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The Economics of Crime: Investigating the Drugs–Crime Channel

Empirical Evidence from Panel Data of the German States

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Non–technical summary:
Drug addiction is a topic of major public concern. This is partially due to the assumption that there might exist a causal relationship from drug abuse to increasing crime rates. In fact, a cursory inspection of the problem might lead to this conclusion. Many surveys indicate that drug users are more likely to have a connection with the criminal justice system (through arrests and incarcerations) compared to non–drug users, and criminal justice system data indicate that a large percentage of arrestees test positive for illicit drug use at the time of their arrest. However, drug use may simply be the "catalyst" for criminal activity, but the interrelationships between drug use and crime are more complex and require more than a two–dimensional view of the drugs–crime nexus. In this paper, this link is analysed within the well–known Becker–Ehrlich model of the economics of crime, augmented by the consideration of currently discussed factors like demographic changes, unemployment, and income inequality. Three different channels from drug abuse to crime are considered: systemic, economic and pharmacological effect, each of which has a specific impact on different crime categories. Evidence from a panel of the German Laender (the German "states") allows us to exploit the very heterogeneous experiences in densely populated urban areas such as Berlin and Hamburg (which are also states, so–called "Stadtstaaten", i.e. "city–states") and sparsely populated areas such as Lower Saxony. Some considerable heterogeneity is also given due to the German federal system, according to which state governments are responsible for their police and the fight against crime within the borders of the corresponding Laender. This gives us the interesting opportunity to test the performance of conservatively ruled governments against the performance of social democrats and other coalitions. Moreover, our disaggregate German data set enables us to look at differences between West and East Germany, where a very quick convergence towards the western drug addiction rates seems to take place, and where recent general crime rates were even exceeding West German figures. Based on a variety of econometric approaches, it turns out that there is a significant drugs–crime nexus, which has been ignored in most previous applications of the Becker–Ehrlich framework, but that illicit drug use is far from being the only or exclusive driving force behind the evolvement of crime rates. The highest impact of drug use is on property crimes such as robbery and theft. This can be attributed to a dominating economic effect of drug abuse. In spite of a different measure of the drug problem (we use drug offences and not deaths due to drug poisoning), different econometric

methods (panel econometrics versus time series analysis) and different observational units (German states versus New York City), our results are similar to those in a recent article by Corman and Mocan (2000, American Economic Review), underlining the robustness of found results.

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Abstract

The rising trends both in drug addiction and crime rates are of major public concern in Germany. Surprisingly, the economic theory of crime seems to ignore the drugs–crime nexus, whereas the criminological literature considers illicit drug use a main reason of criminal activities. This paper provides an econometric assessment of the drugs–crime channel within a Becker–Ehrlich model of crime supply. We analyse three different channels from drug abuse to crime: system–related, economic–related and pharmacological effects. Estimation with panel data from the German states allows us to take into account further factors that might influence both drug abuse and crime. The results indicate that drug offences have a significant impact, in particular on property crimes. We attribute this to a strong economic–related channel of drug abuse on crime.

1 Introduction

The rising trends both in drug addiction and crime rates are of major public concern in Germany. In particular, in East Germany the use of narcotics was not widespread prior to unification, but a negative catch up process has to be observed in this area.[1] Public concern about narcotics and crime covers both moral and economic aspects. The analysis mainly concentrates on the costs of drug addiction and related crimes which include expenditures of the public health system for drug addicts, negative productivity effects of drug use, tax evasion of black market activities, costs of prosecution among others.[2] Furthermore, drug abuse may contribute to an increase in overall crime rates.

In fact, the evidence of a strong connection between illicid drug use and a wide range of criminal activities seems to be overwhelming. For instance, Beck et al. (1993) report that 49% of U.S. State Prison Inmates committed their offence under the influence of drugs or alcohol, and 17% indicated committing their offence to get money to buy drugs. Harrison and Gfroerer (1992) found that 26.1% of persons booked for any violent crime, and 24.7% of persons booked for any property crime used alcohol, cannabis and cocaine. A recent research study of the British Home Office analysed the results of urine tests carried out on 839 people arrested in five areas of England (London, Cambridge, Manchester, Nottingham and Sunderland) showed that nearly two thirds tested positive for at least one illegal drug. Moreover, the Home Office estimates that one third of acquisitive crime is drug–related (see NACRO, 1999). German official crime statistics reveal that among the total number of offences cleared by the police 7.5% were under the influence of illegal drugs and 7.6% were under the influence of alcohol in 1999 (Bundeskriminalamt, 2000). For robbery, respective shares were 14.8% and 14.0%, and for homicides 6.4% and 27.1%, respectively.

Following Goldstein (1985) and Goldstein, Brownstein and Ryan (1992), criminologists categorise statistics of the kind mentioned above by providing three different explanations of drug–related crime (see also Newcombe, no year, and Corman and Mocan, 2000):

[1] Some stylized facts are provided in section 2.

[2] See Hartwig and Pies (1995).

System–related crimes include those that are directly or indirectly related to the system of drug production and drug trafficking, which are impossible on a larger scale without concomitant crimes such as corruption, intimidation, extortion and crimes of violence. Competition for drug markets and customers cause disputes and rip–offs among individuals involved in the illegal drug–market, murders as means of enforcing systemic codes, killing of informants, injury or death resulting from disputes over drug possession, territory, etc. (Goldstein, Brownstein and Ryan, 1992). Thus, on the one hand these crimes originate from interdicting the production and traffic of drugs and on the other hand from the high rents, which can be obtained from violating the law. Concomitant crimes raise market entry barriers for potential concurrent suppliers in order to protect monopolistic rents from drug traffic. Levitt and Venkatesh´s (2000) analysis of the financial activities of a drug–selling streetgang shows that drug selling is an extremely dangerous activity. Death rates in their sample are 7 percent annually.

Economic–related crimes include those crimes that are committed as a result of his or her compulsion to obtain drugs (Goldstein, Brownstein and Ryan, 1992). Seen from an economist's viewpoint, economic–related crimes are more related to the demand side of the illegal drug market, whereas systemic effects can be attributed to the supply side. The high costs of narcotics resulting from the market power of the suppliers combined with a low price elasticity resulting from addiction require high income. If the drug addicts can afford their consumption out of current income or wealth, an increase of criminal offences is not to be expected on the demand side. However, a large fraction of drug addicts are younger people without finished education and other groups of the population with low income from legal activities. These addicts might decide or rather are forced to finance their consumption through prostitution or illegal activities like theft and robbery.

Victim/offender use–related crimes include those that are consequential to the consumption of drugs by the victim or offender, since the ingestion of a drug may cause irrational or violent behaviour. This effect of drug abuse is also called the pharmacological effect.

The major part of the empirical evidence in the literature on drug–related

crime is based on correlative evidence between drug addiction or drug offences and criminal activity. However, third factors might be responsible for both drug consuming and crime, e.g. poverty and unemployment may be claimed to be the true underlying causes of both use of narcotics and acquisitive crime. In a rare exception to the criminological literature, Otero–Lopez et al. (1994) have found support of this view. Based on a survey of over two thousand male students between 14 and 18 years of age, the authors claimed support for the notion that peer, family, and individual factors were more predictive of both risk behaviours than either risk behaviour was on the other.

Economists who follow the general approach of "The Economics of Crime" (Becker 1968, Ehrlich 1973) for testing the deterrence hypothesis are used to control for "third factors". However, economists usually ignore the importance of illicit drug use in economic crime studies. Corman and Mocan (2000) provide a remarkable exception. Based on monthly time series from New York City the authors compare the relative magnitudes of the effects of local law enforcement activities on crime with the magnitude of variations in drug use on crime. They find that law enforcement effects on crime are stronger and more significant than drug usage, which only has a small effect on property crimes.

The purpose of this study is to provide an econometric assessment of the economics–of–crime model with a special focus on the impact of illicit drugs on crime. Unlike Corman and Mocan (2000), who were only able to consider deterrence, poverty and drug usage as explanatory variables in their high–frequency data set coming from a big metropolis, we take a broader view to the crime problem, inspired by recent social and economic problems like unemployment, migration, inequality, and demographic changes in Europe. The focus of our contribution has changed from the traditional testing of the deterrence hypothesis to the analysis of socio–economic, drug–driven and demographic factors.

Evidence from a panel of the German Laender (the German "states") allows us to exploit the very heterogeneous experiences in densely populated urban areas such as Berlin and Hamburg (which are also states, so–called "Stadtstaaten", i.e. "city–states") and sparsely populated areas such as Lower Saxony. Some considerable heterogeneity is also given due to the German federal system, according to which state governments are responsible for their police

and the fight against crime within the borders of the corresponding Laender. This gives us the interesting opportunity to test the performance of conservatively ruled governments against the performance of social democrats and other coalitions. Moreover, our disaggregate German data set enables us to look at differences between West and East Germany, where a very quick convergence towards the western drug addiction rates seems to take place, and where recent general crime rates were even exceeding West German figures.

Our results indicate that ignoring the effect of drug use in empirical models of the economics of crime would lead to an omitted variable bias. Drug offences have a relatively strong effect on property crimes and on vandalism, but estimated elasticities are below those of the used indicator of law enforcement which is measured by clear–up rates.

