German Economic Review ■(■): 1–23

Crime, Deterrence, and Democracy

Libor Dušek
CERGE-EI

Abstract. *The article provides new evidence on the effects of a major shock to deterrence on crime. The collapse of communism in the Czech Republic in 1989 was followed by sharp reductions in the probability and severity of punishment and by sharp increases in crime rates. I investigate whether deterrence was a significant contributor to the post-1989 growth in crime on a panel dataset of Czech regions. The results show strong deterrence effects for robbery, theft and intentional injury, but not for murder and rape. About 25% of the increase in robberies and 50% of the growth in thefts is accounted for by weaker deterrence.*

JEL classification: *K*42, *K*14, *P*37.

Keywords: Crime under transition; deterrence; economics of crime.

1. INTRODUCTION

Does deterrence cut crime? The empirical literature testing the basic prediction of the economic model of crime has taken several approaches. The early articles used data aggregated at the level of counties, states or countries, and regressed the crime rates on empirical measures of the probability and severity of punishment [e.g., Ehrlich (1973), Wolpin (1980), Cornwell and Trumbull (1994)]. The weakness of this approach is the lack of a clear source of exogenous variation in deterrence; it is therefore difficult to give the estimated deterrence effects a causal interpretation. Later approaches overcame this weakness by using an explicit identification strategy. Some authors found instruments for changes in deterrence [e.g., Levitt (1997), Evans and Owens (2007)], exploited variation in legislative changes [e.g., Shepherd (2002)] or most relevantly for this article, studied the effects of major short-term shocks. Di Tella and Schargrodsky (2004), Klick and Tabarrok (2005) and Draca *et al.* (2011) find large reductions in certain crimes during large increases in the deployment of police forces in the wake of terrorist attacks or during terror alerts. These approaches, however, often estimate the effects of policy interventions (e.g., putting more policemen on the street) rather than the behavioral relationship postulated by the economic model of crime – the link between the probability and severity of punishment and the crime rates.

This article combines the last approach with the first. It investigates the effect on crime of a large and sudden drop in deterrence brought about by the collapse of communism in the Czech Republic. It also estimates the conventional deterrence effects of the probability of charges, probability of conviction and the length of prison sentence. The ability to estimate the effects of the three criminal

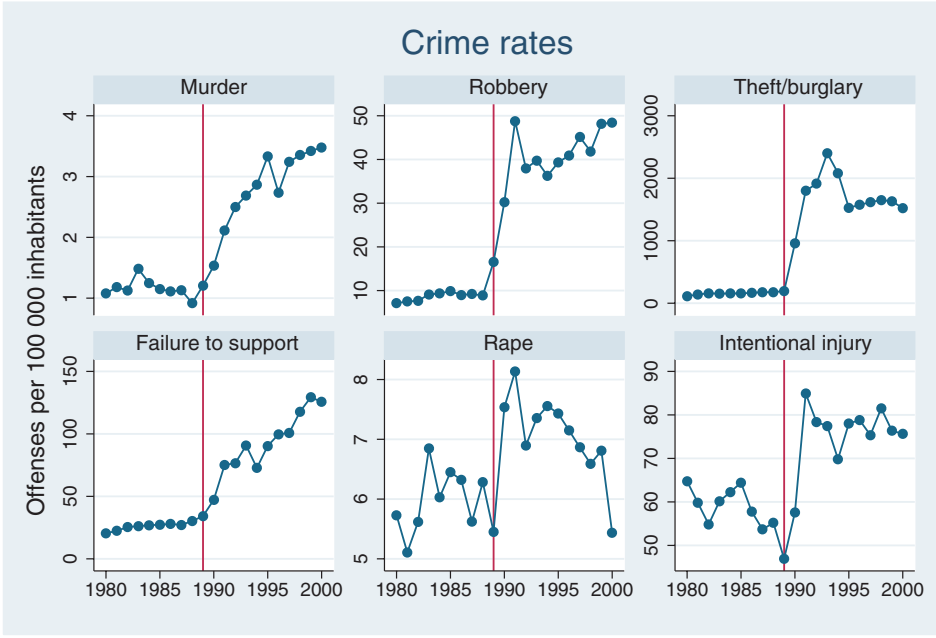

Figure 1 Crime rates

justice variables is also an improvement in the literature because of the lack of consistent conviction data for the US states or counties.[1]

The abrupt regime change in November 1989 was soon followed by very sharp declines in the probability that an offender is arrested, charged and convicted. The variation in deterrence generated by this shock is rarely observed within a single jurisdiction. For example, in 1988, the chance that someone committing a robbery would be charged was 78%; of those charged with robbery, 82% were convicted and 85% of those convicted were sentenced to prison. Just 4 years later, only 36% of robberies translated into charges, only 53% of charges resulted in convictions and 76% of convicts were sentenced to prison. Similar declines occurred for other offenses.[2]

In addition, an increase in crime has turned out to be an unexpected and unpleasant side effect of democracy. The murder rate increased from 0.93 in 1988 to 2.5 in 1992 and continued to rise until the late 1990's (see Figure 1). The rise in property crime was even more pronounced. Just during the first post-revolution year, the number of thefts and burglaries increased fivefold, and later stabilized at around eight times its level under communism. Crime became one of the major negative aspects of post-1989 development and one of the major concerns of ordinary citizens as well as politicians (Tucek *et al.,* 1999).

1. Mustard (2003) is a rare deterrence study using the conviction and sentence county-level data in the US; Mustard succeeded to collect such data for four US states.
2. To put the numbers in perspective: One of the largest shocks to police deployment studied in the literature (Draca *et al.,* 2011) was a 34% increase in police hours in London after the July 2005 terrorist attacks. In Wolpin (1980)'s analysis of robberies in California, England and Wales and Japan, the clearance rate fell from 38.5% to 23.5% in California and from 50.7% to 42% in England and Wales during the 16-year sample period.

