables of annual shifts ('time dummies'). The coefficients which are to be estimated are represented by β and the $k \times 1$ coefficient vector Γ. Through incorporation of the lagged crime rate, $O_{s(t-1)}$, as additional regressor, the model is also suitable for the depiction of possible dynamic structures of crime incidence. Note that the specification of equation (4.2) includes the complete cascade of deterrence, i.e. of police, public prosecution, court decision and kind of imprisonment. This comprehensive coverage avoids any misspecification due to missing variables, a problem put forward by Mendes and McDonald (2001), and Mustard (2003). Conviction rates and time served are theoretically important, but rarely used. Mustard (2003) shows that omitting them would cause an underestimation of the effect of the arrest rate by as much as 50% because of the negative correlation of these two variables with the arrest rate.

Model 2 (the fixed-effects model with lagged explanatory variables) can be derived from Model 1 by replacing $\mathbf{X}_{st}$ with $\mathbf{X}_{s(t-1)}$ in the above equation. Model 3 can be derived from Model 1 by formation of first differences, and is transformed as follows:

(4.3) $$\Delta \ln(O_{st}) = \alpha + \tilde{\mathbf{X}}_{st}\mathbf{\Gamma} + \lambda_t + \varepsilon_{st}\,^{19}$$

The large and, in comparison with the cross-sectional dimension, dominant time-series dimension of the data set used (T=25, N=10) suggests consideration of time-series-specific problems such as integration, co-integration and serial correlation. Integrated and non-stationary time-series possess a high degree of persistence which does not, *per se*, represent a problem, but is frequently associated with a violation of the classical assumptions. Moreover, the time-series literature shows that when one integrated variable is regressed on another integrated variable this can lead to the problem of *spurious regressions* which also holds for fixed-effect models (Entorf 1997). Generally, the integration of time-series can be remedied by first differencing the data. Given that there is not only application of first differences but

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[19] The use of $\tilde{\mathbf{X}}$ in place of $\mathbf{X}$ denotes that levels (or logarithmic levels) of the explanatory variables are replaced by their first differences. Differencing of time dummies would imply that an annual effect in the change of the crime rate would be completely neutralised in the following year. Since this is not plausible, the differencing of time dummies was abandoned. α represents a constant which cannot be taken into account in Models 1 and 2 due to the use of state-specific constants. A lagged endogenous variable is no longer present as regressor because, first, any economic or criminological motivation for the inter-temporal dependence of change rates of crime incidence is less apparent than in the case of levels. Second, a lagged endogenous variable in Model 3 would inevitably lead to inconsistent estimations. Although inconsistencies might occur in Models 1 and 2, too, for large T they tend to be less important than in case of Model 3 (Wooldridge 2002).

also of fixed-effects models based on (logarithmic) levels, integration tests for panel data were conducted first.[20]

The results (p-values) from four different panel integration tests according to Im, Pesaran and Shin (2003) are presented for all dependent variables (see Table A3). As expected, stationarity can be assumed for the variables in first differences. However, also most (logarithmic) levels of crime rates prove to be stationary. This applies especially to murder and manslaughter, in addition to rape and indecent assault. Moreover, all tests based on variant 1 of the IPS-test (no lags, no trend included) reject the null of non-stationarity. Indications of non-stationarity arise mainly for tests including a (rather unrealistic) trend (specifications 2 and 4). Tests for all 105 explanatory variables are not detailed here for reasons of space. [21] In summary, it can be noted that for all variables in first differences and for 76 (i.e. for 72%) of all variables in levels non-stationarity could be dispelled. The hypothesis of non-stationarity can not be rejected for the levels of the control variables per-capita GDP, unemployment rate and share of migrants. Bearing in mind the fact that the dependent variables in the analysis were more in keeping with I(0) than I(1) processes and most of the explanatory variables (especially the criminal prosecution indicators) are stationary, it does not, on the one hand, make sense to examine co-integration relations while, on the other hand, the danger of producing nonsense regressions using fixed-effects estimations is quite marginal.

A further problem of estimation with panel data – especially in the case of a larger time-series dimension – is frequently caused by the existence of serial correlation of residuals. Serial correlation is mainly a problem of regression in levels (and not in first differences) and might 'only' cause misleading estimates of standard errors (a problem which is counteracted by calculating autocorrelation- and heteroskedasticity-robust standard errors), but can, however, also be an indication of a misspecification of the model and, correspondingly, of biased estimation of coefficients themselves. For instance, serial correlation might reflect a possible dynamic misspecification of the model which is often accounted for by inclusion of lagged endogenous variables as additional regressors. In the crime context, a factual justification of such an enhancement of the econometric model can be seen in the existence of recidivist

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[20] Integration tests for the complete panel have a higher statistical power than conventional unit root tests on individual time series of panel data sets.

[21] Results are available upon request.

offenders who, to the extent that they are not arrested and jailed, contribute not only to the crime rate of the current period but also of subsequent periods.[22]

Thus, including lagged endogenous variables becomes primarily relevant for fixed-effects models. Nickell (1981), however, shows that using a lagged dependent variable as regressor in the fixed-effects model violates the Gauss-Markov Theorem and would lead to inconsistent parameter estimates. As the so-called *Nickell bias* has the order $O(1/T)$, its magnitude depends on the time-series dimension of used panel data. Judson and Owen (1999) show that the bias arising from the coefficient of the lagged endogenous variables in the LSDV (least squares dummy variable) model can, even at T=30, amount to 3-20% of the true value of the coefficient. Accordingly, they suggest the corrected LSDVC estimator based on Kiviet (1995), which, however, has not previously been applied to unbalanced panels and is correspondingly not utilized in the present study.[23] For unbalanced panels from T=30 onwards Judson and Own recommend the use of the LSDV estimator, whereas for T=20 a GMM procedure according to Anderson and Hsiao (1981) and Arellano and Bond (1991) would be preferable. The reason for making use of the LSDV estimator (for T=25) in the following is twofold: Firstly, the bias caused by the LSDV estimators for the coefficients of the remaining (non-predetermined) explanatory variables are already negligibly low for T=20 (Judson and Owen 1999), meaning that problems should arise, if at all, only when the long-term effects (based on the coefficient of the lagged dependent variable) of criminal prosecution indicators are calculated. The latter, however, are, if anything, underestimated due to the negative bias of the (generally positive) coefficients of the lagged endogenous variables such that any reasoning based on significant variables would represent a conservative interpretation of the influence of criminal prosecution on crime.

Potential simultaneity between the crime rate and explanatory factors of deterrence might require the use of instrument variable estimators (IV estimators). When the incidence of crime is not only influenced by the clearance rate but also vice versa, estimates which do not account for the endogeneity of explanatory variables might lead to inconsistency problems.

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[22] However, given that German imprisonment rates amount to almost only one tenth of US imprisonment rates, the analysis does not explicitly adjust deterrence estimates for potential incapacitation effects, as many studies based on US crime data do. It is thus assumed that the pool of potential criminals is sufficiently large and not significantly reduced by imprisonment, and that the rather small group of incapacitated offenders is easily substituted out of this pool.

[23] Gaps in data arise for the smaller federal states such as Bremen in the time-series of the logarithmic crime rates and criminal prosecution indicators for low-incidence offences (e.g. murder) committed by juveniles. Moreover, following some communication with representatives of the German Statistical Office, we treated some few faulty data points as missing because of their evidently misrecorded entries.

There are several conceivable reasons for the interrelation of crime rate and clearance. The size of the clearance rate can be due to, for example, the overloading of police resulting from an unexpected rise in crime. Owing to the overloading of police capacity the clearance rate will sink, the absolute number of cases solved remaining constant. Since the crime rate rises simultaneously, the negative partial correlation between clearance rate and crime incidence would be overestimated in least-squares applications. This could be counter-balanced by a potential underestimation for at least two reasons. First, criminal policy would respond to increasing crime rates by allocating public resources to the police, resulting in higher clearance rates. A second reason is related to the share of undocumented crimes in the true number of crimes which likewise depends on police resources, in particular for offence types revealed by monitoring/controls and/or random spot checks. Two thirds of petty thefts in Germany, for example, are cases of shoplifting (Bundeskriminalamt, 2004). As a rule, however, registered cases of shoplifting are characterised by an offender being caught red-handed, the case being cleared immediately. If, *ceteris paribus*, the number of registered cases of shoplifting were now to increase through an increase (decrease) in controls, the petty-theft rate would then rise (fall) with simultaneously increasing (decreasing) specific clearance rate. This apparently positive correlation between crime rate and clearance rate can lead to a state where a true deterrent effect is not only underestimated in econometric studies, but is possibly not verifiable and even produces an empirical result which is the exact opposite. Against this background, IV estimations are conducted with the goal of neutralising possible simultaneity relationships between crime rate and clearance rate.[24]

The successful application of IV estimations crucially depends upon the existence of adequate instrument variables which are correlated with the endogenous explanatory variables while being simultaneously uncorrelated with the error term. In the following, the offence-specific attempt ratios (i.e. the ratio of non-completed offences of all registered offences in an offence group) and indicators of the crime-scene distribution classed according to size of municipality (cf. Table 1) are used as potential instrument variables. This seems to be a reasonable choice since, firstly, an influence on the clearance rate is to be expected from both variables. *Ceteris paribus,* (merely) attempted offences ought to result in less thorough police investigative efforts than completed offences and detective work in an urban environment should prove to be more difficult than in rural areas. Secondly, it may be reasonably assumed that the ratio of

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[24] Simultaneities between the crime rate and other criminal prosecution indicators are also conceivable. As these are less apparent than in the case of the clearance rate, however, they remain unaccounted for.

attempts and the regional crime-scene distribution cannot be considered prime determinants of crime which should be incorporated into equations (4.2) and (4.3). These variables emerge ex post from the realisation of illegal activities and have no theoretical correspondence in the econometric crime model.[25]