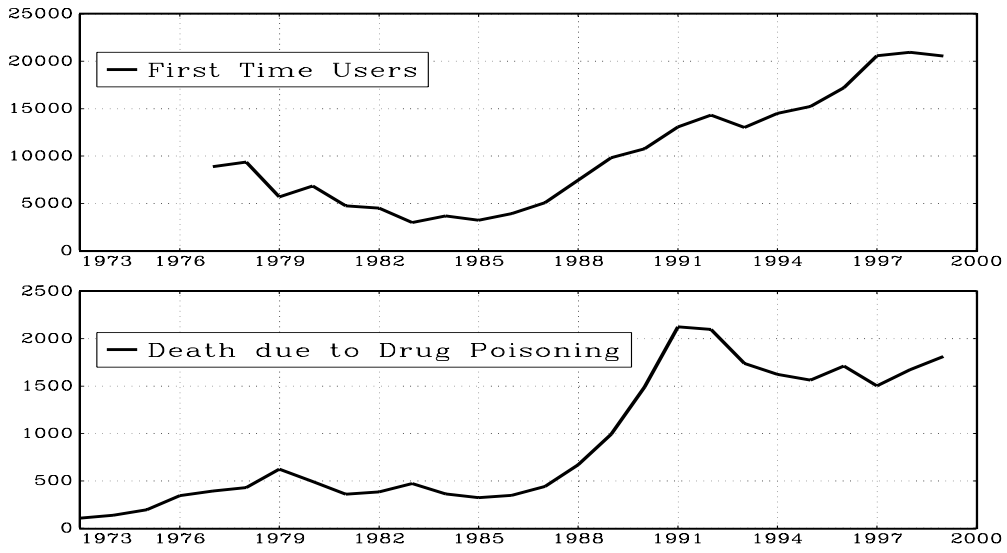
The remainder of this article is organised as follows. Section 2 describes general tendencies of drug abuse and crime rates and provides stylized facts on the direct crime–drugs nexus and potential third factors. The economic modelling framework and the choice of relevant variables are introduced in section 3, section 4 describes the data sources and provides some descriptive statistics while section 5 covers econometric considerations. The estimation results are summarized in section 6. They allow for conclusions on the extent to which illegal drug use contributes to the development of overall crime rates. The findings are linked to the public issue of drug related crimes in section 7.

2 Crime, drug offences and potential third factors of crime

2.1 General tendencies

Due to the illegal nature of drug abuse and drug related crimes, it is difficult to obtain reliable data on the extent of these phenomena. Corman and Mocan (2000) use the number of deaths which are due to drug poisoning as a proxy for drug use. Figure 1 shows these numbers for Germany in the lower panel, while the upper panel depicts the number of first time users of drugs, which became noticed by the police.

Figure 1: First time users and deaths due to drug posisoning



Source: Bundeskriminalamt (1999, 2000); own calculations.

The number of deaths due to drug use are not a very close proxy for the development of drug use for several reasons. First, there exists a time lag between drug use and death caused by drug abuse, since a large fraction of these deaths is caused by physical decay due to persisting drug abuse.[3] Second, the number of deaths is influenced by changing concentration of narcotics within the drugs supplied (Bundeskriminalamt 2000). Furthermore, drug–addicted may move from rural areas to cities during their "drug career". Then, the use of death rates may overstate drug abuse in the German city states compared to the other states. Consequently, estimates based on a panel of German states might be biased using this proxy. Using the number of first time users is not a satisfying proxy either. First, the numbers depend on the awareness of the police officers who get into contact with the drug user. Thus, these numbers might be biased downward for areas where drug

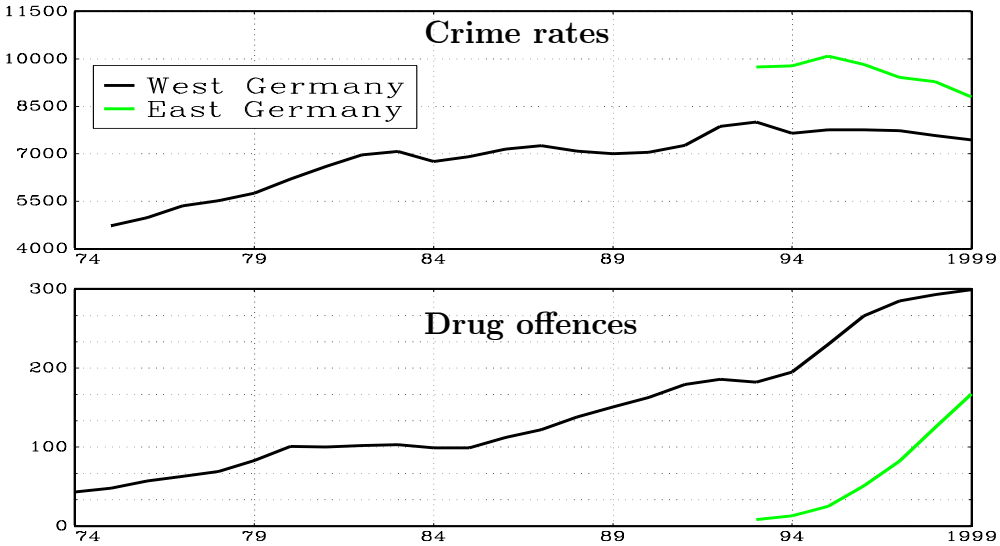
[3]For example, no relevant number of deaths which are due to drug poisoning are yet reported for East Germany in 1999. In contrast, the number of reported first time drug users, increased by 23.4% in East Germany from 1998 to 1999, while a slight decrease of 1.8% in West Germany for the same time period corresponds to an increase in the number of deaths by 8.2%.

abuse is less common. Second, these numbers measure flows into the pool of drug users. Since no estimates of the outflow are available, it seems difficult to obtain a proxy of the stock of drug addicts which is more relevant for our analysis of the drug–crime nexus.

Given the limits of these proxies for drug abuse, the numbers on direct drug offences reported by the German Federal Criminal Police Office (Bundeskriminalamt) appear to be a more sensible choice as a proxy for the overall development of drug abuse. These numbers appear even more suitable to monitor the impact of drug abuse on overall crime rates.

The relevance of an analysis of drug abuse and its impact on overall crime rates is substantiated by the increase of drug abuse as measured by these numbers from the German Federal Criminal Office. Figure 2 and Table 1 show the development of overall crime rates and offences against drug related laws.

Figure 2: Crime rates and drug offences (cases per 100 000 inhabitants)



Source: Bundeskriminalamt (1999, 2000); own calculations.

The upper panel of Figure 2 plots the development of overall crime rates in West and East Germany. While West German data exhibit no clear ten-

dency during the 1990s, East German crime rates start at a higher level in 1993 and slowly adjust downwards. The development of drug offences shown in the lower panel shows a rising trend for West Germany and a fast adjustment of East German rates. From the early seventies to the end of the nineties, the numbers increase from less than 50 to almost 300 cases per 100 000 inhabitants for West Germany. However, the increase is not uniform. In recessionary periods like the early eighties and again in 1992/93, the numbers remain almost constant. In East Germany after unification almost no offences against drug related laws are reported. Reliable numbers are available only from 1993 on. They show a tremendous increase over the six year period to 1999, when East German figures amounted already to more than 50% of West German figures.

Like all crime related data, these numbers have to be interpreted with some care since an increase might result from a real increase in offences, a stiffening of relevant laws, or an increase of the share of known cases among all cases. However, a stiffening of relevant laws cannot be observed during the 1990s. Thus, also underreporting might have been more pronounced in East Germany immediately after unification, the sharp increase in cases from 1993 to 1999 indicates that the overall trend might be mainly determined by an increase in offences.

In Table 1, a disaggregation is undertaken with regard to the characteristics of the federal states. The first two entries show that the rate of offences is much higher in the city states, which might correspond to a supply side effect on the one side and higher income opportunities on the other. However, in contrast to the other states, these city states experienced a decline in the rates of drug offences from 1998 to 1999 (771 compared to 786 for Hamburg and 590 compared to 700 for Bremen). Next, the numbers for the federal states in West Germany with highest and lowest case numbers exhibit some dispersion, which, at least partially, might be attributed to the higher share of urban population in Nordrhein–Westfalen as compared to the rather rural state Schleswig–Holstein. However, the stronger increase in case numbers for Schleswig–Holstein seems to indicate a negative catch up similar to the one just described for East Germany. In fact, in 1999 the numbers for Schleswig–Holstein became larger than those for the Saarland (208 in 1999, but already 164 in 1993). Finally, the last two entries show the development for the East German federal states with highest (Brandenburg) and lowest (Sachsen) case

numbers in 1993. Besides the enormous increase in cases, these figures also seem to indicate some adjustment between federal states.[4]

Table 1: Drug offences (cases per 100 000 inhabitants)

federal state	1993	1999	Change
Federal state corresponding to cities			
Hamburg	437	771	76%
Bremen	450	590	31%
Other federal states, West Germany			
Max.: Nordrhein–Westf.	213	321	51%
Min.: Schleswig–Holstein	85	243	186%
Other federal states, East Germany			
Max.: Brandenburg	11	184	1573%
Min.: Sachsen	6	142	2267%

Source: Bundeskriminalamt (1994, 2000); own calculations.