The growth in crime after the fall of communism was by no means unique to the Czech Republic. Table 1 shows the crime rates for Hungary, Poland and East Germany. Like in the Czech case, homicides, robberies and thefts increased quickly by a factor of two or more in these countries. The table is meant to be only illustrative as I was not able to obtain sufficiently detailed data for other countries that would allow a reliable empirical analysis. I therefore confine the article to a single country, at a cost of having fewer observations and forgoing the cross-country variation but at a benefit of using regional data that contain detailed deterrence measures and are comparable over time and across geographical units.

The dataset is a panel of the Czech Republic's regions. In addition to the variation over time, there is substantial variation between regions in the change in deterrence from the pre-1989 to the post-1989 period. I estimate the relationship between measures of deterrence and crime rates for six crime categories: murder, robbery, theft (including burglary), failure to support, rape and intentional injury.[3] The key specification is a seemingly unrelated regressions model with lagged deterrence variables. I find that deterrence has statistically and economically significant effect on robberies, thefts, intentional injuries, and, in some specifications, also on the failure to support. However, I do not find statistically significant deterrence effects for murders and rapes. The estimates of the elasticity of the crime rate with respect to the probability of charge lie between -0.25 and -0.87 for robberies, and between -0.51 and -0.66 for thefts. The elasticities of the crime rate with respect to the conditional probability of conviction and the expected length of prison sentence are smaller in magnitude. I also predict how the crime rates would have evolved if deterrence had stayed at the 1989 levels. One quarter of the growth in robberies and over one half of the growth in thefts and intentional injuries during the 1990's can be explained by the fall in deterrence.

A natural concern is that the estimates do not reflect the effect of weaker deterrence but the effect of unobservable shocks associated with the transition from communism to democracy which also contributed to the growth in crime. For example, replacing central planning with the basic institutions of capitalism inevitably increased the gains from criminal activities: free trade made it easier to sell stolen goods abroad; open borders attracted crowds of tourists that are potential targets of robbers and thieves; higher incomes and household wealth increased the value of goods that can be stolen[4]; and the rise in entrepreneurial activity gave rise to new types of conflicts that potentially may be resolved by violence. Rising unemployment reduced the opportunity costs of criminal activities. New social phenomena such as drugs, human trafficking and organized

3. These crimes were selected because they are serious or most numerous. To clarify the definitions of less-standard crimes: Failure to support is defined as non-fulfilling one's legal duty to materially support another person, e.g. when a divorced father stops making alimony payments, and is punishable by imprisonment (section 213 of the Czech Criminal Code). Intentional injury comprises only non-serious intentional injuries (section 221 of the Czech Criminal Code).
4. This can be documented by the increase in the stock of consumer durables. The number of cars per 100 households rose from 62 (1990) to 70 (2000), and the number of refrigerators/freezers rose from 118 (1990) to 153 (2000). Data on less basic durables are not available until the mid-1990's but for example video recorders were a rarity in the socialist economy while in 1995 there were 29 video recorders per 100 households and in 2008 there were 48. (Source: Czech Republic Yearbooks)

Table 1 International comparison: recorded rates of criminal acts per 100,000 inhabitants (averages over 2 years)

Year	Hungary			Poland			East Germany*		
	Intentional homicide	Robbery	Theft	Intentional homicide	Robbery	Theft	Intentional homicide	Robbery	Theft
1986–1987	2.1	15	929	1.5	20	306	0.7	5	
1988–1989	1.9	16	1 199	1.5	21	340			
1990–1991	2.4	33	647	2.4	44	552	1.0	35	529
1992–1993	2.9	30	2 415	2.9	50	498	4.1	123	5 854
1994–1995	2.9	25	2 217	3.1	65	588	5.5	141	6 400
1996–1997	2.7	28	2 751	3.0	73	407	4.7	144	5 956
1998–1999	2.6	30	2 715	5.7	102	417			

Notes: *Figures for Federal Republic of Germany starting from 1990 onward and all figures for East Germany were obtained from Polizeische Kriminalstatistik Deutschland. Population data come from World Development Indicators produced by the World Bank, for GDR and FRG from www.populstat.info. Because I was not able to obtain data for all years preceding 1990 for all three countries, some numbers reported in the table represent either 2-year averages or observations for only one of the 2 years when data for both years were not available.
Source: UN Surveys on Crime Trends and the Operation of Criminal Justice Systems, Polizeische Kriminalstatistik Deutschland

crime have altered the nature of certain crimes such as murders and robberies (Cejp, 2003).

I do acknowledge that such shocks undoubtedly contributed to the growth in crime. I control for some of them (e.g., changes in unemployment or income inequality) but it is fruitless to hope that all of them could ever be captured as observable variables in any dataset. Still, there are several arguments and specifications supporting the claim that the estimates indeed capture deterrence effects (presented in detail in Section 4). They are based on the lack of correlation between the post-1989 changes in deterrence and pre-1989 observables at the regional level, the patterns in the estimated year fixed effects, and the absence of a structural break in the estimated deterrence effects.

2. DEMOCRACY AND DETERRENCE

The transition from communism to democracy brought a large decline in deterrence through several channels. One was a major shakedown of police forces undertaken immediately after the 1989 Velvet Revolution. It involved abolishing the secret police, laying off or degrading many higher rank officers, and reorganizing the internal structure and procedures. These measures together reduced (at least temporarily) the capability of the police to prevent and to investigate crime. The second important channel, I argue, was a wide range of civil rights reforms that eliminated the oppressiveness and abuses in the communist system of (in)justice. They generally restricted the powers of law enforcement authorities, protected citizens against certain practices of those authorities and made punishment less severe.[5]

Specifically, the length of time during which a person can be detained was shortened from 48 to 24 hours, and the limit was being strictly enforced. The investigation procedure was substantially reorganized. The old procedure made it possible to carry out investigation, collect evidence and only after that inform the suspect about the charges; the new procedure requires all investigations to be carried out against a particular person who has to be informed about them from the beginning.