4.2. Estimation results

Linking econometric results with the descriptive evidence presented above, Tables 4 and 5 first focus on serious theft and aggravated assault representing important types of property crimes and violent crimes, respectively.[26] A short summary of included explanatory deterrence indicators is reviewed for the sake of convenience (for details see Section 3):

a) General Penal Code / Adults (persons aged from 21 to under 60 years)

- Clearance rate   =   *total cleared cases / total registered cases*
- Sentencing rate =   *persons indicted and convicted / suspects, aged 21 to under 60 years*
- Imprisonment rate =   *persons sentenced to non-suspended imprisonment* / persons sentenced, *aged 21 to under 60 years*
- Probation rate =   *persons sentenced to suspended imprisonment* / persons sentenced, *aged 21 to under 60 years*
- Fine rate =   *persons sentenced to fine (as most severe sentence)* / persons sentenced, *aged 21 to under 60 years*
- Average length (in months) of non-suspended prison sentence of persons sentenced aged from 21 to under 60 years
- Average number of per-diem fines [if fine is most severe sentence] of persons sentenced 21 to under 60 years

b) Juvenile Penal Code / Juveniles (persons aged from14 to under 18 years)

- Clearance rate (see above)
- Sentencing rate =   *persons indicted and convicted / suspects, aged from 14 to under 18 years*
- Imprisonment rate =   *persons sentenced to non-suspended imprisonment* / persons sentenced, *aged 14 to under 18 years*
- Probation rate =   *persons sentenced to suspended imprisonment* / persons sentenced, *aged 14 to under 18 years*

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[25] Other variables with potential relevance to the instrumentation for the clearance rate are public debt and electoral cycles, as proposed by Levitt (1997). However, both variables prove to be weak or wholly irrelevant instruments and must therefore be excluded from further analysis in order to avoid (serious) distortions of the estimate coefficients (cf. Bound, Jaeger and Baker 1995 and Staiger and Stock 1997 on the *weak-instrument* problem).

[26] The Stata™ module ivreg2 by Baum, Schaffer and Stillman (2002) was used for all estimations, which offers not only various IV estimators but also enables the calculation of heteroskedasticity and autocorrelation-robust standard errors.

- Rate of disciplinary and corrective measures = *sentenced to disciplinary or corrective measures (as most severe sentence)* / persons sentenced, aged from 14 to under 18 years

- Average length (in months) of non-suspended prison sentence of sentenced persons aged from 14 to under 18 years

Table 4 reveals that the clearance and sentencing rate prove to be the most important crime-reducing factors. These indicators display highly significant estimates across all three model specifications. While the effect magnitudes for Model 3 are immediately evident from the table (the semi-log specification implies that an increase of one *percentage point* in the clearance rate, for example, leads to a decrease of 1.5 percent in serious theft), in the case of Models 1 and 2 there is need of a differentiation between (reported) short and long-term effects (or short and long-term semi-elasticities). The latter are obtained by assuming a long-term equilibrium of the crime rate ($O_t=O_{t-1}$). The long-term effect of the clearance rate in Model 1 is, for example, –2.623 (= -1.322 / (1 – 0.4960)).

In none of the cases do the remaining criminal prosecution indicators display significant coefficients across all three models. If, however, significant results are reported, they are in accordance with the deterrence hypothesis. Increasing rates of probation (relative to incarceration), for instance, seem to have a crime enhancing effect as suggested by the theoretical model, although significance (at the 5% level) can only be reported for one out of 6 cases (adults, Model 1).[27] The large and positive coefficients on the rate of disciplinary and correctional measures (Models 1 and 3) indicate that juveniles do not adequately respond to the idea of the Juvenile Penal Law, according to which young offenders needed to be educated, not punished (Heinz 2006). On the contrary, intensified application of such measures instead of imprisonment would be associated with increasing crime rates. Harshening punishment, however, does not prove to be a promising alternative either, as the length of time served turns out to be insignificant. Thus, our econometric results imply that serious theft by juveniles could be cut back by a more rigorous enforcement of the existing juvenile penal law. This includes conviction (instead of dismissal and dropping cases by public prosecutors and judges) and sentencing to juvenile custody (instead of educational measures and probation), but does not include longer prison terms.

Legal income opportunities seem to be better covered by the potential risk of unemployment than by GDP per capita as the latter shows ambiguous signs of influence and just one

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[27] Note that there are three types of sentences adding up to unity. As we are mainly interested in the effect relative to unconditional imprisonment, we employ the latter as reference category.

(negative) significant estimated coefficient (adults, Model 1). The positive coefficients of the unemployment rate throughout all specifications confirm previous results found in the literature indicating that poorer prospects of employment lead to an increase in property crimes (see, e.g., Raphael and Winter-Ebmer 2001, Lin 2008). This conclusion can be confirmed by the results for petty theft (see Table A7, Appendix). Contrary to popular belief, the share of migrants does not have any significant effect on serious theft.

There is no instrumentation of the clearance rate for serious theft. To the extent that the instruments proved to be relevant indicated by testing the exclusion restriction (each in Model 3), their exogeneity is discarded on the grounds of the test for overidentifying restrictions at the 10% (but not 5%) level. However, testing the endogeneity of the clearance rate revealed that instrumentation had to be abandoned since the hypothesis of exogenous clearance rates cannot be rejected (cf. p-values of endogeneity tests).[28] The same holds for aggravated assault discussed below (see Table 5).

[Tables 4 and 5 about here]

The crime curbing effect of higher sentencing rates (i.e. indictment and conviction instead of diversion and dismissal) is confirmed for aggravated assaults. Only estimated coefficients of Model 2 (lagged explanatory variables) do not show any significance. Other results are less clear and partly contradict expectations derived from the traditional rational choice theory. While findings corroborate the crime-reducing effect of police activities (cf. clear-up rates) at least for juveniles, young violent offenders are not deterred by unconditional imprisonment. Instead, higher shares of convictions effecting imprisonment conditional on probation and disciplinary/correctional measures would scale back the number of aggravated assaults committed by juveniles back. Again, increasing the length of custody sentences does not have the expected effect of lowering crime. The sign is even positive and significant in one case (adults, Model 1) and insignificant in all remaining specifications. Financial fines do not play any significant role.

The effect of unemployment on aggravated assault is less obvious than in the case of serious theft. While it is positive (although insignificant) for juveniles, it is negative and even significantly negative in the case of Model 1 for adults. Raphael and Winter-Ebmer (2001), who report similar experiences (i.e. negative signs) for the violent crimes 'rape' and 'murder', discuss potential reasons such as misspecification, but from presented results on 'rape and

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[28] See notes at the bottom of Table 4 for more details on IV related tests.

indecent assault', 'murder/ manslaughter'and 'robbery' (see Tables A4 to A7, Appendix) it can be inferred that the negative effect measured on assault is rather an exception to otherwise crime enhancing effects of unemployment.

Higher GDP p.c. does not seem to have any short-term effect (Model 3), but wealthier regions and more prosperous time periods appear to be associated with lower assault rates committed by adults. The conclusion of a crime reducing impact of wealth is confirmed by most estimated coefficients on GDP for other types of crime (see Tables A4 to A7, Appendix), although only robbery is affected in a significant way (at conventional significance levels). For juveniles, too, in most cases no significant effect from varying GDP p.c. on crime has been found. Significant coefficients are only reported for aggravated assaults (Model 1, positive sign) and for robbery (Model 2, negative sign), such that the overall conclusion would be that there is almost no significant marginal influence stemming from higher or lower wealth in particular regions.

The impact of migration rates is mixed, however with the number of insignificant results exceeding the significant ones. While for aggravated assaults Model 1 shows a positive sign for adults, Model 2 reveals a negative sign for juveniles. Pre-empting the discussion of the remaining types of crime, only 5 out of 36 estimations (6 types of crimes, 6 estimations each) showed significance of migration, out of which 3 were positive and 2 negative. Thus, we cannot conclude from our data that higher migration rates are associated with more crime.

Table 6 contains a summary of all results in which the types of crime are pooled in two general categories: murder and manslaughter, rape and indecent assault, together with aggravated assault are subsumed under 'violent crimes', and serious theft, petty theft and robbery are pooled as 'property crimes'. Presented figures indicate the percentage of significant estimates being consistent with the economic theory of informal, custodial and non-custodial sentencing derived in Section 2. Inspecting results for the clearance rate, 67% (56%) of the estimates for property offences by adults (juveniles) are significantly negative (at the 5% level) and correspondingly consistent with the economic theory of crime, when relying on all econometric specifications (1) to (3) equally.[29] Conversely, no contradictory result has been found. The same finding holds for violent crimes, but the share of negative coefficients is substantially smaller than for property crimes (less than 50%) which can be

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[29] Information criteria and R-squared suggest that Model 2 is dominated by Model 1. Skipping specification 2 leads to percentages of significant values presented in parentheses in Table 6. This procedure would lead to generally higher shares of estimates confirming the deterrence hypothesis; see, in particular, sentencing rates.

attributed to the fact that violent offenses – not least because of the frequently immediate interaction and/or acquaintance of offender and victim – are solved relatively frequently in any case.

[Table 6 about here]

As already stated for theft and assault, the sentencing rate proves to be the most reliable deterrence indicator, both for property and violent offences. For the subsequent stages of the criminal prosecution process, however, robust deterrent effects in accordance with theory can be detected only for the education/correction-measure rate in property offences involving juveniles. For juvenile violent offenders, there are confirming but also significant contradicting effects, implying that more 'lenient sentencing' might likewise result in lower crime rates. Increasing the severity of punishment does not curb violent crime. There is rather a modest indication of the opposite 'building criminal capital behind bars' effect as longer prison terms are associated with significantly higher crime rates in one specification of each age group. Thus, summing up, the most important insight is that a deterrent effect on potential offenders is exerted especially by the first two stages of the criminal prosecution process.