The statistics of the German Federal Criminal Police Office also provides some further information on the link between (illegal) drug use and other crime categories. Unfortunately, these data are not very comprehensive and do not allow for a causal interpretation. Nevertheless, they may provide some further stylized facts. For example, Bundeskriminalamt (1998), p. 68, indicates that in 1997 14% of robbery cases, which have been solved, were committed by drug addicts. For robbery of shops and handbags this rate increases to 26% and 25%, respectively. Furthermore, shop–lifting under aggravating circumstances was committed in 33% of solved cases by drug addicts. However, a large share of unsolved cases makes it difficult to draw inferences from these findings. Comparable figures for crimes of violence are not provided for drug addicts, but Bundeskriminalamt (1998), p. 69, reports that 60% of violent bill dodging and 41% of solved cases of manslaughter were committed under influence of alcohol. Consequently, at least the pharmacological effect of drug abuse might have an even stronger impact on overall

[4]The numbers for Sachsen–Anhalt, which were still smaller than those for Brandenburg in 1993 (9 compared to 6 drug offences per 100 000 inhabitants) grew at a rate of 2300% from 1993 to 1999 reaching 216 cases in 1999, which marks the maximum for the East German federal states for that year.

crime rates, in particular for crimes of violence, when legal drugs like alcohol are also taken into consideration.

2.2 General crime trends and the direct crime–drugs nexus

The figures on drug offences reported in the previous section do not cover all crimes, which might be related to drug–addiction and the market for illegal drugs. They include the so called direct procurement crimes such as theft from pharmacies.[5] However, further economic–related crimes are included in overall crime figures as well as system–related crimes. In order to obtain a first hint on a potential direct crime–drugs nexus, Figure 3 plots the development of drug offences in the upper panel against the developments of crimes of violence and property crimes in the lower panel. All data are for West Germany and indexed to the base year 1975.

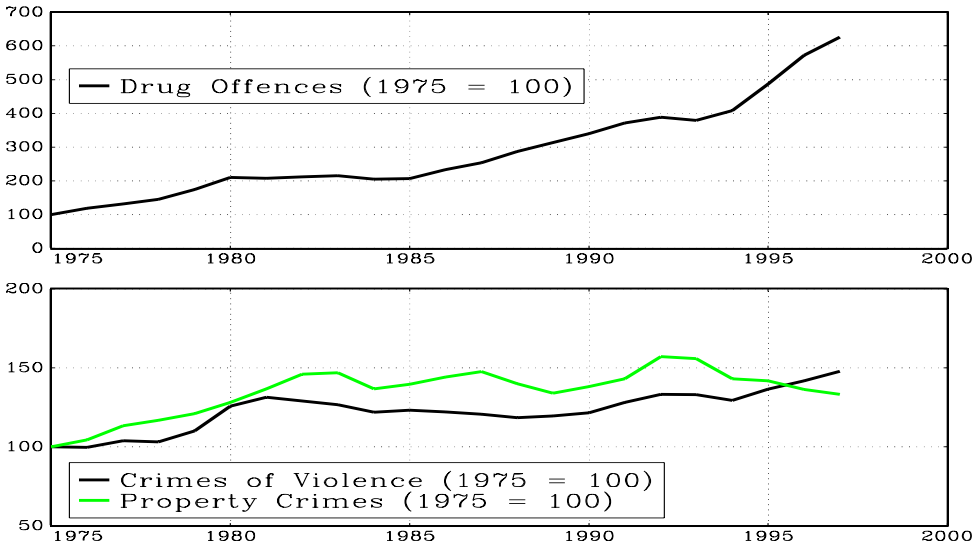
The crime rates of all considered crime categories exhibit an increasing trend. However, the trend in drug offences is much more pronounced than in the other crime categories. Given the joint trend, it is not surprising that the correlation between drug offences and the other two crime categories is substantial. In fact, the correlation with crimes of violence amounts to 0.80, and the correlation with property crimes to 0.61.[6] However, given that the trends in all crime categories might be determined by further (common) factors, it is not appropriate to draw far reaching causal conclusion from these findings. In particular, it is not adequate to deduce a stronger effect on system–related crimes, which are more likely to be crimes of violence, relative to the effect on economic–related crimes, which fall into the category of property crimes. An assessment of the impact of drug offences on overall crime rates requires a comprehensive model which controls for potential third factors.

Partly, higher crime rates seem to be explicable by a more intensive work of the police itself. This surprising conclusion might be drawn from Figure 4,

[5]Surprisingly, the statistics indicate, that only about 60% of these directly drug related crimes are committed by drug–addicted. In Bundeskriminalamt (1998), p. 68, this observation is explained by a non complete assessment of drug–addiction among criminals.

[6]The highest correlation of drug offences with a more disaggregated set of crime categories is found with theft. It amounts to 0.93.

Figure 3: Trends in crime rates (West Germany)



Source: Bundeskriminalamt (1999, 2000); own calculations.

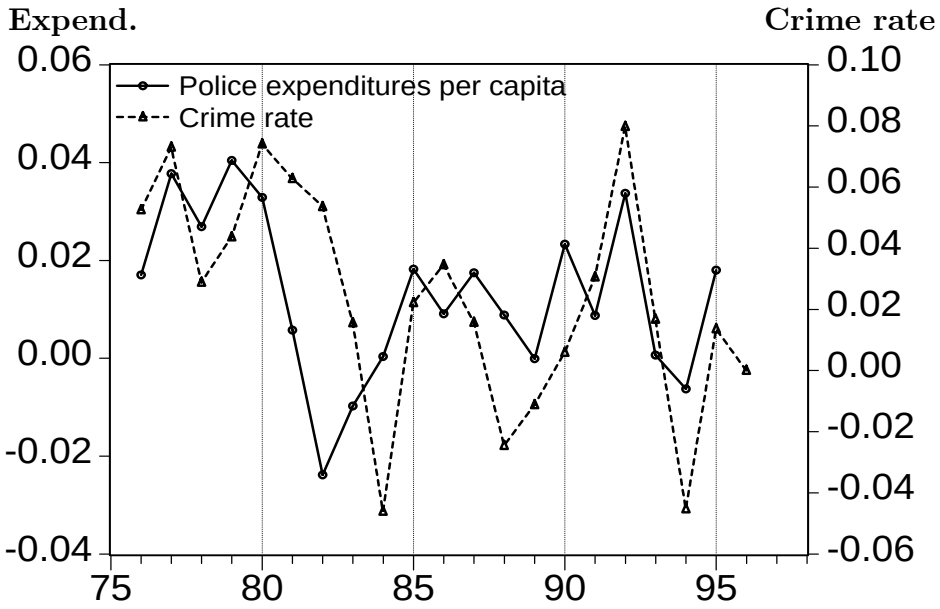
which shows growth rates of expenditures on police per capita and (total) crime rates in Western Germany. The high positive correlation of 0.47 [7] indicates that a better financial endowment enables the police to light up the share of "dark figures" of official crime statistics, since more criminal acts can be processed and registered. As the share of unreported crimes renders official crime statistics suspect as a basis upon researchers wish to make inferences, we need to consider this helpful information in our econometric model (see Section 3).

2.3 Potential third factors

Third factors, which might influence the crime–drugs nexus, are all those, which determine drug consumption, overall crime rates or both. Conse-

[7] As can be seen from the calculation of cross–correlation coefficients, police expenditures are rather leading than lagging with respect to crime rates: The coefficient is 0.46 if is estimated using a one–year lag of crime, and it is −0.10 if crime would lead by one year.

Figure 4: Changes in police expenditures and crime rates



Source: Bundeskriminalamt (1999, 2000), Öffentliche Finanzen, (various years); own calculations.

quently, all the socio–economic variables, found to be important in the econometric modelling of crime rates, have to be considered, e.g. measures of income and income distribution (GDP, unemployment, share of young men), a distinction between rural areas and cities, or political factors such as ruling party or coalition. Since these factors might also be linked to drug consumption, Table 2 shows some correlations between the number of drug offences per inhabitant and these factors.

Again, the bivariate correlations do not allow for a causal interpretation. For example, the positive correlation between a conservative government and the number of drug offences at the federal level might be due solely to the fact that a conservative government was in place for the whole period 1981 – 1997, i.e. during the period with highest increase in the number of drug offences. Nevertheless, the results indicate the potential importance of neglecting third factors, which exhibit some statistical correlation both with drug offences and overall crime rates.

Table 2: Drug offences and third factors

Correlation between drug offences and	Cross section of West German Laender in 1990	Time series for West Germany 1975–1997
Unemployment rate	0.71	0.61
Share of young men	-0.50	-0.76
GDP (1991 = 100) per capita	0.83	0.93
City states	0.89	—
Ruling party is conservative	-0.47	0.68

Source: Bundeskriminalamt (1994, 2000); own calculations.

Our estimation will include dummies for each year and each of the German Laender in order to control for further factors, e.g. the development of prices on the market for illegal drugs.[8]

3 Economic modelling and choice of Specification

As is well known, the standard theoretical framework of "The Economics of Crime" is based on Becker's (1968) seminal article. Becker's theory of deterrence is an application of the general theory of rational behaviour under uncertainty. Optimising individuals engage in criminal activities when expected payoffs of the criminal activity exceed the costs of criminal activity, mainly given by the probability and severity of sanctions. Ehrlich (1973) extended Becker's model by considering a time allocation model. Since time can be allocated to legal and illegal activities, besides deterrence "third"

[8]Unfortunately, the price data are not yet available on a Laender base.

variables of legal and illegal income opportunities start to play a central role in empirical tests of the Becker–Ehrlich model, approximated by abilities, family income, human capital, and other socio–economic variables.