The rights of defendants, such as the right to remain silent, the right to have consultation with counsel at any time, the right to have counsel present during interrogation, and the right to read all documentation regarding one's case during all stages of the criminal process were newly granted or expanded. Wiretapping of communication between the defendant and his counsel was disallowed without exception. Release on bail was made possible. Decisions regarding arrest and pretrial detention were shifted from the state attorneys to the judges.

Few people would prefer living in a society where the civil rights just described are denied. However, limiting the powers of law enforcement authorities and extending the rights of offenders increases the chance that a guilty offender is not punished. Such institutional changes would be reflected in a reduction in the empirical probability that an offender is charged, convicted and sentenced to

5. Vujtech *et al.* (2001) provide an overview of the reforms.

prison, although it is difficult to assess the contribution of specific changes. Anecdotal evidence includes a survey conducted among police officers at the end of 1990 who generally complained that 'the 24 hour limit on the detention of suspects is the greatest obstacle in collecting evidence' (Tomin, 1991). According to a conversation with a judge, a high fraction of cases in the early 1990's were dismissed on purely procedural grounds, since the police did not yet adapt to the new rules and were violating some of the new rights of defendants.

The democratic reforms also reduced the severity of punishment by the elimination of the death penalty,[6] by improvements in prison conditions, and by a gradual shift away from imprisonment towards alternative forms of punishment such as public works, contractual settlement between offender and victim and probation.

Finally, deterrence would have likely declined even in the absence of any policy changes through the 'resource saturation' mechanism (Fisher and Nagin, 1978, p. 364). The initial increase in crime immediately following the 1989 revolution could arguably be attributed to factors unrelated to deterrence. Holding resources devoted to enforcement fixed (at least temporarily), such an exogenous increase in crime would reduce the fraction of offenses the police and courts are able to clear. Offenders update their perceptions of the probability of punishment and choose to commit more crime, potentially starting a vicious circle in which more crime breeds more crime.

Several authors investigated the relationship between democracy and crime without addressing deterrence per se. Williams and Serrins (1995) exploit the availability of data on crime in the Soviet Union during perestroika. They observe that crime rates in the USSR are an order of magnitude below those in the United States of America, and that such a large difference can hardly be explained by differences in incomes, inequality or other economic factors. On the other hand Pridemore (2001) constructs an alternative time series of homicides in Russia from the national vital statistics and finds that during the 1980's the homicide rates in Russia and the United States were roughly equal. Andrienko and Shelley (2005) analyze the determinants of violent crime in post-Soviet Russia. Their focus is on the influence of ethnic and political conflict rather than on more standard deterrence variables. Since their dataset covers the years 1992–2000, they cannot assess how much the determinants of crime changed since the Soviet period.

This article is directly related to Lin (2007) who regresses crime rates in a world-wide panel of countries (already including some of the post-communist countries) against an index of democracy and finds that democracy is associated with higher rates of minor offenses such as theft but lower rates of serious offenses such as murder. This finding contrasts sharply with the experience of the Czech Republic and other post-communist countries where all crimes, including murders, increased substantially.[7] Lin (2007) also documents that more democratic countries have, on average, weaker deterrence.

6. The occurrence of capital punishment under communism, while rare, was much more frequent than in the US states that currently use it. 1200 murders were committed and 17 offenders were executed for murder during 1980–1989, implying that about one in 70 murders was punished by death. In contrast, one in 300 murders was punished by death in Texas, the US state with the highest execution rate, during 1976–1997 (Katz *et al.*, 2003, p. 319).
7. However, the relative change in crime rates is consistent with Lin's findings, as the percentage increase in serious offenses was much lower than the percentage increase in minor offenses.

3. DATA

The panel dataset covers the period from 1980 to 2000. All variables are observed at the level of eight administrative regions ('*kraje*') that constituted the main units of regional police and court administration since 1960. The measures of deterrence are constructed from the *Criminal Statistics Yearbooks* published by the Ministry of Justice (1981–2001). They report the number of cases completed at each step of the criminal process for each offense defined by the criminal code. From that information I construct:

P^A, the probability of charge, measured as the number of defendants charged at court divided by the number of offenses. It is a summary measure of the 'productivity of police' – its ability to identify and apprehend offenders and to collect sufficient evidence to bring offenders to court.

P^C, the conditional probability of conviction, measured as the number of defendants convicted of a particular type of offense divided by the number of defendants charged. It captures the 'productivity of the courts', as well as the burden of proof required to convict a defendant, and the degree of procedural rights granted to defendants.

F, the expected length of prison sentence faced by a convicted offender. It is constructed as the number of offenders sentenced to prison divided by the number of offenders convicted, times the average length of a prison sentence. The average length of prison sentence is computed from the information on the distribution of prison sentences – the yearbook reports the number of offenders sentenced to a prison term of <6 months, 6–12 months, 1–2 years, 2–5 years, more than 5 years, life imprisonment or the death penalty.[8]

The remaining criminal justice variables are the number of policemen employed by the Police of the Czech Republic in each region, which was provided by the personnel department at the Ministry of the Interior from their internal records, and the average real wage in the public sector which proxies for the cost of police.

The variable to be explained, the number of offenses, is recorded in the Ministry of Justice yearbook up to 1994. From 1992 onward, the number of offenses has been recorded in the *Statistics of Crime in the Czech Republic*, an internal report of the Police Directorate (1992–2001), using a slightly different methodology. For the overlapping years 1992–1994, I select the higher of the two values as the number of offenses actually used in the analysis.