IV estimates were made use of in only 2 of 36 cases, these being in Models 1 and 2 for petty theft by juveniles. The fact that instrumentation was necessary precisely in the case of petty theft by juveniles and results in quantitatively substantial and statistically highly significant coefficients of the clearance rate is an interesting result, since petty theft is heavily dominated by shop theft amongst juveniles and can, as stated above, be considered as the cause of an estimation bias on the coefficients of the clearance rate towards zero in OLS estimates, which indeed were insignificant. Otherwise, it is found that the available instruments possess no, or only limited, explanatory relevance for several offence groups (especially for murder and manslaughter). There is, however, evidence that endogeneity of the clearance rate bears no serious problems, except for petty theft by juveniles. This is attested to by the fact that in cases where relevant and exogenous instruments could be found (see, for instance, robberies of adults) tests did not show any indication of endogenous clearance rates.

4.3. Discussion of ratio bias

The crime data used stem from official crime statistics and correspondingly reflect only the volume of crime registered by police and not the actual incidence of crime. If there is a problem of dark figures (which could be substantial for most offence groups according to

victim studies, cf., e.g. Forschungsgruppe Baden-Wuerttemberg, 1998) both the crime rate and the clearance rate will be flawed by measurement errors, in the case of dependent variables (registered cases/ inhabitants) affecting the numerator and in the case of the explanatory variables (cleared cases / registered cases) the denominator. Thus, if, in accordance with the economic theory of crime, it is assumed that the actual effect of the clearance rate on the crime rate is negative, the constellation described above – also known as *ratio bias* – might lead to an exaggeration of the deterrent effect of clearance. Estimated coefficients of the sentence rate might likewise be influenced by the *ratio bias*. A possible reason can be seen in the 'redefinition'[30] of criminal cases in the course of the criminal prosecution process since information from the police is used for the crime rate in the numerator, and the sentencing rate (persons sentenced / suspects) is composed of both police statistics in the denominator and information from the courts in the numerator. If redefinition relating to certain offences is a quantitative problem, a potential for a spurious negative correlation between crime rate and sentencing rate arises because a high degree of redefinition simultaneously signifies higher crime rates and lower sentencing rates.

Griliches and Hausman (1986) present a method that estimates the extent of the measurement error problem in explanatory variables of panel data, and, where necessary, helps correcting potential inconsistencies. The intuitive element of this approach lies in the fact that the magnitude of the bias induced by the measurement error depends on the choice of estimation model. Estimations based on differenced data have the tendency to magnify the measurement error problem as a large amount of true information (*signal*) is removed from the data, resulting in the variance of differenced variables being characterised to a larger degree by measurement errors (*noise*) compared to variables in levels. Accordingly, differenced variables based on more distant time periods (X_t-X_{t-j}, with *j>1*) ought to contain more substantial information and are thus less influenced by measurement errors than variables in first differences. Accordingly, it is to be expected that estimated coefficients display diminishing biases when the time lag between current and past realisations of the variables increases. While Griliches and Hausman consider the case of measurement errors in explanatory variables, Levitt (1988a) extends the approach to the problem of the *ratio bias*

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[30] 'Redefinition' describes the process whereby the original police classification of an offence, which, in case of doubt, is based on assumption of the most serious circumstances, can be subject to another (generally less serious) classification at subsequent stages of the prosecution process (by public prosecutors or in court), such that a person who is a suspected murder in records documented by the police, for example, might eventually be documented as aggravated assault in statistics on convictions.

relevant to crime studies and arrives at the following formula for the asymptotic inconsistency of the coefficient of the deterrence variable of interest:[31]

(4.4)
$$\text{plim }\hat{\beta}_j - \beta = -\frac{\sigma_\gamma^2(1+\beta)}{\sigma_{a/c}^2(1-\rho^j)+\sigma_\gamma^2}$$

In the context of the present study, $\hat{\beta}_j$ refers to the estimator of β of the clearance and/or sentencing rate, σ_γ^2 is the variance of the registration rate (= 1-*dark figure*) or redefinition rate, $\sigma_{a/c}^2$ the variance and ρ the serial correlation of the true clearance and/or sentencing rate. From equation (4.4) it is clear that the measurement error problem does not necessarily lead – as is the case with Grilliches and Hausman – to some bias of the estimation coefficient towards zero, but rather that in the case of $0 > \beta > -1$ there is a negative bias of the already negative coefficients, resulting in an overestimation of the deterrent effect. However, the higher the time lag j is, the lower this bias becomes, assuming the likely case of some positive serial correlation of the clearance and sentencing rates. The coefficients of the suspected variables (for $0 > \beta > -1$) should, therefore, prove to be more strongly negative in an estimation model with first differences based on lag j=1 than in differenced models with j=2, and in a model with j=2 more strongly negative than in a model with j=3 etc.

Table 7 contains estimation results for clearance and sentencing rates obtained with models in ascending (j=1, 2, 3, 4, 8) time lags. Coefficients of the clearance rate diminishing across the estimates occur only for serious theft by adults. Surprisingly, the opposite result, i.e. increasing coefficients, appears for murder and manslaughter. The *ratio bias* could also be responsible for this result, for if the true coefficient of the clearance rate is smaller than '-1', the bias from equation (4.4) has a positive sign, such that the effects become more strongly negative when differences are based on a longer space of time – as observed here.[32] A further substantial explanation is found in the delayed reaction of the crime rate to changes in the clearance probability, for which Levitt (1998a, p. 358) offers two explanations; the information deficit of potential offenders and long-term prison sentences of repeat

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[31] Levitt (1998a) discusses the *ratio bias* using the example of the *arrest rate* in the USA. This study can be applied directly to the clearance and sentencing rates of the present study.

[32] For $\beta < -1$ (in addition to the presently less relevant case $\beta > 1$) the measurement error problem causes a corresponding distortion of $\hat{\beta}$ towards zero, as in Griliches and Hausman (1986).

offenders.[33] In the case of the sentencing rate it seems evident that the estimation results for aggravated assault and robbery by adults and for murder and manslaughter by juveniles are influenced by the *ratio bias*. Moreover, for rape and sexual harassment (adults) and for robbery (juveniles) steadily increasing coefficients are present, a fact which also points to *ratio bias*, in as far as the true coefficients are less than '-1'.

[Table 7 about here]

Summing up, with regard to the relevance of the *ratio bias* for the set of all 17 coefficients which were weakly significant (at the 10% significance level) according to the specification in first differences (Model 3), it can be maintained that the bias may have led to overestimations in 4 of the 17 coefficients of the clearance and sentencing rates, and in 4 cases to underestimations of the deterrent effect. In the 9 remaining cases there is no indication of *ratio bias*. Thus, the *ratio bias* does not represent a general problem, although it must be taken account of in individual cases.

5. Conclusions

This study comprises the first comprehensive analysis of the deterrent effect of criminal prosecution in the Federal Republic of Germany. 'Comprehensive' means that the entire criminal prosecution process from the police investigation to the judge's verdict is illustrated and analyzed using unique data, and is subsequently related to crime rates from six offence groups representing the 'classic crimes'. A further innovation is the separate assessment of adults and juveniles, for whom two distinct models of varyingly repressive sanctions are provided, the general penal code and the juvenile penal code. Several problems with potential detrimental influence on the quality of estimations ranging from the persistence of time series in crime panel data to simultaneity and measurement-error problems have been tested and addressed as comprehensively as possible.

The results show that a deterrent effect is exerted by the first two stages of the criminal prosecution process. Accordingly, a crime reducing impact would be obtained for higher clearance rates, in particular for crimes against property. The clearest results, however, are

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[33] "First, if criminals are poorly informed about the true likelihood of arrest, one might expect to observe a gradual change in criminal behavior in response to increased law enforcement. Second, if criminals are repeat offenders, the fact that some criminals arrested in one year are convicted and serve prison terms that run into the following year leads to a dependence of this year's crime rate on last year's arrest rate".

obtained for the sentencing rate, i.e. the product of the indictment rate and the conviction rate. Their effects prove to be significantly negative for crimes involving violence and property in the large majority of all tested specifications. Conversely, for the indicators of the severity of punishment (type and extent of punishment) no robust deterrent effects could be detected. Thus, as suggested by the theoretical framework of this article, the answer to the question 'Is being soft-on-crime the solution to rising crime rates?' is twofold: 'Being soft' by increasing the use of informal sanctioning does not seem to be a promising criminal policy, whereas 'being soft' by driving custodial sentences back in favor of non-custodial sentences proved to be successful, as no significant (adverse) effect from increasing the share of offenders being on probation or being fined on crime can be observed, while future costs due to increasing prison populations, stigmatization and accumulation of criminal capital have been avoided. This conclusion might support the prevailing opinion of many European criminologists and experts, in particular for juvenile crime. A more far-reaching hypothesis suggesting that the deterrent effect of criminal prosecution is generally marginal must, however, be abandoned.

Thus, a corresponding implication for European law-and-order policy is to be found in the recommendation of a critical examination of the social desirability of the increasing use of diversion by public prosecutors, i.e. of dropping cases for reasons of the so-called *expediency principle*. Against the background of high social costs of crime in general and currently rising costs due to aggravated assaults in particular (see general trends in Section 2), it is questionable whether this tendency of public prosecution is actually economically and socially expedient.

Thus, 'general deterrence' is capable of curbing crime rates, but just by a more rigorous application of existing penal laws rather than by reforms extending the severity of measures. The latter strategy, followed in the U.S., would bear the risk that the prison population increases without any effect of deterrence. However, criminalizing large parts of the population might cause some 'crime-bears-crime' problems, as peer effects and social interaction among inmates worsen future legal prospects of released offenders. Recidivism of a steadily growing group of repeat offenders, however, might *ceteris paribus* lead to permanent inflows into the criminal justice system and overloaded prison capacities. It seems as if the U.S. criminal policy is caught within such dynamics. European policy, on its part, should avoid the error of playing down the risk of its own vicious circle of (violent) crime. Cutting back some diversion reforms such as the exaggerated practice of dropping cases for reasons of expediency, for example, might prevent much harsher future measures that would

become necessary in response to public pressure when rates of violent crime are going to continue their current upward trend.