These considerations have led to the basic Becker–Ehrlich specification of the so-called "supply of offences" (see Grogger 1991, Ehrlich 1996, Levitt 1996, Corman and Mocan 2000, and Entorf and Spengler 2000, for recent applications). It is commonly written in logarithmic form:

$$\ln O = \alpha + \beta \ln D + \gamma \ln Y + \delta \ln X \tag{1}$$

where O is the crime rate (number of offences per 100,000 inhabitants), D is deterrence, Y is income opportunity and X represents "other influences", with the latter becoming increasing influence in the recent literature.

In our work, in which we are interested in the drugs–crime nexus, we have chosen five different crime categories. System–related crimes of drug offenders (here: drug traffickers) are suspected to be a major source of violent crimes, of which we analyse the categories "murder" and "assault". Economic–related crimes of drug offenders (here: drug addicts) consist of providing (illegal) income necessary to finance illicit drugs. Hence, "theft" and "robbery" should be affected by this kind of criminal motivation. The pharmacological effect is not subject of any economic reasoning. As "vandalism" might be considered as a crime distant from the idea of the rational offender, we are interested in the potential explanatory power of illegal drug use on this type of crime. In general, however, it is not clear that the pharmacological effect increases crime.[9] The evidence concerning the pharmacological effects of illegal drug use is rather mixed. Marijuana, for instance, seems more likely to reduce aggressive behaviour (Fagan 1990).

In most studies, the effect of deterrence variables (clear–up or conviction rates, length of arrest, fines) are found to be more or less negative, i.e. in line with predictions from theory (see, for instance, Eide, 1994, for a survey). In our specification, as in most applications of the Becker–Ehrlich model, we measure deterrence by clear–up rates. We refrain from testing deterrence by use of an indicator of the severity of punishment, because the identification of state–specific law interpretations is difficult to obtain and is left to future

[9]However, there exists some evidence of a considerable effect on traffic offences, which are not subject of our present analysis.

research.

Our study uses four different proxies of legal and illegal income opportunities. The first one is the usual indicator, (real) GDP per capita, which is, according to Ehrlich (1973), a measure of illegal income opportunities. It has, therefore, a positive expected sign in the crime–supply equation. Second, changing inequality is supposed to affect legal income opportunities. Due to the choice of our data set, that is based on evidence from the German states, we are not able to include standard measures of inequality such as percentage of population below some poverty lines, Gini coefficients etc., because they are not obtainable from official statistics at the state level for the whole period under consideration. Instead we use an indicator which measures whether income positions within the hierarchy of all incomes have improved or not. More precisely, the second indicator of income opportunities employed in our study, which is supposed to measure tensions arising from changing inequality, looks $I(\Delta(y_{it} - y_t)/y_t > 0)$, where y_{it} and y_t are state specific income and German average income, respectively. The resulting dummy variable is 1 if the state has experienced an improvement of its relative income position, and the variable is 0 if the state has not. The expected sign is unclear. Persons who choose between legal and illegal income opportunities, and who are looking for a legal job and/or certain reservation wage levels, would be more successful in prospering regions, suggesting that better legal income opportunities would lead to a negative sign. On the other hand, states that do better than the average provide lucrative targets and attract potential criminals who, moreover, might leave degrading regions. Such "crime migration" would result in a crime enhancing effect, i.e. a positive sign.

Unemployment rates measure absence of legal income opportunities, and are integral part of most empirical models of the Becker–Ehrlich type, although the expected positive sign cannot be observed in many econometric studies (Chiricos 1987, surveying 68 studies, shows that fewer than half find positive significant effects). Raphael and Winter–Ebmer (2001) argue that the failure to control for variables that exert pro–cyclical pressure may downwardly-bias estimates of the unemployment–crime effect. Thus, in line with Raphael and Winter–Ebmer (2001), Cook and Zarkin (1985) and related literature, we control for cyclical effects by introducing a variable that indicates recessions, $I(\Delta \ln y_{it} < 0.01)$, i.e. a dummy variable being 1 if annual real GDP growth

is below one percent (0 otherwise). The expected sign of this fourth income opportunity variable is positive: low legal income opportunities make illegal activities a more lucrative alternative to legal work.

Demographic factors are strongly correlated with crime, at least in a bivariate framework. For instance, of 100 suspects in 1999, more than 75 are male, and more than 40 are committed by offenders of less than 25 years of age. Young men aged 15–24 years are suspected to have committed 27% of all registered crimes, whereas the population share of this group is only 6% (Bundeskriminalamt, 2000). These facts have led us to consider the share of young men under 25 years of age in the crime–supply equation. Moreover, a high percentage of crimes in Germany is committed by foreigners. In 1999, more than 25% of all suspects were foreigners, whereas the population share is about 9% (Bundeskriminalamt, 2000). It should be noted, however, that there are many reasons why foreigners are over–represented in the group of suspects.[10] However, in order to avoid potential omitted–variable biases, we have included the share of foreigners as a further demographic factor in our set of explanatory variables.

As demonstrated in Section 2 of our paper, expenditures on German police are positively correlated with registered crime, most probably because additional financial means could be used by the police to reduce the share of unreported crimes. Thus, since the dependent variable is registered crime, available from official police statistics, and not (unobservable) actual crime, it is important to control for such "crime producing" factors in order to achieve crime rates adjusted for distortions arising as a consequence of varying government expenditures.

Finally, the description of our data seems to suggest that conservative governments are more successful in fighting or preventing crimes. In addition to

[10]First, they may be more often wrongly suspected than the native population. Second, there are some laws – like the foreigner and asylum laws – which can, by definition, only be broken by foreigners. Third, foreigners who reside in Europe are to a higher percentage young men. Fourth, some foreigners may be in European countries after fleeing their homeland, because they were offenders there. Finally, most foreigners enter European countries, because they had no economic success in their home country. The latter may be due to factors that foster crime, for example, lack of education. These points should be kept in mind when judging the coefficients of the foreigner variable in our empirical results.

correlative evidence presented in Section 2, it might be interesting to note that in our sample (1976 – 1995) conservative party participation in state governments is associated with crime rates being 33.7% lower in conservatively governed states and government periods. Of course, there are other ways of interpretation. For instance, voters of Christian–democrat parties may be more law–abiding than voters of other parties. Another explanation may be that conservative parties are more successful in rural or wealthy regions, whereas crime is an urban phenomenon, located in cities with social problems like unemployment and illicit drug use, rendering bivariate correlation coefficients potentially spurious. To judge suppositions of this kind would require the consideration of the conservative government effect in a multivariate context. In our framework, we use a dummy variable indicating whether conservative parties (CDU or CSU) belong to the ruling coalition of the respective state at time t.

4 Data

The data consist of a balanced West German panel containing annual data from all 11 states (Laender) that formed the Federal Republic of Germany prior to the German unification in 1990. Berlin, which contained a West and East German part, is treated as a West German state in our empirical analysis.[11] Since during the years following the unification there were difficulties in the registration of crimes and clear–ups in the five new states (Brandenburg, Mecklenburg–Vorpommern, Saxony, Saxony–Anhalt, Thuringia), we include time–region dummy variables for Berlin during the years 1990 to 1992.[12] In order to rely on relatively long time series, and since drug related crimes would need a different approach in East Germany, we refrained from including data from the five new states.

[11] This can be justified by the fact that former West–Berlin is about 65% larger in population and 150% larger in GDP than East–Berlin. Because of the fast adjustment of East–Berlin's living conditions to West German standards the united city may be more appropriately considered West German than East German.

[12] According to notes provided in our data source (Bundeskriminalamt (1996)) East German police statistics of the years 1990 to 1992 are biased downwards due to administrative adjustment problems. Thus, 1993 is the first year after unification which allows for a reasonable comparison between East and West German crime figures.

Table 3 describes all variables used in our estimations. Crime and clear–up rates are taken from the German Federal Criminal Police Office. We use the rate of drug related crimes per inhabitant for the German Laender. This variable comprises illegal drug consumption and trade with narcotics, but does not include drug related crimes, such as theft of drugs from pharmacies or theft in order to obtain money for drug consumption. Therefore, our proxy variable can be considered as exogenous with regard to the crime categories we are interested in. The variables `FOREIGN` (percentage of foreigners in the population), `GDP_H` (real Gross Domestic Product per capita in constant prices), `M15-24` (percentage of males aged 15–24 in the population), `CONSERV` (ruling party is conservative), and `REL_IMPRV` (relative improvement between states' GDP and federal GDP)and `RECESSION` are calculated on the basis of data from the Federal Statistical Office of Germany (Statistisches Bundesamt). The variable `UR` (unemployment rate) is taken from annual reports of the Federal Employment Service (Bundesanstalt für Arbeit). Data on police expenditures can be found in statistics on public finance (Öffentliche Finanzstatistiken) published by Federal Statistical Office of Germany.