The reliability of the data covering the totalitarian period needs to be addressed. One might be naturally concerned that the official statistics intentionally underreported the number of crimes as Pridemore (2001) documents to have been the case of homicides in Russia. Fortunately, such concerns can be minimized in the Czech case. First, the Ministry of Justice yearbook was an internal government document, not a propaganda material. In fact, it had been treated as

8. From 1991, the reported intervals of prison sentences are <1 year, 5–15 years, more than 15 years and life imprisonment. To construct the average length of a sentence, I assume that the average length of a sentence within each reported interval is equal to the midpoint of that interval, i.e. I take 3 months for the interval of 0–6 months, and so on. For punishments over 5 years, I assume the average length is 10 years. I imputed 50 years as the equivalent punishment for the death penalty or life imprisonment.

classified and was made available to the public only after 1991. Second, the data came directly from the police, state attorneys and court administrative records and the computerized collection methodology did change over the sample period. The reported numbers of offenses, charges, etc. were produced as simple counts of forms that the officials filed with each step in the criminal procedure.[9]

The possibility of wrongful convictions raises a different concern. If a non-negligible fraction of persons convicted by the communist judiciary were in fact innocent, the probability of conviction constructed from the data overstates the probability of conviction faced by the true offender. Such a measurement error, however, biases the estimate of the deterrent effect of convictions downwards since the true probability of conviction declined after 1989 by less than the observed probability.

I also use several socioeconomic variables that proxy the supply of potential offenders, the gains from committing crime, and the income opportunities from legitimate activities. The supply of potential offenders largely depends on the age and gender composition of the population as a disproportionate fraction of crimes is committed by young men. To save the degrees of freedom I construct a single summarizing measure referred to as the 'effective supply of offenders': Denoting s_{ajt} the share of men of age a living in region j in year t, and q_{act} the average (across all regions) fraction of crimes c committed by persons of age a in a given year, the effective supply is then computed as $ESF_{cjt} = \sum_a s_{ajt} q_{act}$. Note that the effective supply is specific for each crime category.[10] The gains from criminal activities are proxied by the average wage in the region. The legal income opportunities are captured by the unemployment rate among males aged 20–29 and by a measure of wage inequality, the ratio of the average wage in the construction industry to the average wage in the financial services industry.[11]

9. For example, when the police determine that a criminal offense was committed, based on their own investigative activities or a report from the victims or witnesses, the responsible officer has to fill in a paper form with detailed information about the offense. For statistical purposes, a shorter version of the form is entered into the electronic database. Even if the higher authorities that produce the aggregate statistics are honest, the measurement error in the aggregated data still may arise if the local officers underreport or overreport cases in the electronic database; however, such sources of error are in no way unique to the communist or transition countries.
10. The computation of q_{act} is based on the number of offenders in each 5-year age interval who were either investigated (till 1990) or charged (since 1991) for each offense, as reported in the Ministry of Justice Yearbook. The share of men in the overall population by 5-year age intervals was provided by the Czech Statistical Office.
11. All wage and unemployment data come from 'Structure of Earnings Survey' and 'Employment and Unemployment in the CR as Measured by the Labour Force Sample Survey' series produced by the Czech Statistical Office. For the years prior to 1990, no unemployment measures were available, and for the years 1990–1992, only the nation-wide unemployment rate was available. The very concept of unemployment was unknown under the centrally planned economy, so I impute unemployment among men aged 20–29 to be zero in all regions for the years prior to 1990. For the years 1990–1992, I take the assumption that the ratio of the region-level unemployment rate among men aged 20–29 and the nation-wide unemployment rate was the same as in 1993, and impute the values accordingly. The same procedure was adopted for the wage data, where the industry-region observations on average wage are available since 1993 while for the years prior to 1993, only the region-wide average wage is available. Moreover, wage data were available for 1980, 1985 and 1990, but only since then at annual intervals; hence, the missing years during the 1980's were filled in by linear extrapolation. All wage variables were deflated to real 1989 Czech *koruna*.

Table 2 summarizes the crime rates and deterrence measures before and after the regime change. It also shows a substantial variation across regions both in the level of deterrence, and, more importantly, in the changes in deterrence from communism to democracy. For example, while the conditional probability of conviction for robbery fell by 22.4% on average, there is a region (Central Bohemia) where it fell by a mere 10.3% and a region (North Bohemia) where it fell by as much as 37%. This variation across regions provides an additional source of identification.

Figure 1 shows the trends in crime rates for each crime category. The year of the regime change (1989) is highlighted. The murder rate increased from approximately one murder per 100,000 to almost three. The robbery rate more than quadrupled, while the theft/burglary rate increased more than ten times. Moreover, the short-term drop in thefts after 1994 should most likely be attributed to a change in reporting methodology rather than to any actual decline. Rape appears to be the only crime category for which the number of offenses, after the initial jump, returned back to the pre-1989 levels.

Figure 2 shows the evolution of the empirical probability of charge. It substantially decreased in the first few years of democracy for all crimes except murder. While on average 79% of robbers were brought to court before 1989, only 54% were brought afterwards. This decline in police productivity is equally pronounced for thefts, where the probability of charge declined from 33% to 19%. The probability of charge rebounded in the mid-1990's almost to the pre-1989 levels for all crimes except robbery.

Figure 3 shows the evolution of the empirical probability of being convicted conditional on being charged. Under the communist judiciary, people charged with crime faced near-certainty of being found guilty – specifically, 96%, 77% and 83% for murder, robbery and theft, respectively. After the revolution, these probabilities dropped to 72%, 61% and 55%, and then rebounded almost to the pre-1989 levels for all crimes except thefts.

Finally, Figure 4 demonstrates the courts' proclivity to use prison as a form of punishment. The democratic reforms initiated a gradual decline in the use of prisons (with the obvious exception of murders). For example, 59% of thieves were sentenced to prison in 1988, while only 30% were in 2000.

4. ESTIMATES

4.1. Static framework

The starting point for estimating the relationship between deterrence and crime is a conventional fixed effects specification:

$$\log Y_{ijt} = \beta_i^A \log P_{ijt}^A + \beta_i^C \log P_{ijt}^C + \beta_i^F \log F_{ijt} + \beta_i^X X_{jt} + \lambda_{ij} + \lambda_{it} + \varepsilon_{ijt} \qquad (1)$$

The subscripts i, j and t denote the crime category, region and year, Y is the crime rate and X is a vector of socioeconomic variables. λ_{ij} *and* λ_{it} are region and year fixed effects. The year fixed effects for 1989 are normalized to zero; thus the fixed effects for other years have the interpretation of an average percentage change in crime rates compared to 1989 that is unexplained by the observables.