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FIGURES

Figure 1: Theft in Germany, 1963 - 2005
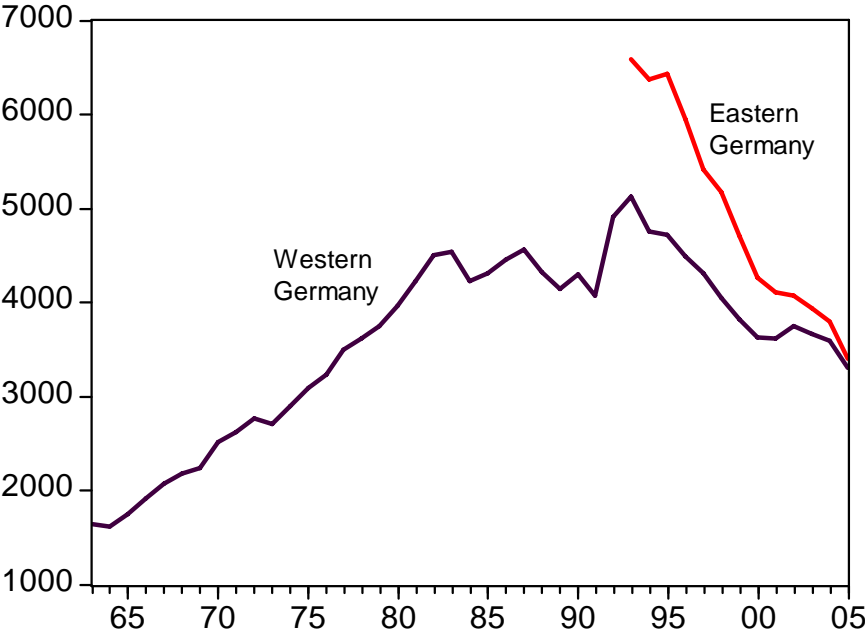
Notes: Reported cases of theft (serious theft plus petty theft) per 100,000 inhabitants; Source: GESIS-ZUMA (2007), PCS

Figure 2: Violent Crime in Germany, 1963 – 2005
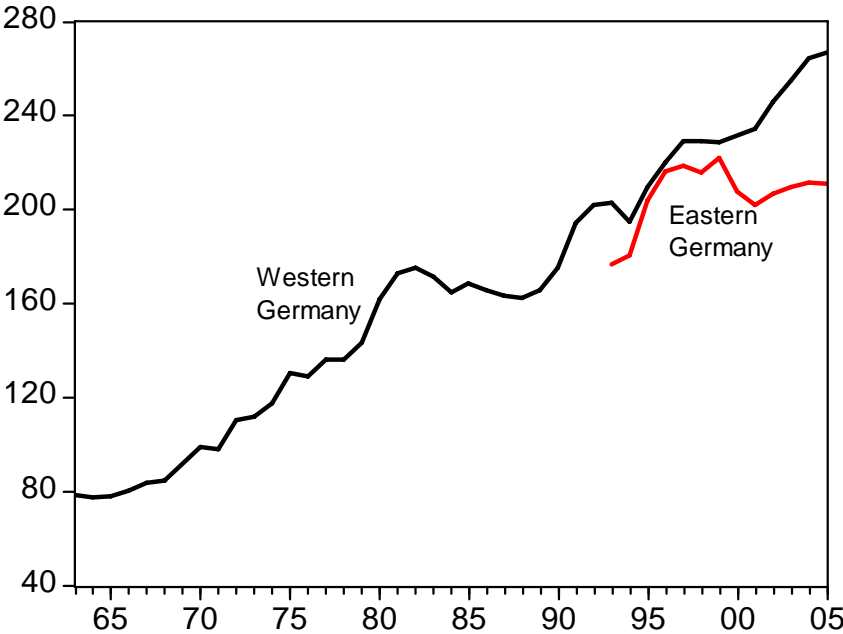
Notes: Reported cases per 100,000 inhabitants; violent crime summarizes murder/ manslaughter, rape and sexual offences, robbery and assault; Source: GESIS-ZUMA (2007), PCS

Figure 3: Serious theft by adults (21-60 years) in the federal states of former West Germany (except Berlin), 1977-2001
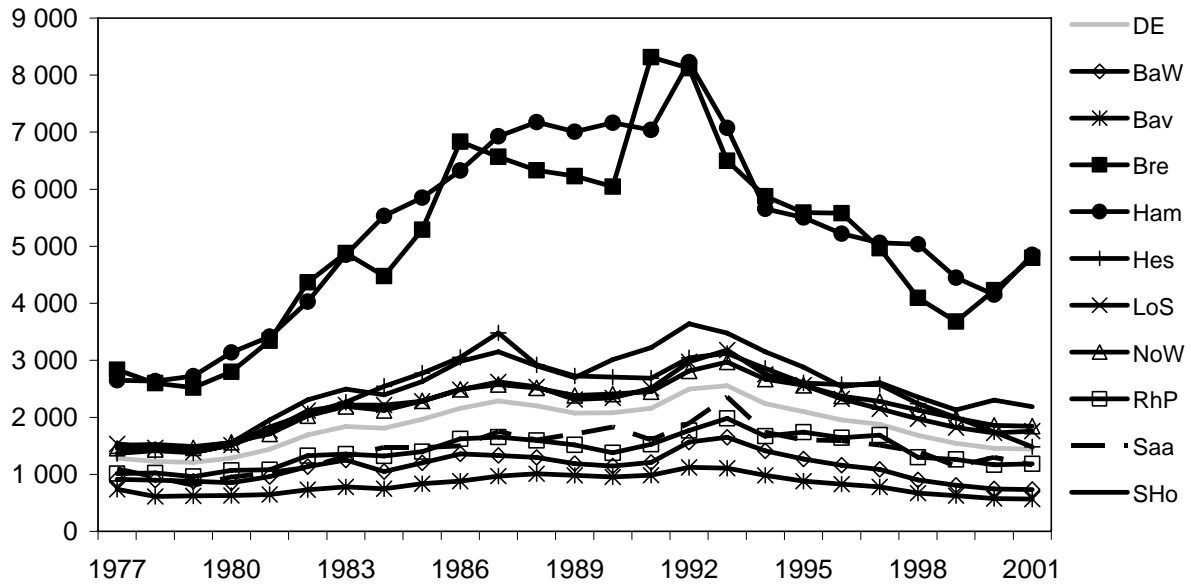
Notes: Cases per 100,000 inhabitants of the age group; presentation on the basis of PCS and Spengler (2004)

Figure 4: Clearance rate for serious theft in selected federal states of former West Germany 1977-2001
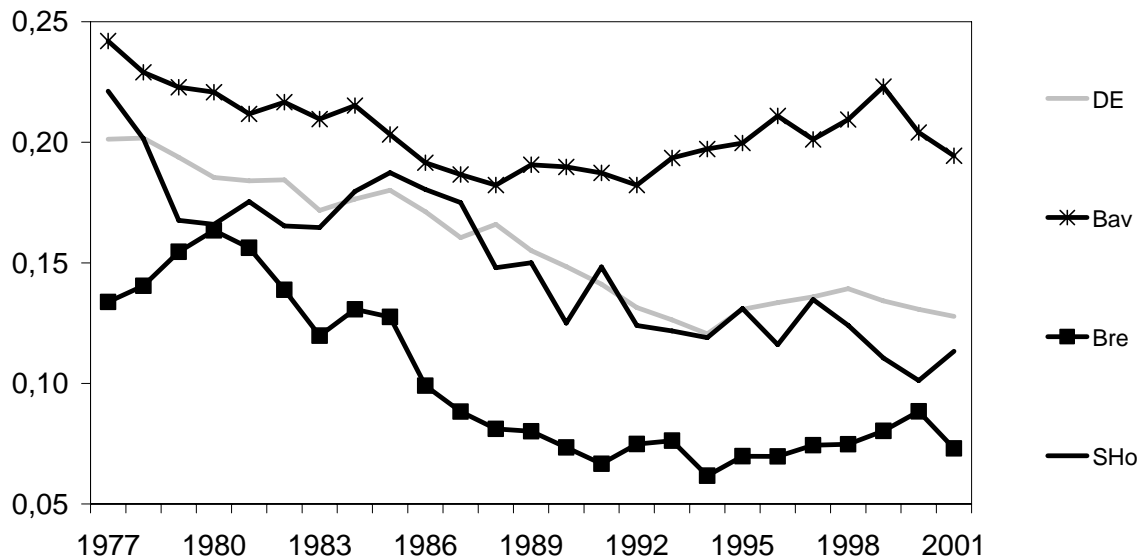
Notes: Solved cases as share of registered cases; presentation on the basis of PCS and Spengler (2004)