5 Econometric considerations

Empirical investigations on the causes of crime suffer from the fact that a substantial share of crimes is not registered by the police. This shortcoming is particularly severe for cross–sectional analysis. In contrast to cross–sectional studies, fixed–effect modelling allows us to control for unobserved heterogeneity within the used panel data of the German states. Since the share of reported crimes might differ between states, the inclusion of state dummy variables considers unobserved heterogeneity stemming from this potential source of bias. It should be noted, however, that this conclusion requires the assumption of a time invariant structure of unreported crimes between states. Experience with similar data (Entorf 1996, Entorf and Spengler 2000) has shown that the inclusion of state effects also covers the explanatory power of population density. It is excluded from the set of explanatory variables because it is dominated by fixed–effects which, of course, does not rule out that urban factors do play a crucial role for the heterogeneity of crime within Germany.

Table 3: Descriptive statistics of pooled data

Variable			Mean	Std.Dev.
O1 - O5	=	Crime rates calculated as number of crimes known to the police per 100,000 inhabitants		
O1	=	Murder and manslaughter	5.22	2.21
O2	=	Serious assault	128.32	65.89
O3	=	Vandalism	725.96	270.76
O4	=	Robbery	74.04	68.47
O5	=	Theft (with and without aggravating circumstances)	5236.76	2635.17
P	=	Percentage of crimes cleared up by the police	45.73	6.15
P1 - P5	=	crime specific clear–up ratios (see O1 - O5)	24.0 – 93.4	-
DRUGS	=	Number of drug offences per 100,000 inhabitants	154.70	113.11
FOREIGN	=	Percentage of foreign citizens in the population	7.93	3.22
GDP_H	=	Real gross domestic product per capita in prices from 1991	37679.26	9750.14
UR	=	Unemployment rate	7.93	3.22
M15-24	=	Percentage of males aged 15–24 in the population	7.36	1.07
POL/GDP	=	Police expenditures /GDP	0.0066	0.0058
RECESSION	=	Dummy variable that takes the value 1 if real GDP growth is below 1 percent	0.30	-
REL_IMPRV	=	Dummy variable, takes the value 1 if $\Delta(y_{it} - y_t)/y_t > 0$	0.51	-
CONSERV	=	Dummy variable that takes the value 1 if the state is ruled by a Christian party (CDU or CSU), or if a Christian party belongs to the ruling coalition of political parties	0.48	-

As regards the time dimension of panel data, it is known that stochastic trends in cross–sectional units might lead to spurious fixed–effect modelling (Entorf 1997, Granger and Hyung 1999). Even in the stationary but (strongly) serially correlated case, statistical inference in applied fixed–effects panel econometrics is often based on (asymptotic) standard errors of the ordinary least squares estimator without consideration of any potential serial correlation of estimated residuals which would render standard t–values and F–statistics of only descriptive use.

We start by presenting Levin–Lin (1992) panel unit root tests in Table 4, which, however, do not lead to unambiguous conclusions with respect to potential nonstationarity of the data. Given this uncertainty, and given well known difficulties in interpreting panel unit root tests as well as the nature of used crime data that are measured as cases per 100,000 inhabitants, which would lead us to the discussion of how to interpret nonstationarity in time series consisting of rates, we decided to treat the German state panel crime data as stationary. However, we inform about potential serial correlation by calculating a statistic provided by Bhargava, Franzini and Narendranathan (1982), who modified the classical Durbin–Watson statistic for the use of panel data which we call BFN–DW. Moreover, we corrected for serial correlation of residuals of the crime–supply equation by considering the model

$$\ln O_{it} = \alpha_i + x'_{it}\beta + \epsilon_{it} \tag{2}$$

$$\epsilon_{it} = \rho\epsilon_{i.t-1} + u_{it}, \tag{3}$$

which is estimated using nonlinear regression techniques (for details, see Davidson and MacKinnon, 1996, pp. 331–341). Finally, we also employed data in first–difference form (more precisely: growth rates). This approach follows the time–series analysis of crime rates in New York City by Corman and Mocan (2000), who motivate their approach by the current controversy on the issue of unit roots and by uncertainties about the true data generating mechanism within small samples. Hence, in such samples using differenced data can an be considered an approximation of the exact structure. Note that first differencing of (serially uncorrelated) panel data eliminates state–specific constants (see equation 2).

A further issue often neglected in panel data econometrics is contemporaneous correlation among residuals of cross–sectional units (i.e. states). In principle, the method of seemingly unrelated regression (SUR) is assigned to

this problem. Since we are dealing with N=11 and T=20, SUR is feasible. Thus, in order to achieve results comparable to panel econometrics, we have performed SUR by estimating 11 ("unrelated") state equations, and by restricting state–specific parameters to be common parameters, i.e. $\beta_i, = \beta$ for all $i = 1, ..., 11$.

Table 4: Panel Unit Root Test

	Test statistic	Result (5% significance)
Murder	-7.69	I(0)
Assault	-5.31	I(1)
Theft	-8.62	I(0)
Robbery	-1.80	I(1)
Vandalism	-6.58	I(0)
Drug offences	-3.57	I(1)

Panel unit root test using state–specific intercepts. The critical value (-5.60) is taken from Levin and Lin (1992). All test equations use the DF–specification (without augmented lags). Tests are based on data in logarithmic form.

Some sensitivity checks address the question of potential endogeneity of drug offences, because a criminal lifestyle leads to experimentation with illicit drugs and use of narcotics when carrying out criminal acts (Chaiken and Chaiken 1990), a possibility that might imply the presence of a potential simultaneous equation bias. It will be tested by using ruling parties and prices of illegal drugs as instruments of illegal drug use, and by running a Hausman–specification test.

The significance of deterrence seems to be well documented for the US, where recent contributions by Corman and Mocan (2000) and in particular by Levitt (1996, 1997, 1998) confirm early results of, for instance, Ehrlich (1973). In our German case study, deterrence is measured by the percentage of (registered) offences cleared by the police. Endogeneity of this indicator will be discussed and a TSLS–estimation will be presented.

6 Estimation results

Regression results are summarised in Tables 5–14. Tables 5–10 present models with state–specific effects (see first columns M1, A1 etc.), and both state–specific and time–specific effects (see second columns M2, A2 etc). Both types of regression are based on restricted SUR estimation that allows to consider contemporaneous correlation between residuals from different states. NLS–correction for serial correlation within time series of cross–sectional units follows in columns (M3), (A3) etc. To make results comparable, all estimations are based on the same specification.

As can be seen from the low BFN–DW statistic, serial correlation is high for one–way and two–way fixed–effect models. Thus, inference based on calculated t–values would not be well defined (note that the SUR covariance matrix of residuals considers contemporaneous cross–correlation but assumes absence of intertemporal linkages). Moreover, the inclusion of time effects leads to some obvious deviations from other results. This observation reveals some weakness of time dummies, since they hide or disguise temporary phenomena as recessions, for instance, which we just want to identify in order to measure their effects on crime. Thus, though each specification has its merits and its defects, we would prefer estimations with correction for serial correlation. They still consider unobserved heterogeneity (the inclusion of fixed–effects is tested using F–tests), but they don't suffer from potential misinterpretation due to misleading t–values or difficult interpretation of estimated parameters.

Table 15 and Table 16 summarise important results based on AR(1)–adjustment and estimation in differences. The latter are taken from the first columns (M, A, etc.) of Tables 10–14. Growth rates regressions, too, are performed using restricted SUR.[13] Table 15 informs about the parameters of main interest in this paper, i.e. the effects of deterrence and drug offences. The drugs–crime nexus is significant for all considered crime categories except murder. In

[13] In principle, estimates using fixed effects and estimates based on growth should more or less coincide, if the chosen specification is correct (see equation 2). Note, however, that the dummy variables "recession" and "improvement of state–specific income position" have been included in both level and growth rates specifications such that a direct comparison is not possible.

particular, the estimated elasticities for theft and robbery are about 0.1.[14] However, the argument that illicit drug use is an exclusive factor of crime, a supposition often heard from criminologists and sometimes based on mere bivariate correlation, cannot be maintained. Deterrence, too, is a significant factor. The elasticities for theft and robbery with regard to deterrence, for instance, range between -0.1 and -0.4. Furthermore, legal and illegal income opportunities (see the summary in Table 16) and some demographic factors exhibit a significant influence on crime rates.

The negative impact of drug offences on murder is a surprising result, which would contradict its system–related effect, even when a potentially calming effect of some narcotics is acknowledged. However, inspection of Table 10 reveals a poor fit (R–squared = 0.125) and signs of overdifferencing (BFN–DW=2.63) for the murder equation, suggesting that the negative sign might result from an omitted–variable bias and mis–specification. More reasonable is the positive but insignificant effect of drug offences based on the AR(1)–specification.

When comparing the three potential drug–crime channels presented in the introduction, then economic–related and pharmacological effects seem to dominate system–related effects. One might conclude that wars of drug–selling gangs, as they are studied by Levitt and Venkatesh (2000), are of minor importance in Germany. Somewhat surprising, however, are comparable results of Corman and Mocan (2000) for the U.S., who report results consistent with ours. They even found that both murder and assault growth rates are not significantly related to changes in the growth rate of drug use at all. An explanation may be that used drug measures are more related to drug consumption than to drug related violence stemming from the intersection between sellers.