Table 2 Summary statistics

		Murder		Robbery		Theft/burglary		Failure to support		Rape		Intentional injury	
		Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.
Crime rate (offenses per 100,000 inhab.)	Communism	1.20	0.60	9.2	8.9	161	126	24.3	13.3	5.9	2.0	55.8	21.0
	Democracy	2.87	1.38	41.8	32.3	1713	1061	91.6	35.2	7.2	2.1	73.0	30.6
	Percentage change	148.1	51.7	351.4	95.5	1054.3	157.2	351.3	181.6	22.6	11.3	30.2	17.3
Probability of charge	Communism	0.63	0.18	0.79	0.12	0.33	0.10	0.55	0.10	0.69	0.11	0.73	0.13
	Democracy	0.68	0.17	0.54	0.17	0.18	0.08	0.59	0.15	0.48	0.11	0.49	0.15
	Percentage change	7.5	9.9	−32.3	12.2	−45.4	5.0	7.7	8.9	−29.9	7.2	−33.2	4.7
Probability of conviction	Communism	0.98	0.62	0.77	0.18	0.84	0.07	0.70	0.11	0.67	0.16	0.66	0.10
	Democracy	0.71	0.38	0.59	0.15	0.55	0.09	0.57	0.12	0.50	0.19	0.51	0.11
	Percentage change	−25.0	14.7	−22.4	9.9	−34.1	6.0	−17.7	7.7	−23.7	13.5	−22.0	5.0
Probability of prison sentence	Communism	0.98	0.05	0.87	0.08	0.62	0.06	0.69	0.08	0.86	0.08	0.21	0.05
	Democracy	0.99	0.03	0.70	0.10	0.31	0.08	0.24	0.10	0.65	0.16	0.09	0.04
	Percentage change	1.5	0.9	−19.4	4.3	−49.3	8.1	−64.7	5.3	−24.5	5.6	−58.4	9.0
Length of Prison sentence (months)	Communism	132	33	50.3	8.8	20.1	3.3	12.4	1.3	51.2	7.6	9.2	1.9
	Democracy	127	25	48.9	5.2	15.0	2.6	9.5	1.3	56.2	12.2	12.4	4.4
	Percentage change	−2.7	9.7	−2.2	7.9	−24.4	10.0	−23.1	7.8	10.4	13.8	37.5	21.2

Notes: Observations for communism and democracy are averages over 1980–1989 and 1990–2000, respectively.
Percentage change denotes the average (across regions) percentage difference between the communism and democracy averages.