Figure 5: Sentencing of serious theft as subject to the general penal code (adults aged from 21 to under 60 years) in selected federal states of former West Germany 1977-2001
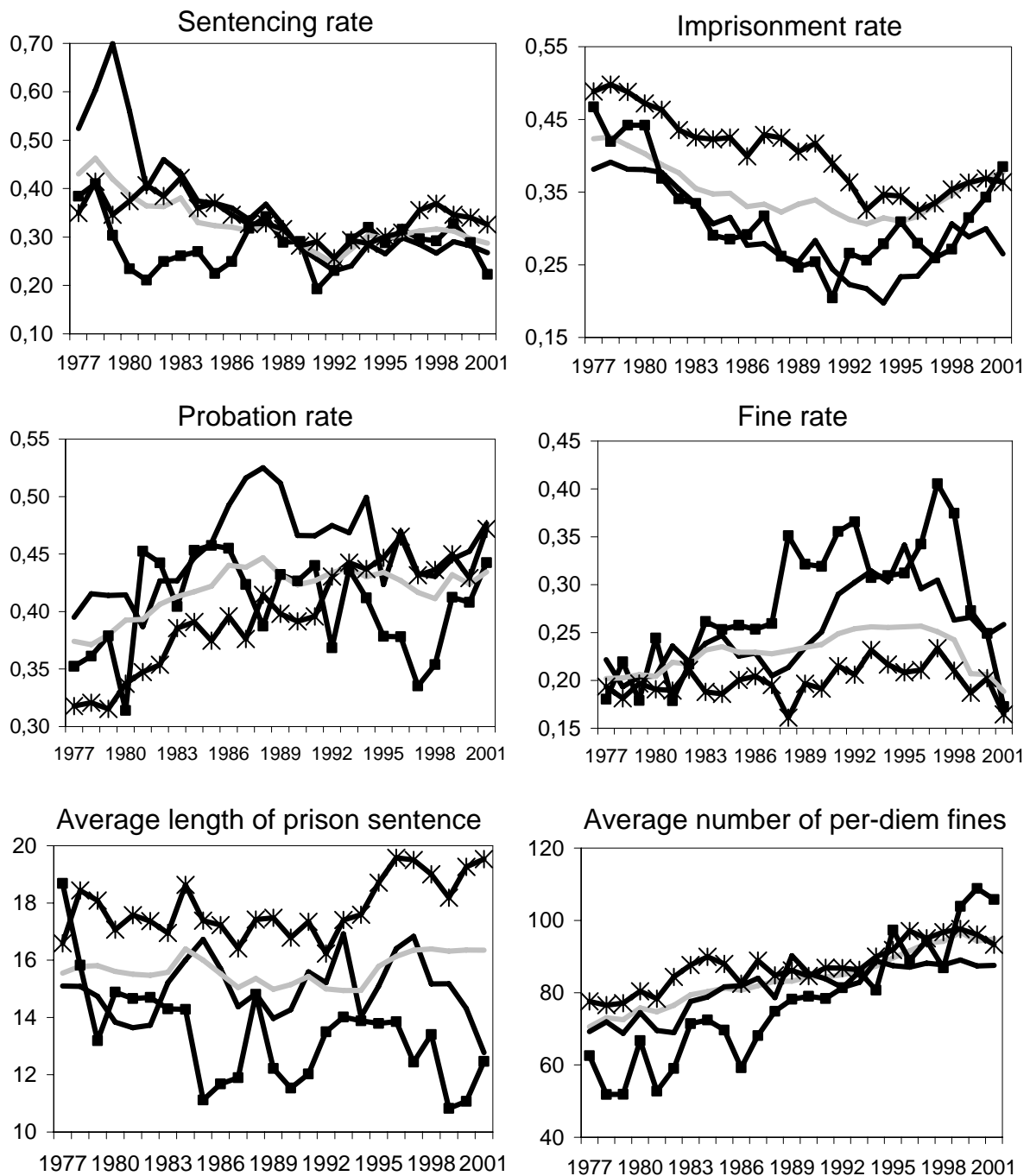
Notes: Presentation on the basis of PCS, StVStat and Spengler (2004) All rates are depicted as proportional values. For explanatory legend see Figure 4.

TABLES

Table 1: The development of the sanctioning practice in Western Germany, 1977 – 2001

	(1) Share of reported crimes cleared by the police (clearance rate)	(2) Share of suspects brought to court (indictment rate)	(3) Share of defendants convicted in a trial (conviction rate)	(4) Share of convicts with unconditional imprisonment (imprisonment rate)	(5) Share of convicts with prison sentence on probation (probation rate)	(6) Share of convicts with financial fine (fine rate)	(7) Share of adolescents (19-21) convicted according to adult penal law
Serious Theft							
1977-1981	19.3	46.5	85.2	41.1	38.2	20.7	13.5
1982-1986	17.7	44.0	83.3	35.1	42.0	22.9	9.2
1987-1992	15.0	37.4	80.3	32.7	43.4	23.9	7.1
1993-1997	12.9	36.1	81.0	31.6	42.9	25.5	9.9
1998-2001	13.3	35.4	81.3	36.3	42.5	21.1	10.1
Aggravated Assault							
1977-1981	86.2	35.1	64.0	10.1	20.9	69.0	29.7
1982-1986	85.6	34.7	63.4	11.2	23.9	64.8	20.2
1987-1992	84.0	31.2	61.1	10.6	24.3	65.1	15.8
1993-1997	83.5	30.3	63.4	10.4	29.2	60.4	15.7
1998-2001	85.0	30.4	63.6	14.7	49.7	35.5	10.8

Notes: Average rates (in percent) of listed time periods; rates of clearance, indictment and conviction refer to the total of all age groups (at least 14 years of age), rates of imprisonment, probation and fine refer to the adult penal law (21 years and older). Data sources: PCS and StVStat.

Table 2: Discretionary sanctioning practices at the state level: Bavaria versus Schleswig-Holstein

		Bavaria		Schleswig-Holstein	
		1977-1990	1991-2001	1977-1990	1991-2001
Sentencing rate	Murder/ Manslaughter	28.0	28.0	23.0	27.4
	Rape and indecent ass.	29.7	28.8	24.3	21.1
	Robbery	29.3	29.1	30.8	25.6
	Aggravated assault	19.5	19.7	19.4	14.2
	Petty theft	37.0	38.1	46.4	26.4
	Serious theft	35.9	31.6	43.5	27.0
Imprisonment rate	Murder/ Manslaughter	93.8	93.4	93.1	95.1
	Rape and indecent ass.	60.3	55.0	54.0	49.5
	Robbery	72.6	63.5	64.2	48.0
	Aggravated assault	12.0	14.0	10.4	10.6
	Petty theft	8.6	7.2	3.8	2.8
	Serious theft	44.2	35.2	32.7	25.2
Expected length of imprisonment (in months)	Murder/ Manslaughter	23.2	25.4	19.6	24.5
	Rape and indecent ass.	5.1	5.7	3.0	3.1
	Robbery	5.4	4.9	4.3	2.4
	Aggravated assault	0.26	0.40	0.23	0.20
	Petty theft	0.10	0.08	0.05	0.02
	Serious theft	0.58	0.41	0.38	0.13

Notes: Rates are adjusted for changes in the structure of the German residential population and restricted to the age group of 21 to under 60 years (see the text for details); entries represent averages of denoted time periods in per cent. Sentencing rate = (indictment rate) x (conviction rate); expected length of imprisonment = (clearance rate) x (indictment rate) x (conviction rate) x (imprisonment rate) x (average length of imprisonment).

Table 3: The influence of P(prison| arrest)$_x$ on crime category 'x' in simple panel regressions

	log(crime$_C$)	log(crime$_C$)	log(crime$_C$)	log(crime$_C$)	Δ log(crime$_C$)
	(1)	(2)	(3)	(4)	(5)
log P(prison| arrest)$_C$:					
• Murder/ manslaughter	-0.378[**] (0.173)	-0.411[**] (0.043)	-0.234[**] (0.042)	-0.246[**] (0.043)	-0.234 (0.031)[**]
• Rape	0.077 (0.120)	-0.529[**] (0.062)	-0.102[**] (0.033)	-0.122[**] (0.031)	-0.151[**] (0.022)
• Robbery	-1.411[**] (0.254)	-1.326[**] (0.117)	-0.685[**] (0.064)	-0.234[**] (0.047)	-0.129[**] (0.029)
• Aggravated Assault	0.201 (0.114)	-0.366[**] (0.042)	-0.079[**] (0.027)	-0.112[**] (0.026)	-0.056[**] (0.015)
• Petty theft	-0.294[**] (0.050)	-0.267[**] (0.051)	-0.142[**] (0.020)	0.010 (0.021)	-0.191[**] (0.024)
• Serious theft	-0.810[**] (0.098)	-0.746[**] (0.106)	-0.635[**] (0.038)	-0.174[**] (0.037)	-0.305[**] (0.040)
Panel data	no	yes	yes	yes	yes
State effects	no	no	yes	yes	no
Year effects	no	no	no	yes	no
Growth rates of P(prison| arrest)	no	no	no	no	yes
No of obs.	25	242	242	242	232

Notes: Columns (1) to (5) cover 30 bivariate regressions (6 categories, 5 different econometric specifications) with crime category 'C' on the left-hand side and the corresponding probability of prison given arrest on the right-hand side of each equation; entries present estimated crime-specific coefficients and asymptotic standard errors (in parentheses) on P(prison| arrest) in time series (equation (1)) and panel regressions (equations (2)-(5)) of the period 1977 – 2001 and West German states (without Berlin); specifications in (1) to (4) use log-log specifications, estimations in column (5) are based on growth rates. F-tests confirm the existence of included fixed and period effects. [**]) denotes significance at the conventional 1%-significance level.

Table 4: Regression results for serious theft

Explanatory variables	Adults			Juveniles		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Lagged dep. var.	.4960** (.0520)	.4507** (.0802)	–	.5977** (.0553)	.6368** (.0621)	–
Clearance rate	-1.322** (.2003)	-.9829** (.2612)	-1.507** (.3568)	-1.083** (.3120)	-.2993 (.3333)	-.7323 (.4513)
Sentencing rate	-.6062** (.0824)	-.2935** (.1116)	-.8269** (.1560)	-.4099** (.1297)	-.0207 (.1221)	-.6336** (.1427)
Probation rate	.4396* (.1781)	.3562 (.2034)	.3632 (.2246)	.4986 (.3253)	.1198 (.2739)	.1966 (.2751)
Fine rate	-.0094 (.2806)	-.0014 (.2424)	.3055 (.3052)	–	–	–
Rate of educational and disciplinary measures	–	–	–	.7211** (.2534)	.1140 (.2262)	.4938* (.2252)
ln(length of imprisonment)	-.1204 (.0635)	-.1603* (.0642)	.0109 (.0757)	.0898 (.0826)	-.0733 (.0684)	.1262 (.0730)
ln(number of per-diem fines)	.0597 (.0715)	.0759 (.0726)	-.1106* (.0546)	–	–	–
ln(per-capita GDP)	-.3357* (.1548)	-.0562 (.1450)	-.5498 (.2942)	.2692 (.1842)	.0421 (.2785)	.5230 (.4517)
Unemployment rate	1.576* (.6168)	1.907** (.6040)	1.327 (1.829)	1.680* (.7834)	1.401 (.8375)	1.438 (1.582)
Rate of migrants	.3269 (.7722)	.1622 (.8004)	-2.420 (2.042)	-.5431 (.9115)	.0313 (.9723)	-2.426 (1.867)
Testing exclusion of instruments	.2399	.6512	.0018	.1719	.3440	.0001
Testing overidentifying restrictions	.0498	.2679	.0999	.0360	.0192	.0833
Endogeneity test of clearance rate	.057	.375	.123	.232	.924	.963
Number of observations	232	235	232	234	237	234
R^2	.9930	.9909	.6769	.9863	.9837	.4551