The results for legal/illegal income opportunities are largely in accordance with our expectations, with the exception of the insignificance of estimated coefficients on GDP per capita for property crimes, where we expected a significant positive effect (because of the presence of more lucrative targets). On the other hand, the insignificant effect might be the result of more effective protection measures taken by more wealthy home owners. Higher unemployment rates lead, when significant, to a raise in crimes against property, and

[14] Benson et al. (1992) obtain similar results using a cross–section of Florida county data.

to an increase in murder. However, the effects on vandalism show a surprising negative sign, which again might be a problem of some omitted–variable bias (R–squared = 0.155).

Crime problems are reinforced during recessions, as becomes clear from the third column of Table 16. The strongest effect can be observed for theft. Moreover, thieves and robbers seem to be attracted by prospering states, or, put differently, they might fly degrading regions: see the significant positive effects of "relative improvement".

Summing up results from Tables 15 and 16, the economic model of crime, enhanced by the drugs–crime channel performs "best", i.e. in terms of accordance with theory, for crimes against property, in particular theft. This is confirmed in terms of predictive power. R–squared statistics of burglary and theft are highest among all crime categories both in levels and growth rates (theft: 0.989/ 0.316, burglary: 0.985/ 0.246, see AR(1)–estimation/ growth rates estimation in Tables 7, 8, 12, 13).

Demographic variables and other controlling factors, finally, do not comprise surprising results. A higher incidence of young men, who have rather low legal income opportunities but dispose of relative good physical strength, i.e. high illegal income opportunities, and foreigners, who might also suffer from the insufficient assimilation into the German society, would increase the number of crimes, particularly property crimes. Police expenditures lead to the expected effect of producing more (registered) cases. Criminal policy of conservative state governments do not perform better than their non–conservative counterparts. On the contrary, when other factors such as GDP per capita, demographics etc. are included, states with Christian conservative parties perform even worse, although the positive sign of "conservative government" is not significant, at least when estimations based on AR(1)–adjustment are considered.

Due to its insignificance in levels, "conservative government" has been left out in the analysis of growth rates. It has been used as instrumental variable of two potentially endogenous variables, namely "drug offences" and "clear–up rate". Unfortunately, also with respect to these variables the explanatory power is rather weak, when exogenous variables of Tables 5–14 are already included as explanatory variables of the suspicious variables. Mis–specification due to potential endogeneity of drug offences is tested using a

Hausman test. Estimated average prices per gram heroin (German average), made available by the German Federal Criminal Office, serve as a second instrumental variable. All but one estimation (vandalism) do not show any significance.

It is difficult to address the question of potentially endogenous clear–up rates in a convincing way on the basis of aggregate data. The advantage of our approach compared to existing frameworks is the use of police expenditures as additional explanatory variable. As is well known from the Frisch–Waugh theorem, the inclusion of this control variable allows us to eliminate its simultaneous influence on endogenous crime rates and on clear–up rates in least square regressions. This virtue of the Frisch–Waugh theorem helps us to reduce an important source of simultaneity, that is the potential response of politicians to increasing crime rates, which would lead them to increase expenditures on police, which in turn might force higher clear–up rates and more cases proceeded by the police, i.e. higher registered crime rates.

Nevertheless, we also performed an instrumental variable approach as further sensitivity check although it is difficult to identify reasonable instrumental variables. Many candidates belong to the set of explanatory variables of the crime–supply equation itself so that they cannot be used as instruments. We used "criminal policy", measured by the "conservative government" dummy, and expenditures on courts in the German states as additional instrumental variables. It should be noted that F–tests testing the joint marginal explanatory power of these variables in regressions on clear–up rates are only weakly significant. Two–stage least squares regressions confirm the expected sign of deterrence (except assault), but results become insignificant and the magnitude of coefficients changes. Therefore, summing up the results of this sensitivity analysis, they do not contradict the implications of the economic theory of crime.

Table 5: Panel regression results, data in levels

	log (Murder)		
	(M1)	(M2)	(M3)
Deterrence			
- log (clear-up rate)	-1.17*	-0.86*	-0.97*
	(0.15)	(0.16)	(0.32)
Drugs			
- log (drug offences)	0.07*	0.03	0.05
	(0.03)	(0.03)	(0.07)
Income opportunities			
- log (real GDP/head)	-0.84*	-0.71*	-0.86
	(0.16)	(0.18)	(0.44)
- log (ur)	0.09*	0.26*	0.14*
	(0.03)	(0.06)	(0.06)
- recession (Δ log (real GDP) < 0.01)	-0.024	-0.078*	0.000
	(0.016)	(0.019)	(0.023)
- improvement of state-specific income position	-0.001	-0.020	0.020
	(0.011)	(0.012)	(0.022)
Demographics			
- log (share of young men, 15–24)	0.30*	0.90*	0.25
	(0.09)	(0.27)	(0.24)
- log (share of foreigners)	0.37*	-0.01	0.29
	(0.10)	(0.14)	(0.21)
Control			
- log (police expenditures/GDP)	0.40*	0.33	0.34
	(0.17)	(0.19)	(0.41)
- conservative government	0.014	-0.014	-0.049
	(0.015)	(0.019)	(0.057)
Fixed effects	yes	yes	yes
Time effects	no	yes	no
AR(1)-coefficient	-	-	0.48*
			(0.08)
BFN-DW-statistics	1.13	1.14	2.13
Adjusted R-squared	0.770	0.776	0.816

First two columns: SUR–estimation; third column: AR(1)–modelling of residual, White´s (1980) heteroskedasticity–consistent standard errors in parentheses (3rd col.); sample: West German states (11), 1976–1995 (220 observations).

Table 6: Panel regression results, data in levels

	log (Assault)		
	(A1)	(A2)	(A3)
Deterrence			
- log (clear-up rate)	0.42*	0.28	-0.44
	(0.12)	(0.15)	(0.37)
Drugs			
- log (drug offences)	-0.01	-0.03	0.08*
	(0.01)	(0.2)	(0.04)
Income opportunities			
- log (real GDP/head)	0.64*	0.58*	0.12
	(0.07)	(0.08)	(0.28)
- log (ur)	0.05*	0.14*	-0.04
	(0.01)	(0.02)	(0.04)
- recession (Δ log (real GDP) < 0.01)	0.009	-0.003	0.002
	(0.007)	(0.009)	(0.009)
- improvement of state-specific income position	0.014*	0.004	0.004
	(0.004)	(0.005)	(0.007)
Demographics			
- log (share of young men, 15–24)	0.28*	-0.49*	0.31*
	(0.04)	(0.11)	(0.13)
- log (share of foreigners)	0.48*	0.33*	0.40*
	(0.04)	(0.06)	(0.11)
Control			
- log (police expenditures/GDP)	0.73*	0.44*	0.32
	(0.07)	(0.09)	(0.20)
- conservative government	-0.028*	-0.008	0.028
	(0.010)	(0.012)	(0.015)
Fixed effects	yes	yes	yes
Time effects	no	yes	no
AR(1)–coefficient	-	-	0.81
			(0.06)
BFN–DW–statistics	0.56	0.55	2.11
Adjusted R–squared	0.949	0.954	0.980

First two columns: SUR–estimation; third column: AR(1)–modelling of residual, White´s (1980) heteroskedasticity–consistent standard errors in parentheses (3rd col.); sample: West German states (11), 1976–1995 (220 observations).

Table 7: Panel regression results, data in levels

	log (Theft)		
	(T1)	(T2)	(T3)
Deterrence			
- log (clear–up rate)	-0.45*	-0.44*	-0.42*
	(0.03)	(0.03)	(0.07)
Drugs			
- log (drug offences)	0.11*	0.12*	0.10*
	(0.01)	(0.01)	(0.03)
Income opportunities			
- log (real GDP/head)	-0.09	-0.10*	-0.12
	(0.06)	(0.05)	(0.12)
- log (ur)	0.08*	0.16*	0.09*
	(0.01)	(0.02)	(0.02)
- recession (Δ log (real GDP) < 0.01)	0.012*	-0.009	0.028*
	(0.006)	(0.006)	(0.009)
- improvement of state–specific income position	-0.003	-0.011*	0.016*
	(0.004)	(0.004)	(0.008)
Demographics			
- log (share of young men, 15–24)	0.49*	0.37*	0.48*
	(0.03)	(0.08)	(0.07)
- log (share of foreigners)	0.36*	0.31*	0.37*
	(0.04)	(0.04)	(0.07)
Control			
- log (police expenditures/GDP)	-0.01	-0.03	0.00
	(0.06)	(0.06)	(0.11)
- conservative government	0.031*	0.033*	0.024
	(0.007)	(0.008)	(0.013)
Fixed effects	yes	yes	yes
Time effects	no	yes	no
AR(1)–coefficient	-	-	0.34
			(0.09)
BFN–DW–statistics	1.33	1.50	1.82
Adjusted R-squared	0.987	0.992	0.989

First two columns: SUR–estimation; third column: AR(1)-modelling of residual, White´s (1980) heteroskedasticity–consistent standard errors in parentheses (3rd col.); sample: West German states (11), 1976–1995 (220 observations).