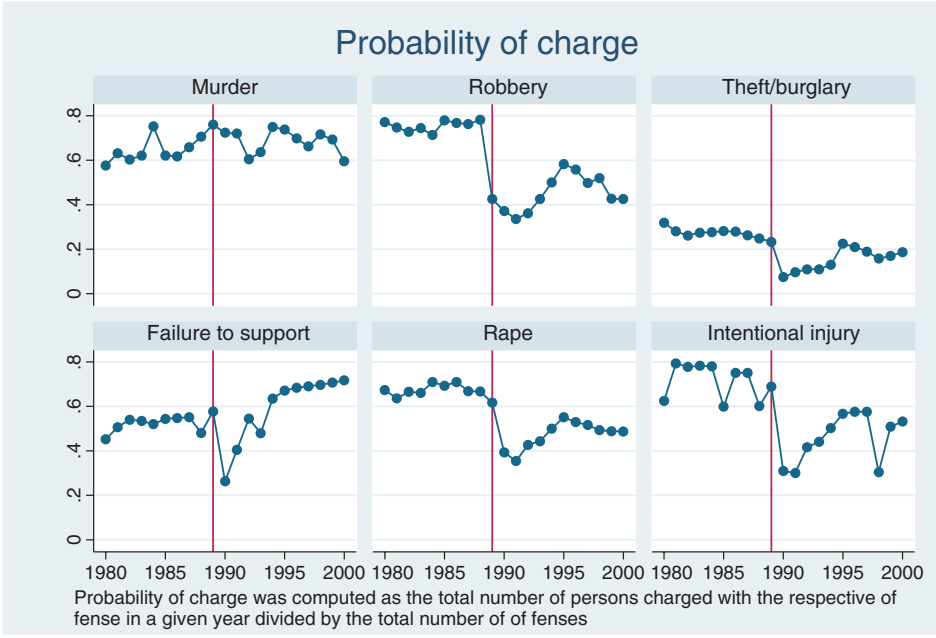

Figure 2 Probability of being charged

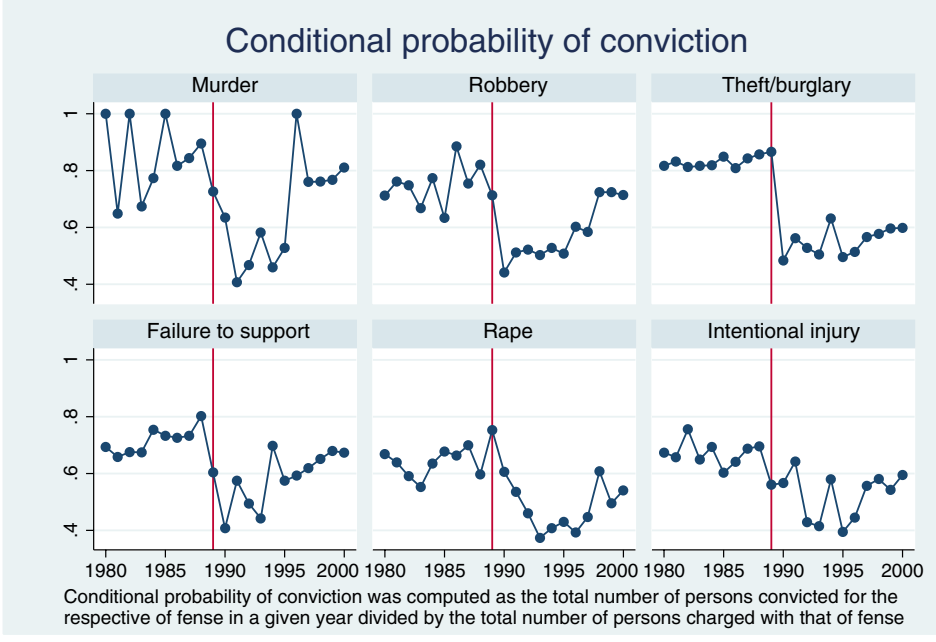

Figure 3 Conditional probability of conviction

It is likely that the error terms ε_{ijt} are correlated across offenses within a region-year, and are also serially correlated within region-offense. To account for the first correlation, equation 1 is estimated as a system of seemingly unrelated

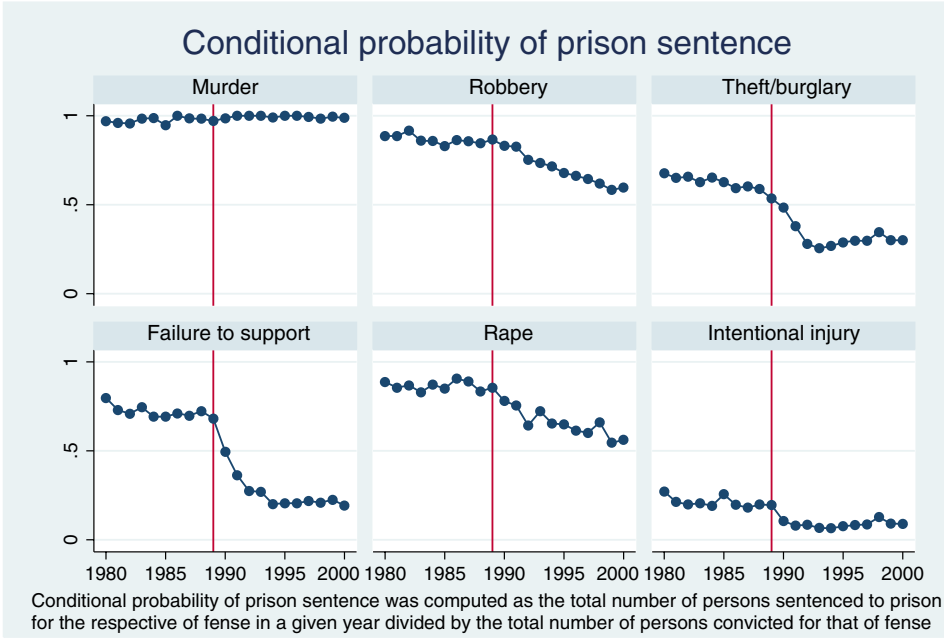

Figure 4 Conditional probability of prison sentence

regressions. To account for the serial correlation, one would ideally cluster by region when computing the standard errors. The conventional clustering corrections have, however, poor properties when the number of clusters is small. I follow the recommendation in Cameron *et al.* (2008) and Angrist and Pischke (2008, pp. 293–322) and estimate the standard errors by block bootstrapping. In block bootstrapping the entire clustering units (regions) are being re-sampled instead of individual observations.

The estimates are presented in Table 3. All coefficients on the probabilities of charge and conviction have the expected negative sign. Also, for all crime categories, the coefficient on at least one of the probabilities is statistically significant, and both of them are statistically significant for robbery, theft rape and injury.[12]

There are potentially two specification issues with the basic SUR framework. One, the SUR estimates of the coefficients on P^A would be biased toward -1 if the number of offenses is measured with error, which is likely due to underreporting.[13] Second, measuring P^A_{ijt}, P^C_{ijt}, and F_{ijt} by their contemporaneous values

12. The statistic for the Breusch-Pagan test for independent equations is 69.9, therefore we reject the hypothesis of no correlation of error terms across equations.
13. The degree of underreporting can be inferred from the International Crime Victimization Survey conducted in the city of Prague in 2000. According to the survey, 96% of car thefts, 73% of bicycle thefts, 68% of burglaries, 46% of robberies and 41% of small thefts of personal property were reported to police. Since there were no victimization surveys in the Czech Republic prior to 1989, one is left to speculate about how the degree of underreporting changed under democracy. For example, if people report a theft because reporting may increase the chances of getting the stolen object back, the incentive to report weakens when the probability of arrest and conviction falls.

Table 3 Static seemingly unrelated regressions

	Murder	Robbery	Theft	Failure to support	Rape	Injury
Probability of charge	−0.281	−0.700***	−0.660***	−0.378***	−0.184*	−0.469***
	(0.241)	(0.154)	(0.050)	(0.135)	(0.107)	(0.112)
Probability of conviction	−0.351***	−0.239***	−0.355***	−0.124	−0.135***	−0.149***
	(0.090)	(0.075)	(0.057)	(0.128)	(0.040)	(0.054)
Expected punishment	0.120	0.048	−0.129	−0.392**	−0.009	−0.090**
	(0.153)	(0.134)	(0.099)	(0.190)	(0.049)	(0.039)
Effective supply of offenders	2.396	6.499**	4.247***	−1.656	−0.517	−0.121
	(2.849)	(2.798)	(1.416)	(2.664)	(1.566)	(3.033)
Average wage	−0.394	−0.507	−0.894	−2.135	−0.088	0.178
	(2.144)	(1.995)	(1.273)	(2.556)	(0.820)	(1.839)
Inequality	−0.034	−1.521	−1.433**	0.500	−0.035	0.221
	(1.695)	(0.982)	(0.648)	(1.908)	(0.744)	(1.149)
Unemployment men 20–29	−0.044	−0.003	−0.010	−0.083**	−0.036**	−0.010
	(0.032)	(0.023)	(0.021)	(0.037)	(0.016)	(0.036)
Region fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	167	167	167	167	167	167
'R-squared'	0.83	0.97	0.99	0.97	0.87	0.92