Notes: Calculations on the basis of PCS, StVStat and Spengler (2004). All estimations contain state-specific constants and time dummies (two-way fixed effects), heteroskedasticity and autocorrelation-robust standard errors in parentheses. '**' and '*' represent significance at the 1% and 5% level, respectively. At the bottom of the table the p-values of three standard tests in the context of IV regressions are provided. The tests are needed because for a 2SLS approach to be valid, the instruments have to be correlated with the endogenous explanatory variable and at the same time uncorrelated with the error term of the IV regression. But even if the former requirements are met the IV approach should only be used if the presumed endogenous explanatory variable is indeed endogenous because the 2SLS estimator is less efficient than OLS if the explanatory variables are exogenous. Following this logic the test of excluded instruments is the F-test of whether the four (potential) instruments are jointly significant in the first-stage regression of a 2SLS model, i.e. if the instruments are relevant determinants of the clearance rate. The Hansen-Sargan test of overidentifying restrictions has the joint null hypothesis that the instruments are valid instruments, i.e., uncorrelated with the error term, and that the excluded instruments are correctly excluded from the estimated equation. Under the null, the test statistic is distributed as chi-squared in the number of overidentifying restrictions. A rejection casts doubt on the validity of the instruments. The endogeneity test of the clearance rate is performed as a simple regression test recommended by Wooldridge (2002). In a first step the clearance rate is regressed on all exogenous variables (including those in the structural, i.e. crime, regression and the additional IVs) and the residuals (e_hat_clearance) are extracted. In a second step we add e_hat_clearance to the crime regression (which also includes the clearance rate) and test for significance of e_hat_clearance using OLS. If the coefficient on e_hat_clearance (indicated by the t-statistics) is statistically different from zero, we conclude that the clearance rate is indeed endogenous.

Table 5: Regression results for aggravated assaults

Explanatory variables	Adults			Juveniles		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Lagged dep. var.	.5975** (.0527)	.6927** (.0598)		.6422** (.0488)	.6932** (.0551)	
Clearance rate	-.2408 (.2654)	.2956 (.3008)	-.1138 (.5130)	-1.024** (.3902)	.1708 (.4570)	-1.585** (.5629)
Sentencing rate	-1.876** (.2586)	-.0333 (.2811)	-1.602** (.2368)	-.6476** (.1058)	-.0668 (.1411)	-.5337** (.1101)
Probation rate	.0200 (.2128)	-.0416 (.2305)	.1000 (.2617)	-.5421 (.3109)	.5188 (.3182)	-.7118** (.2568)
Fine rate	.0469 (.1886)	-.2189 (.2143)	.3135 (.2603)	–	–	–
Rate of educational and disciplinary measures	–	–	–	-.5239* (.2258)	.3288 (.2439)	-.5240* (.2074)
ln(length of imprisonment)	.0873** (.0296)	.0649 (.0369)	.0245 (.0249)	-.0324 (.0374)	.0093 (.0409)	-.0229 (.0286)
ln(number of per-diem fines)	.0797 (.0771)	.0925 (.0851)	-.0536 (.1053)	–	–	–
ln(per-capita GDP)	-.0260 (.1702)	-.0632 (.1509)	-.0720 (.2648)	.5207* (.2508)	.1336 (.3241)	.4335 (.4581)
Unemployment rate	-1.247* (.5343)	-.7293 (.5016)	-1.078 (1.386)	1.336 (.9644)	1.380 (1.198)	.4646 (1.703)
Rate of migrants	2.431** (.7178)	.0011 (.9175)	.0023 (1.610)	-1.285 (1.276)	-1.971* (.9481)	2.121 (2.563)
Testing exclusion of instruments	.1120	.1037	.0071	.000	.0100	.0025
Testing overidentifying restrictions	.0804	.4541	.3274	.8514	.7393	.4131
Endogeneity test of clearance rate	.693	.431	.154	.841	.275	.464
Number of observations	232	235	232	227	231	225
R^2	.9666	.9551	.3372	.9812	.9777	.3252

Notes: See Table 4.

Table 6: Proportion (in %) of significant coefficients on deterrence indicators, by type of offence, age-group and concordance with the economic theory of crime

	Violent offences				Property offences			
	Adults		Juveniles		Adults		Juveniles	
	pro	contra	pro	contra	pro	contra	Pro	contra
Clearance rate	33 (50)	0	33 (50)	0	67 (50)	0	56 (50)	11 (17)
Sentencing rate	67 (100)	0	67 (100)	0	78 (100)	0	56 (83)	0
Probation rate	0	0	0	11 (17)	11 (17)	0	0	0
Fine rate	0	0	–	–	17 (25)	0	–	–
Juvenile educ./correc. rate	–	–	33 (50)	33 (50)	–	–	33 (50)	0
Length of imprisonment	0	11 (17)	0	11 (17)	11 (0)	0	0	0
Number of per-diem fines	0	0	–	–	17 (25)	0	–	–

Notes: Calculations on the basis of PCS, StVStat and Spengler (2004). Figures represent percentage of estimated coefficients that confirm ('pro') or contradict ('contra') theoretically expected signs (see Section 2) of the deterrence hypothesis (at least) at the 5% significance level. Entries summarize econometric Models 1 to 3, and Models 1 and 3 (in parentheses), respectively. Sentencing to fines is applied for adults only, and educational/correctional measures are limited to the juvenile penal law.

Table 7: Estimation coefficients for clearance and sentencing rates from models in differences with increasing time lags (*ratio bias* tests)

	Adults					Juveniles				
	j=1	J=1	j=3	j=4	j=8	j=1	j=1	j=3	j=4	j=8
Clearance rate										
Murder and manslaughter	-.597**	-.637**	-.704**	-.774**	-.975**	-.932	-2.40**	-3.14***	-3.26***	-4.71**
	(.294)	(.309)	(.335)	(.356)	(.480)	(.812)	(1.00)	(1.17)	(1.11)	(2.26)
Rape and indecent assault	-.491***	-.459***	-.418***	-.410**	-.593***	.381	.545	.540	.731	1.19
	(.130)	(.129)	(.145)	(.173)	(.192)	(.397)	(.430)	(.532)	(.635)	(.832)
Aggravated assault	-.114	-.322	-.334	-.304	-.123	-1.59***	-1.45**	-1.44**	-1.45*	-1.04
	(.513)	(.589)	(.604)	(.626)	(.652)	(.563)	(.590)	(.689)	(.788)	(1.08)
Robbery	-.269	-.353	-.398	-.369	-.229	-.379	-.270	-.132	-.017	-.437
	(.187)	(.215)	(.246)	(.266)	(.302)	(.475)	(.510)	(.514)	(.528)	(.551)
Serious theft	-1.51***	-1.37***	-1.28***	-1.18***	-.449	-.732	-.023	.366	.643	1.69***
	(.357)	(.387)	(.413)	(.439)	(.552)	(.451)	(.479)	(.494)	(.515)	(.596)
Petty theft	.015	-.024	-.060	-.109	-.233	.663**	.592*	.403	.225	-.228
	(.211)	(.252)	(.276)	(.288)	(.328)	(.296)	(.348)	(.369)	(.373)	(.418)
Sentencing rate										
Murder and manslaughter	-1.07***	-1.04***	-1.06***	-1.10***	-1.39***	-1.13***	-1.10***	-.969***	-.878***	-.605
	(.107)	(.119)	(.127)	(.133)	(.269)	(.149)	(.164)	(.188)	(.232)	(.376)
Rape and indecent assault	-.866***	-.940***	-.974***	-.980***	-1.09***	-1.02***	-1.08***	-1.12***	-1.09***	-1.20***
	(.091)	(.091)	(.102)	(.115)	(.131)	(.104)	(.124)	(.144)	(.159)	(.223)
Aggravated assault	-1.60***	-1.52***	-1.48***	-1.45***	-1.20***	-.534***	-.554***	-.557***	-.563***	-.691***
	(.237)	(.228)	(.218)	(.210)	(.199)	(.110)	(.136)	(.162)	(.183)	(.259)
Robbery	-.577***	-.536***	-.519***	-.494***	-.328**	-.878***	-.962***	-1.02***	-1.06***	-1.10***
	(.173)	(.152)	(.157)	(.158)	(.152)	(.140)	(.132)	(.140)	(.145)	(.152)
Serious theft	-.827***	-.835***	-.825***	-.811***	-.577**	-.634***	-.697***	-.700***	-.695***	-.638***
	(.156)	(.154)	(.167)	(.179)	(.219)	(.143)	(.147)	(.155)	(.165)	(.230)
Petty theft	-.673***	-.739***	-.735***	-.746***	-.878***	-.579***	-.791***	-.852***	-.894***	-.839**
	(.137)	(.148)	(.148)	(.151)	(.134)	(.202)	(.244)	(.258)	(.273)	(.361)

Notes: Calculations on the basis of PCS, StVStat and Spengler (2004). All estimations contain state-specific constants and time dummies (two-way fixed effects), heteroskedasticity and autocorrelation-robust standard errors in parentheses. '***', '**' and '*' represent significance at the 1%, 5% and 10% level.