Table 8: Panel regression results, data in levels

	log (Robbery)		
	(R1)	(R2)	(R3)
Deterrence			
- log (clear–up rate)	-0.78*	-0.78*	-0.14
	(0.04)	(0.05)	(0.09)
Drugs			
- log (drug offences)	0.21*	0.17*	0.11*
	(0.02)	(0.02)	(0.04)
Income opportunities			
- log (real GDP/head)	-0.59*	-0.31*	-0.37
	(0.08)	(0.10)	(0.35)
- log (ur)	0.07*	0.24*	0.06
	(0.02)	(0.04)	(0.05)
- recession (Δ log (real GDP) < 0.01)	-0.024*	-0.040*	0.014
	(0.008)	(0.011)	(0.016)
- improvement of state–specific income position	0.008	0.003	0.037*
	(0.006)	(0.009)	(0.012)
Demographics			
-log (share of young men, 15–24)	0.19*	0.40*	-0.10
	(0.05)	(0.20)	(0.17)
-log (share of foreigners)	0.98*	0.62*	0.79*
	(0.06)	(0.07)	(0.14)
Control			
- log (police expenditures/GDP)	-0.01	0.09	0.15
	(0.08)	(0.12)	(0.28)
- conservative government	0.140*	0.124*	0.044
	(0.011)	(0.012)	(0.024)
Fixed effects	yes	yes	yes
Time effects	no	yes	no
AR(1)–coefficient	-	-	0.82*
			(0.05)
BFN–DW–statistics	0.94	0.83	2.09
Adjusted R-squared	0.974	0.980	0.985

First two columns: SUR–estimation; third column: AR(1)–modelling of residual, White´s (1980) heteroskedasticity–consistent standard errors in parentheses (3rd col.); sample: West German states (11), 1976–1995 (220 observations).

Table 9: Panel regression results, data in levels

	log (Vandalism)		
	(V1)	(V2)	(V3)
Deterrence			
- log (clear–up rate)	-0.42*	-0.44*	-0.13
	(0.04)	(0.04)	(0.11)
Drugs			
- log (drug offences)	0.13*	0.12*	0.12*
	(0.01)	(0.01)	(0.04)
Income opportunities			
- log (real GDP/head)	0.05	-0.03	-0.08
	(0.07)	(0.09)	(0.29)
- log (ur)	0.04*	-0.00	-0.06
	(0.02)	(0.10)	(0.05)
- recession (Δ log (real GDP) < 0.01)	0.027*	0.004	0.001
	(0.005)	(0.007)	(0.010)
- improvement of state–specific income position	0.012*	0.005	0.008
	(0.004)	(0.005)	(0.008)
Demographics			
- log (share of young men, 15–24)	0.18*	-0.32*	0.04
	(0.07)	(0.13)	(0.18)
- log (share of foreigners)	0.08	0.09	0.06
	(0.04)	(0.06)	(0.12)
Control			
- log (police expenditures/GDP)	-0.26*	-0.45*	0.16
	(0.07)	(0.09)	(0.18)
- conservative government	-0.004	0.000	0.033
	(0.008)	(0.011)	(0.023)
Fixed effects	yes	yes	yes
Time effects	no	yes	no
AR(1)–coefficient	-	-	0.77
			(0.05)
BFN–DW–statistics	0.60	0.53	2.26
Adjusted R–squared	0.928	0.933	0.972

First two columns: SUR–estimation; third column: AR(1)–modelling of residual, White´s (1980) heteroskedasticity–consistent standard errors in parentheses (3rd col.); sample: West German states (11), 1978–1995 (198 observations).

Table 10: Panel regressions based on growth rates

	dlog (Murder)		
	(M)	(M-IV[2)])	(M-Hausman)
Deterrence			
- dlog (clear–up rate)	-0.48*	-1.64	-0.40
	(0.12)	(2.03)	(0.25)
Drugs			
- dlog (drug offences)	-0.10*	-0.06	0.80
	(0.04)	(0.08)	(0.70)
Income opportunities			
- dlog (real GDP/head)	-0.09	-0.16	-1.67
	(0.60)	(1.12)	(2.06)
- dlog (ur)	-0.01	0.03	0.16
	(0.06)	(0.11)	(0.12)
- recession (dlog (real GDP) < 0.01)	0.035	0.019	-0.028
	(0.019)	(0.039)	(0.054)
- improvement of state–specific income position	0.036*	0.007	0.035
	(0.012)	(0.030)	(0.036)
Demographics			
- dlog (share of young men, 15–24)	0.23	0.15	-0.04
	(0.25)	(0.44)	(0.42)
- dlog (share of foreigners)	0.26	0.17	-0.04
	(0.16)	(0.28)	(0.35)
Control			
- dlog (police expenditures/GDP)	1.31*	1.03*	1.00*
	(0.28)	(0.50)	(0.50)
Hausman–specification test[1)]	-	-	-0.85
		-	(0.72)
Test for overidentification restrictions	-	0.41	-
BFN–DW–statistics	2.63	2.66	2.80
Adjusted R–squared	0.125	0.125	0.143

First column: SUR–estimation; columns two and three: White´s (1980) heteroskedasticity–consistent standard errors in parentheses; sample: West–German states (11), 1976–1995 (220 observations), [1)] Residual from first–step regression of dlog (drug offences) on exogenous variables and instruments, [2)] 2SLS, treating clear–up rates as endogenous

Table 11: Panel regressions based on growth rates

	dlog (Assault)		
	(A)	(A-IV[2)])	(A-Hausman)
Deterrence			
- dlog (clear–up rate)	-0.27*	4.23	-0.65
	(0.14)	(3.89)	(0.37)
Drugs			
- dlog (drug offences)	0.06*	0.05	0.58*
	(0.02)	(0.05)	(0.28)
Income opportunities			
- dlog (real GDP/head)	0.54*	0.92	-0.74
	(0.27)	(0.77)	(0.81)
- dlog (ur)	-0.04	-0.09	-0.00
	(0.02)	(0.05)	(0.05)
- recession (dlog (real GDP) < 0.01)	0.017*	0.027	-0.008
	(0.008)	(0.020)	(0.020)
- improvement of state–specific income position	0.002	0.004	0.019
	(0.004)	(0.010)	(0.014)
Demographics			
- dlog (share of young men, 15–24)	0.56*	0.61*	0.38*
	(0.10)	(0.18)	(0.18)
- dlog (share of foreigners)	0.34*	0.91	0.17
	(0.06)	(0.47)	(0.15)
Control			
- dlog (police expenditures/GDP)	0.42*	0.51*	0.27
	(0.09)	(0.22)	(0.20)
Hausman–specification test[1)]	-	-	-0.51
		-	(0.28)
Test for overidentification restrictions	-	3.03	-
BFN–DW–statistics	2.21	2.28	2.20
Adjusted R-squared	0.205	0.208	0.232

First column: SUR–estimation; columns two and three: White´s (1980) heteroskedasticity–consistent standard errors in parentheses; sample: West–German states (11), 1976–1995 (220 observations), [1)] Residual from first–step regression of dlog (drug offences) on exogenous variables and instruments, [2)] 2SLS, treating clear–up rates as endogenous

Table 12: Panel regressions based on growth rates

	dlog (Theft)		
	(T)	(T-IV[2)])	(T-Hausman)
Deterrence			
- dlog (clear–up rate)	-0.13*	-0.82	-0.24*
	(0.05)	(0.67)	(0.09)
Drugs			
- dlog (drug offences)	0.07*	0.07*	0.35
	(0.02)	(0.03)	(0.23)
Income opportunities			
- dlog (real GDP/head)	0.31	0.90	-0.52
	(0.23)	(0.67)	(0.68)
- dlog (ur)	0.01	0.05	0.06
	(0.03)	(0.04)	(0.05)
- recession (dlog (real GDP) < 0.01)	0.014	0.043	0.001
	(0.007)	(0.028)	(0.018)
- improvement of state–specific income position	0.004	0.019*	0.026*
	(0.005)	(0.010)	(0.010)
Demographics			
- dlog (share of young men, 15–24)	0.54*	0.71*	0.69*
	(0.13)	(0.14)	(0.15)
- dlog (share of foreigners)	0.28*	0.28*	0.27*
	(0.08)	(0.09)	(0.12)
Control			
- dlog (police expenditures/GDP)	0.38*	0.55*	0.49*
	(0.10)	(0.19)	(0.20)
Hausman–specification test[1)]	-	-	-0.29
		-	(0.23)
Test for overidentification restrictions	-	0.10	-
BFN–DW–statistics	2.13	2.12	2.24
Adjusted R-squared	0.316	0.325	0.374

First column: SUR–estimation; columns two and three: White´s (1980) heteroskedasticity–consistent standard errors in parentheses; sample: West–German states (11), 1976–1995 (220 observations), [1)] Residual from first–step regression of dlog (drug offences) on exogenous variables and instruments, [2)] 2SLS, treating clear–up rates as endogenous