Absolute values of block−bootstrapped standard errors in parentheses.
All variables except unemployment are in logs.
*Significant at 10%; **5%; ***1%.

implicitly assumes that offenders have rational expectations about deterrence. However, several studies documented that individuals have highly different perceptions about the probability of punishment and they base them mostly on their own and their peers' past experiences.[14] I address both these issues by replacing P^A_{ijt}, P^C_{ijt}, and F_{ijt} with their one year lags. Given the turbulent social changes of the early 1990's, it may be more plausible to assume that offenders behave 'as if' they had adaptive expectations, i.e. they base their decision to commit crime on deterrence observed last year. This specification also removes the division bias as the lagged value of P^A does not contain the contemporaneous number of offenses in the denominator.

The results are reported in Table 4. Compared to the previous specification, the estimates of β^A_i and β^C_i are smaller in absolute values for all crime categories. The fact that the estimate of β^A_i is smaller could be explained by the removal of the division bias. The fact that the estimates of β^C_i are also smaller opens up a possible explanation that the offenders do in fact have rational expectations and therefore the number of offenses is correlated more strongly with the current rather than the lagged level of deterrence. On the other hand, the estimates of

14. Sah (1991) summarizes surveys on this topic. Lochner (2007) and Rincke and Traxler (2011) provide recent empirical evidence.

Table 4 Static SUR specification with lagged deterrence variables

	Murder	Robbery	Theft	Failure to support	Rape	Injury
Lag probability of charge	−0.100	−0.250***	−0.509***	−0.314	0.027	−0.331*
	(0.103)	(0.058)	(0.080)	(0.219)	(0.102)	(0.173)
Lag probability of conviction	−0.068	−0.147**	−0.140	−0.068	0.054	−0.116
	(0.094)	(0.073)	(0.107)	(0.094)	(0.059)	(0.096)
Lag punishment	−0.086	−0.093	−0.213*	−0.407**	0.022	−0.084***
	(0.153)	(0.228)	(0.129)	(0.170)	(0.034)	(0.031)
Effective supply of offenders	2.249	8.863**	3.483**	−2.538	−3.076	−0.0885
	(2.946)	(3.490)	(1.550)	(3.065)	(3.105)	(3.497)
Average wage	−0.626	−0.366	−1.153	−2.372	−0.086	−0.068
	(2.702)	(1.727)	(1.420)	(2.823)	(0.738)	(2.056)
Inequality	0.0188	−1.198	−1.390*	0.216	−0.831	0.462
	(1.736)	(1.017)	(0.760)	(1.697)	(1.208)	(1.060)
Unemployment	−0.056	−0.022	−0.029	−0.083**	−0.041*	−0.017
	(0.040)	(0.033)	(0.018)	(0.036)	(0.021)	(0.034)
Region fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	159	159	159	159	159	159
'R-squared'	0.82	0.96	0.99	0.97	0.84	0.92

Absolute values of block-bootstrapped standard errors in parentheses.
All variables except unemployment are in logs.
*Significant at 10%; **5%; ***1%.

the deterrent effect of expected punishment have the expected negative sign in all but one crime category, they are larger in absolute value in the specification with the lagged values and they are statistically significant for theft, failure to support and injury.[15]

The estimated deterrence effects have similar magnitude to those found in studies using US state-level or county-level data, at least for robbery and theft. The estimated elasticities of the crime rate with respect to the probability of charge are −0.25 (robbery) and −0.51 (theft). The elasticities with respect to the conditional probability of conviction are −0.15 (robbery) and −0.14 (theft). Somewhat surprisingly, the elasticities with respect to the severity of punishment have higher magnitude and/or higher statistical significance for several crimes, namely theft, failure to support and injury.[16] For comparison, Eide (2000) reports

15. I also attempted to eliminate the division bias by instrumenting the probability of being charged with the ratio of the number of defendants charged to the number of defendants investigated by the police (i.e., persons whom the police identifies as suspects and who would later be charged provided the case against them is strong enough). The instrument is obviously correlated with the regressor since they have a common denominator. If the probability that a person already investigated for a crime is eventually charged is uncorrelated with the measurement error in the number of offenses, $P^{A|I}$ is a valid instrument. Instrumenting for P^A does reduce the estimates of β^A (from −0.70 to −0.41 for robberies, from −0.66 to −0.54 for theft, from −0.38 to −0.2 for failure to support etc.), with little effect on the estimates of β^C. (Detailed IV results are available upon request.)
16. This contradicts Ehrlich (1973) theoretical ordering of elasticities.

that the median estimate (of 118 studies surveyed) of the elasticity of crime rate with respect to various measures of the probability of punishment was −0.7. The study that is probably closest to mine in terms of the choice of explanatory variables and estimation techniques (Cornwell and Trumbull 1994) finds elasticities of −0.36 (with respect to the probability of arrest) and −0.28 (with respect to the probability of conviction). My estimated deterrence effects are larger for robbery, theft and failure to support than for murder, rape and injury, which is also in line with the earlier deterrence literature.

4.2. Discussion

The fall of communism brought about countless social and economic changes that undoubtedly caused an increase in crime (see the discussion in Section 1). The challenge for my estimates is whether they indeed reflect a causal relationship from deterrence to crime or whether they are entirely driven by unobserved shocks that were correlated with deterrence and also caused an increase in crime. Below I present several arguments and specification checks that, considered together, 'by the preponderance of the evidence' support the claim that the estimates indeed capture genuine deterrence effects.