APPENDIX

Proof of results provided in Section 2.

a) Maximize expected utility:

(A1) $\quad E\left(U\right) = p(1-p_{s|c})\, U\left[A + L^b\left(t_\ell\right) + G\left(t_i\right)\right] + p\, p_{s|c} U\left[A + G\left(t_i\right) - F\left(t_i\right)\right]$

$\qquad + \left(1-p\right) U\left[A + L\left(t_\ell\right) + G\left(t_i\right)\right]$

Thus, three different payoffs need to be distinguished. Define

$$Y_1 = A + L\left(t_\ell\right) + G\left(t_i\right)\ ,\ Y_2 = A + L^b\left(t_\ell\right) + G\left(t_i\right)\ ,\ Y_3 = A + G\left(t_i\right) - F\left(t_i\right)$$

Using the implicit function theorem, we first define

$$E_i = \frac{\partial\, E\left(U\right)}{\partial t_i} = p\left(1-p_{s|c}\right) U'\left(Y_1\right) G'\left(t_i\right) + p\, p_{s|c}\, U'\left(Y_2\right)\left[G'\left(t_i\right) - F'\left(t_i\right)\right]$$

$$+\left(1-p\right) U'\left(Y_3\right) G'\left(t_i\right) = 0$$

The second-order condition is

(A2) $\quad E_{ii} = p(1-p_{s|c})U''\left(Y_1\right)G'\left(t_i\right)^2 + p(1-p_{s|c})\, U'\left(Y_1\right) G''\left(t_i\right)$

$$+ p\, p_{s|c}\, U''\left(Y_2\right)\left[G'\left(t_i\right) - F'\left(t_i\right)\right]^2 + pp_{s|c}\, U'\left(Y_2\right)\left[G''\left(t_i\right) - F''\left(t_i\right)\right]$$

$$+\left(1-p\right)U''\left(Y_3\right) G'\left(t_i\right)^2 +\left(1-p\right)U'\left(Y_3\right) G''\left(t_i\right)$$

$E_{ii} < 0 \qquad \Leftrightarrow$ assumptions I to III hold, i.e.

- $U'' < 0$
- $G''\left(t_i\right) < 0$
- $F''\left(t_i\right) > 0$

b) The effect of detection and conviction:

$$\frac{\partial t_i}{\partial p} = -\frac{\dfrac{\partial E_i}{\partial p}}{\dfrac{\partial E_i}{\partial t_i}} = -\frac{\left(1-p_{s|c}\right)U'\left(Y_1\right)G'\left(t_i\right) + p_{s|c}U'\left(Y_2\right)\left[G'\left(t_i\right) - F'\left(t_i\right)\right] - U'\left(Y_3\right)G'\left(t_i\right)}{E_{ii}}$$

$$\text{(A3)} \qquad = -\frac{G'(t_i)\big((1-p_{s|c})U'(Y_1)-U'(Y_3)\big)+p_{s|c}U'(Y_2)(G'(t_i)-F'(t_i))}{E_{ii}}$$

$$\frac{\partial t_i}{\partial p}<0 \qquad \Leftrightarrow$$

- $G'(t_i)-F'(t_i)<0$ \qquad (assumption IV)

- $Y_3-Y_1=L(t_\ell)-L^b(t_\ell)>0 \quad \Rightarrow \quad (1-p_{s|c})U'(Y_1)-U'(Y_3)<0$

  (assumption of 'stigma')

Properties (2.6) follow from (A3).

c) The effect of non-custodial sentencing:

$$\frac{\partial t_i}{\partial(1-p_{s|c})}=-\frac{\dfrac{\partial E_i}{\partial(1-p_{s|c})}}{E_{ii}}=-\frac{pU'(Y_1)G'(t_i)-pU'(Y_2)[G'(t_i)-F'(t_i)]}{E_{ii}}$$

$$=-\frac{(+)-(-)}{(-)}>0$$

Again, the unambiguous sign depends on the validity of Assumption IV.

d) Finally, the crime reducing effect of the gap $L(t_\ell)-L^b(t_\ell)$ ('stigma') is obvious from (A1) and from $E_{ii}<0$.

Table A1: Descriptive statistics of offence-specific variables

Variable	Murder and Manslaughter			Rape and Indecent Assault			Aggravated Assault			Robbery			Serious Theft			Petty Theft		
	M. v.	Std. dev.	Range	M. v.	Std. dev	Range	M. v.	Std. dev	Range	M. v.	Std. dev.	Range	M. v.	Std. dev	Range	M. v.	Std. dev.	Range
Crime rate$_{[21-60]}$	7.01	2.9	2.45-23.6	24.0	9.48	10.5-52.2	143	48.7	82.9-285	68.8	59.7	16.7-331	2436	1675	567-8315	1973	769	1034-4816
Crime rate$_{[14-18]}$	4.93	4.50	0-36.8	34.6	18.3	0-170	375	256	81.1-1296	441	686	58.8-3736	14755	10276	3918-48444	7422	3042	3777-17461
Clearance rate	.939	.039	.740-1	.684	.066	.469-.846	.839	.050	.671-.934	.492	.076	.291-.651	.155	.048	.062-.281	.471	.056	.327-.577
Sentencing rate$_{[21-60]}$	.262	.107	.038-.833	.270	.072	.104-.600	.180	.034	.102-.292	.293	.059	.121-.509	.334	.082	.193-.699	.364	.073	.199-.614
Imprisonment rate$_{[21-60]}$	.908	.063	.667-1	.543	.080	.235-.767	.108	.030	.017-.248	.622	.083	.346-.802	.347	.060	.197-.535	.053	.017	.019-.096
Probation rate$_{[21-60]}$	.081	.057	0-.333	.436	.080	.219-.700	.282	.107	.116-.647	.362	.082	.193-.635	.426	.046	.306-.578	.093	.024	.050-.169
Fines rate$_{[21-60]}$	.011	.031	0-.25	.021	.021	0-.118	.610	.122	.238-.822	.015	.013	0-.095	.227	.047	.114-.405	.854	.036	.766-.923
Length of imprisonment$_{[21-60]}$	91.9	13.6	48-143	39.7	7.39	23.2-79	14.9	3.00	5.25-24.1	42.0	6.33	22.6-61.4	15.6	1.86	10.8-21.9	6.79	1.21	4.08-10.8
Number of per-diem fines$_{[21-60]}$	–	–	–	–	–	–	60.8	19.5	30.6-107	–	–	–	82.8	9.82	51.8-109	26.8	5.71	14.7-41.3
Sentencing rate$_{[14-18]}$	.346	.309	0-1	.326	.182	0-1	.269	.116	.031-.640	.400	.151	.075-.96	.303	.120	.038-.580	.194	.110	.005-.442
Imprisonment rate$_{[14-18]}$	.893	.132	0-1	.313	.131	0-1	.082	.039	0-.292	.315	.096	.103-.691	.145	.046	.057-.402	.042	.024	.012-.144
Probation rate$_{[14-18]}$	.099	.126	0-1	.424	.142	0-1	.149	.057	0-.370	.394	.081	.051-.639	.209	.055	.036-.359	.063	.032	.008-.206
Disciplinary means rate$_{[14-18]}$	.006	.036	0-.375	.222	.123	0-.6	.682	.108	.290-.906	.250	.104	.033-.606	.553	.108	.240-.768	.732	.149	.268-.930
Corrective means rate$_{[14-18]}$	.002	.015	0-.167	.041	.064	0-.444	.087	.077	0-.442	.041	.047	0-.277	.094	.076	0-.369	.164	.126	0-.524
Length of imprisonment$_{[14-18]}$	68.5	11.0	27.6-90	29.2	8.82	6-90	18.4	3.87	6.5-32	25.6	5.20	13.8-42.8	18.7	2.68	10.8-26.6	15.8	3.17	8.4-48.8
Proportion of attempts	.674	.100	.218-.873	.351	.085	.153-.554	.064	.019	.026-.112	.210	.033	.112-.304	.173	.030	.091-.249	.016	.005	.009-.052
Crime scenes < 20 thou. inhabitants	.289	.189	0-.645	.261	.174	0-.566	.246	.163	0-.526	.157	.110	0-.369	.246	.162	0-.532	.230	.157	0-.466
Crime scenes 20 thou.-100 thou. inhabitants	.245	.143	0-.556	.251	.145	0-.612	.234	.134	0-.458	.243	.140	0-.513	.258	.147	0-.504	.261	.148	0-.525
Crime scenes 100 thou.–500 thou. inhabitants	.203	.108	0-.465	.210	.105	0-.578	.237	.114	0-.439	.265	.129	0-.499	.205	.096	0-.352	.222	.099	0-.345
Crime scenes >= 500 thou. inhabitants	.259	.325	0-1	.273	.321	0-.974	.283	.327	0-.998	.333	.318	.220-.996	.289	.336	0-.998	.277	.323	0-.990

Notes: Calculations on the basis of PCS, StVStat and Spengler (2004). The crime rates of adults and juveniles are defined as: the (approximate) number of registered cases from the respective age group / 100,000 inhabitants of the respective age-group. The length of adult and juvenile prison sentences is given in months, and the number of per-diem fines in days. All other variables are proportional values. The prosecution indicators subject to the general penal code and juvenile penal code (especially the minima and maxima) can stand in contradiction to the statutory minimum and maximum sentence. As the StVStat applies only to the violated statute, the minima can lie under the minimum sentence. The maxima can lie above the maximum sentence since in the formation of concurrent sentences, which are the result of one person receiving several concurrent sentences for different offences (committed in conjunction with others), the only statistically registered offence is the one punished with the most severe sentence.

Table A2: Descriptive statistics of socioeconomic variables

Variable	Mean	Standard deviation	Minimum	Maximum
Real per-capita GDP	22,972	5,734	14,892	40,968
Unemployment rate	.086	.032	.021	.168
Foreign-national rate	.079	.032	.029	.176

Notes: Calculations on the basis Statistisches Bundesamt (various issues).