Table 13: Panel regressions based on growth rates

	dlog (Robbery)		
	(R)	(R-IV[2)])	(R-Hausman)
Deterrence			
- dlog (clear–up rate)	-0.11*	-0.79	-0.16
	(0.05)	(2.01)	(0.12)
Drugs			
- dlog (drug offences)	0.09*	0.14	0.20
	(0.02)	(0.11)	(0.25)
Income opportunities			
- dlog (real GDP/head)	0.72	0.20	0.66
	(0.39)	(0.75)	(0.74)
- dlog (ur)	0.12*	0.06	0.09
	(0.05)	(0.06)	(0.07)
- recession (dlog (real GDP) < 0.01)	0.020	0.020	0.032
	(0.011)	(0.031)	(0.026)
- improvement of state–specific income position	0.018*	0.039	0.025
	(0.008)	(0.031)	(0.016)
Demographics			
- dlog (share of young men, 15–24)	0.09	0.23	0.22
	(0.23)	(0.20)	(0.21)
- dlog (share of foreigners)	0.64*	0.82*	0.80*
	(0.14)	(0.17)	(0.17)
Control			
- dlog (police expenditures/GDP)	0.45*	0.55	0.40
	(0.15)	(0.56)	(0.28)
Hausman–specification test[1)]	-	-	-0.10
		-	(0.25)
Test for overidentification restrictions	-	4.05*	-
BFN–DW–statistics	2.23	2.32	2.33
Adjusted R-squared	0.246	0.271	0.279

First column: SUR–estimation; columns two and three: White´s (1980) heteroskedasticity–consistent standard errors in parentheses; sample: West–German states (11), 1976–1995 (220 observations), [1)] Residual from first–step regression of dlog (drug offences) on exogenous variables and instruments, [2)] 2SLS, treating clear–up rates as endogenous

Table 14: Panel regressions based on growth rates

	dlog (Vandalism)		
	(V)	(V-IV[2)])	(V-Hausman)
Deterrence			
- dlog (clear–up rate)	-0.10*	-0.29	-0.14
	(0.04)	(0.60)	(0.10)
Drugs			
- dlog (drug offences)	0.10*	0.12*	-0.99*
	(0.01)	(0.04)	(0.36)
Income opportunities			
- dlog (real GDP/head)	-0.44	-0.18	1.97*
	(0.25)	(0.48)	(0.96)
- dlog (ur)	-0.10*	-0.07	-0.23*
	(0.03)	(0.05)	(0.06)
- recession (dlog (real GDP) < 0.01)	-0.007	-0.005	0.042
	(0.007)	(0.018)	(0.026)
- improvement of state–specific income position	0.017*	0.017	-0.016
	(0.005)	(0.010)	(0.015)
Demographics			
- dlog (share of young men, 15–24)	0.79*	0.65*	1.09*
	(0.15)	(0.17)	(0.22)
- dlog (share of foreigners)	0.10	0.06	0.37*
	(0.09)	(0.12)	(0.15)
Control			
- dlog (police expenditures/GDP)	0.25*	0.30	0.59*
	(0.11)	(0.19)	(0.20)
Hausman–specification test[1)]	-	-	1.12*
		-	(0.36)
Test for overidentification restrictions	-	7.21*	-
BFN–DW–statistics	2.33	2.35	2.34
Adjusted R-squared	0.155	0.166	0.228

First column: SUR–estimation; columns two and three: White´s (1980) heteroskedasticity–consistent standard errors in parentheses; sample: West–German states (11), 1978–1995 (198 observations), [1)] Residual from first-step regression of dlog (drug offences) on exogenous variables and instruments, [2)] 2SLS, treating clear–up rates as endogenous

Table 15: Deterrence versus the drugs–crime nexus

	Deterrence	Drug Offences
Murder	$-0.97^{*}/-0.48^{*}$	$0.05\ /-0.10^{*}$
Assault	$-0.44\ /-0.27^{*}$	$0.08^{*}/\ 0.06^{*}$
Theft	$-0.42^{*}/-0.13^{*}$	$0.10^{*}/\ 0.07^{*}$
Robbery	$-0.14/-0.11^{*}$	$0.11^{*}/\ 0.09^{*}$
Vandalism	$-0.13\ /-0.10^{*}$	$0.12^{*}/\ 0.10^{*}$

Summary of estimated coefficient on clear–up rate and drug offences from Tables 5–14. Reported entries denote "fixed–effect modelling corrected for serial correlation"/"panel regression based on growth rates". Asterisks denote significance at the 5% significance level.

Table 16: Effects of legal/illegal income opportunities

	GDP p.c.	unemployment rate	recession	relative improvement
Murder	$-\ 0.86\ /-0.09$	$0.14^{*}/-0.01$	$0.000\ /\ 0.035$	$0.020\ /\ 0.036^{*}$
Assault	$0.12\ /\ \ 0.54^{*}$	$-\ 0.04/-0.04$	$0.002\ /\ 0.017^{*}$	$0.004\ /\ 0.002$
Theft	$-\ 0.12\ /\ 0.31$	$0.09^{*}/\ \ 0.01$	$0.028^{*}\ /\ 0.014$	$0.016^{*}/\ 0.004$
Robbery	$-\ 0.37\ /\ \ 0.72$	$0.06\ /\ \ 0.12^{*}$	$0.014\ /\ 0.020$	$0.037^{*}/\ \ 0.018^{*}$
Vandalism	$-\ 0.08\ /-0.44$	$-\ 0.06\ /-0.10^{*}$	$0.001\ /-0.007$	$0.008\ /\ 0.017^{*}$

Summary of estimated coefficient on clear–up rate and drug offences from Tables 5–14. Reported entries denote "fixed–effect modelling corrected for serial correlation"/"panel regression based on growth rates". Asterisks denote significance at the 5% significance level.

7 Conclusions and discussion

Drug addiction is a topic of major public concern. This is partially due to the assumption that there might exist a causal relationship from drug abuse to increasing crime rates. In fact, a cursory inspection of the problem might lead to this conclusion. Many surveys indicate that drug users are more likely to have a connection with the criminal justice system (through arrests and incarcerations) compared to non–drug users, and criminal justice system data indicate that a large percentage of arrestees test positive for illicit drug use at the time of their arrest (see French et al., 2000, for a survey of the related criminological literature). However, drug use may be, as French et al. (2000) put it, the "catalyst" for criminal activity, but the interrelationships between drug use and crime are more complex and require more than a two–dimensional view of the drugs–crime nexus. In this paper, this link is analysed within the Becker–Ehrlich model of crime supply, augmented by the consideration of currently discussed factors like demographic changes, unemployment, and income inequality. Three different channels from drug abuse to crime are considered: systemic, economic and pharmacological effect, each of which has a specific impact on different crime categories.

Estimation with panel data for 11 German states allows us to assess the importance of the drug abuse crime link. Based on a variety of econometric approaches, it turns out that there is a significant drugs–crime nexus, which has been ignored in most previous applications of the Becker–Ehrlich framework, but that illicit drug use is far from being the only or exclusive driving force behind the evolvement of crime rates. The highest impact of drug use is on property crimes such as robbery and theft. This can be attributed to a dominating economic effect of drug abuse. In spite of a different measure of the drug problem (we use drug offences and not deaths due to drug poisoning), different econometric methods (panel econometrics versus time series analysis) and different observational units (German states versus New York City), our results are similar to those presented by Corman and Mocan (2000), underlining the robustness of found results.

We are sceptical, however, with respect to the far–reaching policy implications made by Corman and Mocan (2000). Based on the comparison of estimated elasticities of robberies, for instance, which are, 0.18 to 0.28 for drug use and -0.71 to -0.94 for robbery arrests, they conclude that "increased law

enforcement is a more effective methods of crime prevention in comparison to efforts targeted at drug use". Without consideration of any cost–benefit analysis, such suggestions are difficult to give. They would require cost estimates of a one percent change of drug offences and arrests or clear–up rates on the one hand, and estimation of benefits in terms of reduced costs of crime, more particularly of murder, assault, theft, robbery, vandalism etc. on the other. Corman and Mocan (2000) do not use such figures, although costs of crime are available for the U.S. (see, for instance, Anderson 1999; unfortunately, no comparable cost of crime estimates can be obtained for Germany).

Chronic drug users are also victims of crime. This is a neglected aspect when quantifying the benefits of crime reduction. French et al. (2000) find that, relative to non–drug users, chronic drug users are 16 percent more likely to become a victim of crime (and 23 percent more likely to be a perpetrator of crime, and 25 percent more likely to be either a victim or a perpetrator).

The most difficult task, however, is to evaluate the benefits of drug prevention programs, or rehabilitation programs. There is a variety of programs in use, and not all of them are ineffective. A substantial body of research in the US, mainly performed by the Department of Health, has found that treatment programmes can produce marked reductions in illegal drug use and drug related crime. For instance, the United States' 1996 National Treatment Improvement Evaluation Study found that clients reported a decrease of about 50% in the year following treatment and that arrests had declined from 48.2% to 17.2% (NACRO 1999). Of course, there are good reasons to be sceptical about these big successes, and econometricians might suspect some selectivity problems. However, just for this reason much more evaluative work needs to be done before strong conclusions like the one given by Corman and Mocan (2000) can be drawn.

Given the lack of reliable cost–benefit results, besides conventional measures, which try to increase the clear–up rate, programs aiming at reducing the economic effect of drug abuse can be considered. However, in order to obtain sustainable effects, such programs should not contribute to an increase in rents on the illegal drug market, but rather aim at reducing these rents. The development of actual proposals to this end remains on our research agenda.

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