Table A3: *Unit root* tests of dependent variables (p-values)

ln([Offence] / 100.000 inhabitants)	Variants	Adults		Juveniles	
		Levels	1st Differences	*Levels*	*1st Differences*
Murder and manslaughter	1	0	0	*0*	*0*
	2	0	0	*0*	*0*
	3	0	0	*0*	*0*
	4	0	0	*0*	*0*
Rape and indecent assault	1	0	0	*0*	*0*
	2	0	0	*0*	*0*
	3	.049	0	*0*	*0*
	4	0	0	*0*	*0*
Aggravated and grievous bodily harm	1	.020	0	*.003*	*0*
	2	.042	0	*0*	*0*
	3	.108	0	*.062*	*0*
	4	.539	0	*.045*	*0*
Robbery	1	0	0	*.053*	*0*
	2	0	0	*.002*	*0*
	3	.110	0	*.284*	*0*
	4	.200	0	*.152*	*0*
Serious theft	1	.005	0	*.012*	*0*
	2	.094	0	*.125*	*0*
	3	.024	0	*.010*	*0*
	4	.106	0	*.547*	*0*
Petty theft	1	.029	0	*.001*	*0*
	2	.006	0	*.011*	*0*
	3	.114	0	*.021*	*0*
	4	.216	0	*.659*	*0*

Notes: Calculations on the basis of PCS, StVStat and Spengler (2004). The table contains p-values of the Im, Pesaran and Shin (2003) *unit root* tests applied for all dependent variables of the analysis – logarithmic crime rates in columns with the heading 'Levels' and first differences of the logarithmic crime rates in columns headed '1st Differences'. Results are obtained using the Stata™ routine *ipshin* (Bornhorst and Baum 2001). The null hypothesis of the test is the non-stationarity of considered variables. Possible gaps in the time-series were closed using interpolation or extrapolation of the values since the test used is applicable to "balanced" panels only. Test variants 1 to 4 correspond to Dickey Fuller (DF) tests without trend (variant 1), DF tests with trend (variant 2), augmented Dickey Fuller test with lag=1, i.e. ADF(1) test, without trend (variant 3) and ADF(1) tests with trend (variant 4).

Table A4: Regression results for murder and manslaughter

Explanatory variables	Adults			Juveniles		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Lagged dep. var.	.3604** (.0590)	.3765** (.0849)	–	–	–	–
Clearance rate	-.5035 (.4159)	.6266 (.4522)	-.5974* (.2940)	-1.795* (.8705)	-.3031 (1.321)	-.9324 (.8118)
Sentencing rate	-1.128** (.1331)	.1595 (.2204)	-1.068** (.1074)	-1.074** (.1148)	.0208 (.1405)	-1.133** (.1488)
Probation rate	-.1484 (.2022)	.3175 (.2230)	-.1921 (.1266)	-.0194 (.1707)	.3918 (.3245)	-.2341 (.2246)
ln(length of imprisonment)	.0310 (.1210)	.0376 (.0901)	.0510 (.0853)	.1104 (.1707)	-.1808 (.1891)	.4470* (.1803)
ln(per-capita GDP)	-1.100* (.4753)	-.5973 (.4440)	-1.545* (.7280)	1.331 (.7241)	.3161 (.9610)	1.790 (2.044)
Unemployment rate	1.328 (1.925)	2.406 (1.723)	.9681 (2.732)	8.632** (2.406)	-1.408 (3.924)	12.01 (8.111)
Rate of migrants	2.141 (2.067)	2.825 (1.853)	3.928 (4.373)	9.135* (4.360)	15.77** (5.204)	-2.731 (11.00)
Testing exclusion of instruments	.3064	.6140	.6280	.3278	.2786	.0324
Testing overidentifying restrictions	.7652	.7712	.9967	.8392	.9078	.4995
Endogeneity test of clearance rate	.000	.089	.035	.002	.930	.683
Number of observations	232	235	232	193	186	159
R^2	.8471	.7884	.3226	.6695	.4809	.4854

Notes: Financial fines and disciplinary/correctional measures do not apply for murder and manslaughter; otherwise, see Table 4.

Table A5: Regression results for rape and indecent assault

	Adults			Juveniles		
Explanatory variables	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Lagged dep. var.	.4511** (.0761)	.5029** (.0872)		.3047** (.0589)	.3324** (.0934)	
Clearance rate	-.4780* (.1953)	.1756 (.2051)	-.4906** (.1302)	-.4218 (.4649)	.4175 (.5827)	.3811 (.3969)
Sentencing rate	-.9075** (.1327)	.2752 (.1896)	-.8660** (.0905)	-1.065** (.1287)	.3382 (.1785)	-1.018** (.1036)
Probation rate	.0513 (.1248)	.0917 (.1347)	.0490 (.0996)	.1997 (.1509)	.1200 (.1714)	.0812 (.1194)
Rate of educational and disciplinary measures	–	–	–	.9137** (.1723)	-.1747 (.2171)	.7455** (.1397)
ln(length of imprisonment)	-.0732 (.0682)	-.1206 (.0629)	.0338 (.0561)	-.0360 (.0602)	-.0011 (.0523)	-.0040 (.0547)
ln(per-capita GDP)	-.1600 (.2230)	-.0262 (.2347)	-.4939 (.4588)	-.7788 (.4408)	-.3834 (.7228)	-.5949 (.8966)
Unemployment rate	1.336 (.7492)	.9409 (.7302)	1.532 (1.576)	1.158 (1.918)	.7547 (2.249)	6.424 (3.955)
Rate of migrants	-1.132 (.7915)	-.7947 (.8179)	-3.185 (2.130)	1.478 (2.489)	4.598 (3.173)	-12.54 (6.710)
Testing exclusion of instruments	.0342	.0272	.0925	.0407	.0799	.0390
Testing overidentifying restrictions	.8943	.5477	.5087	.0395	.7668	.9174
Endogeneity test of clearance rate	.975	.532	.672	.701	.180	.595
Number of observations	232	235	232	219	221	209
R^2	.9377	.9221	.3662	.7610	.6381	.4454

Notes: Fines do not apply for rape; otherwise, see Table 4.

Table A6: Regression results for robbery

Explanatory Variables	Adults			Juveniles		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Lagged dep. var.	.6347** (.0498)	.6237** (.0573)		.6810** (.0554)	.5932** (.0635)	
Clearance rate	-.4029* (.1741)	-.4701* (.1980)	-.2689 (.1865)	-1.347** (.4191)	-1.609** (.4435)	-.3787 (.4748)
Sentencing rate	-.7656** (.1828)	-.0308 (.1558)	-.5773** (.1728)	-.9313** (.1460)	-.1345 (.1438)	-.8779** (.1402)
Probation rate	-.1989 (.1077)	.1927 (.1168)	-.1562 (.0982)	-.0686 (.1631)	-.3161 (.1911)	.0492 (.1759)
Rate of educational and disciplinary measures	–	–	–	.4084 (.2303)	.0249 (.1969)	.4832* (.2379)
ln(length of imprisonment)	.0053 (.0488)	-.0654 (.0447)	.0634 (.0558)	.0225 (.0904)	-.2076 (.1251)	.1356 (.0901)
ln(per-capita GDP)	-.3948** (.1511)	-.3897** (.1484)	.0236 (.3752)	.2165 (.3042)	-.7876* (.3495)	.2644 (.7152)
Unemployment rate	.7732 (.5317)	1.017 (.5700)	.0689 (1.400)	3.089** (1.159)	1.108 (1.288)	4.123 (2.555)
Rate of migrants	.4153 (.6520)	.2830 (.6095)	1.358 (1.370)	.6332 (1.530)	1.571 (1.336)	2.773 (3.507)
Testing exclusion of instruments	.0000	.0000	.0859	.0025	.0037	.5461
Testing overidentifying restrictions	.5256	.4129	.5390	.1992	.8250	.0170
Endogeneity test of clearance rate	.802	.951	.993	.221	.457	.582
Number of observations	232	235	232	234	237	234
R^2	.9897	.9885	.5162	.9802	.9776	.3925

Notes: Financial fines do not apply for robbery; otherwise, see Table 4

Table A7: Regression results for petty theft

Explanatory Variables	Adults			Juveniles		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Lagged dep. var.	.6281** (.0649)	.6292** (.0608)		.5837** (.0964)	.5541** (.0693)	
Clearance rate	-.0346 (.1906)	-.3483* (.1763)	.0145 (.2106)	-2.392** (.8007)	-2.365** (.7475)	.6632* (.2958)
Sentencing rate	-.2822** (.0952)	.1054 (.0917)	-.6726** (.1370)	-.2568 (.1855)	.0586 (.1696)	-.5788** (.2017)
Probation rate	-1.082 (.7119)	-.4607 (.7579)	-.0056 (.5342)	-.5604 (.5468)	1.049 (.5686)	-.6452 (.3878)
Fine rate	-.3167 (.4979)	-.4385 (.5741)	.8607* (.4283)	–	–	–
Rate of educational and disciplinary measures	–	–	–	.0104 (.4128)	.6374 (.3430)	.0377 (.3896)
ln(length of imprisonment)	.0002 (.0391)	.0037 (.0346)	-.0223 (.0301)	.0418 (.0478)	-.0068 (.0380)	.0297 (.0218)
ln(number of per-diem fines)	-.0508 (.0557)	.0383 (.0538)	-.0801 (.0925)	–	–	–
ln(per-capita GDP)	-.0014 (.1106)	-.0103 (.0972)	.0108 (.1714)	-.3126 (.1608)	-.1825 (.1442)	.2365 (.2889)
Unemployment rate	.0950 (.4303)	.7179* (.3807)	-.7620 (1.164)	2.475** (.9606)	2.886** (.7916)	-.9354 (1.766)
Rate of migrants	.9348 (.5872)	.0788 (.5186)	-.9959 (1.125)	1.369 (.8468)	.6289 (.8690)	-1.132 (1.444)
Testing exclusion of instruments	.0075	.0052	.0203	.0015	.0017	.0001
Testing overidentifying restrictions	.2637	.8506	.5292	.7125	.3206	.4668
Endogeneity test of clearance rate	.064	.892	.010	.001	.018	.454
Number of observations	232	235	232	234	237	234
R^2	.9849	.9844	.6486	–	–	.4384

Notes: See Table 4.