To begin with, the estimates are not solely driven by the fall in deterrence in the first transition year, but also by its rebound (although not to the pre-democracy levels) by the mid-1990's. At that time, the crime rates dropped somewhat from their peaks, and the unobserved shocks were presumably evolving less rapidly than in the early 1990's. Also, the estimates are already conservative; the year fixed effects capture unobservable shocks to crime that were common to all regions. The year fixed effects for 1990 are indeed very large for robbery and theft (1.39 and 1.62, respectively). Hence, a very large part of the discontinuous jump in robberies and thefts is attributed to factors other than deterrence.

With the region and year fixed effects included, the coefficients are identified out of between-region variation in changes in deterrence. The identifying assumption behind equation 1 is that the changes in deterrence were uncorrelated with the unobservable shocks to crime rates. The estimates would be biased downward if the regions experiencing the largest declines in deterrence also experienced the largest unobservable shocks to crime rates. To address the concern, I run simple regressions explaining the change in deterrence measures during the post-1989 period as a function of the change in either the crime rates or deterrence during the five years preceding 1989. If the post-1989 changes were systematically related to pre-1989 changes, one would be worried that deterrence was falling primarily in the regions that were already destined to experience an increase in crime. However, no clear pattern emerges. The partial correlations are significant only for robbery; for other crimes they are insignificant and with varying signs.

I also re-estimated the model in Table 4 with the year of the largest shock – 1990 – excluded. The estimated deterrence effects are actually slightly greater in magnitude.

Additional evidence that the estimates indeed capture deterrence – at least for robbery and theft – can be inferred from the evolution of the estimated year fixed effects. They are plotted in Figure 5 for the SUR specification with lagged

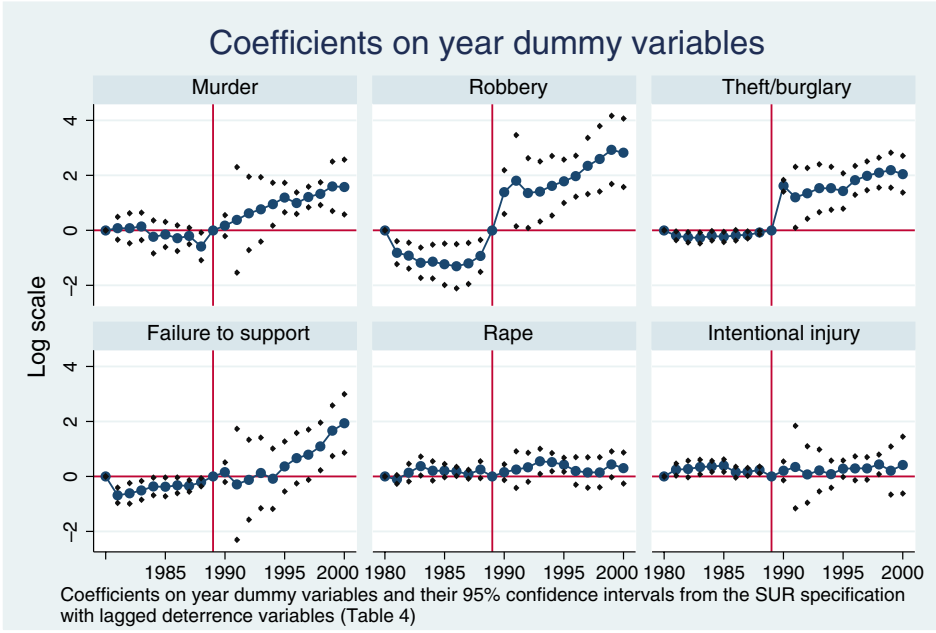

Figure 5 Coefficients on year dummy variables

deterrence variables. For robbery and theft, the year fixed effects jump up sharply in 1990 and then do not change significantly until the late 1990's. However, the robbery and theft rates were substantially higher in all years after 1990 than in 1990. My interpretation is that unobservable factors associated with the sudden shift to democracy did cause an abrupt increase in robberies and thefts but they fully materialized already in 1990 while the subsequent growth can be explained by changes in deterrence and socioeconomic variables.

The last check of the lack of correlation between changes in deterrence and unobservables is based on the structural break in the relationship between deterrence and crime rates. I estimate the same models as in Tables 3 and 4 with each variable also interacted with a democracy dummy (post-1989 years) and test the null hypothesis that the coefficients on the interaction variables are jointly equal to zero.[17] The data may exhibit the structural break for two reasons. It could be a genuine structural break brought about by the regime change. Alternatively, if the changes in unobservables were correlated with the changes in deterrence, they would appear as negative coefficients on the interaction terms even in the absence of a genuine structural break. Table 5 shows the results for the specification with contemporaneous deterrence variables.[18] There is very little evidence suggesting a structural break in deterrence. The null hypothesis is rejected only

17. The *F*-test is performed separately for the deterrence and social-economic variables. There is no interaction on the unemployment variable because measured unemployment was zero until 1989.
18. The results for the specification with lagged deterrence variables are not reported herein because they are very similar and show even weaker evidence of a structural break. They are available upon request.

for failure to support and rape, although in the case of rape there is a rather strange structural break when the elasticity of crime rate with respect to P^A is positive and significant (+0.375), and democracy significantly reduces this elasticity by 0.616. For all the other crimes, none of the interaction terms on deterrence variables are statistically significant, individually or jointly. Among the social-economic variables, the results show a significant structural break only in the average wage for failure to support (with the expected sign, higher real wages associated with a lower rate of failure to support).

4.3. Dynamic framework

The dynamic version of the model incorporates the notion that 'more crime breeds more crime' by endogenizing the probability of punishment and the size of the police force. Holding the enforcement resources fixed, an exogenous increase in the number of offenses reduces the probability of punishment. Observing this, offenders will choose to commit even more crimes this year. The enforcement resources will adjust too, since an increase in crime this year will trigger the public's demand for higher enforcement resources next year. This process can be described by three equations:

$$\log Y_{ijt} = \beta_i^A \log P_{ijt-1}^A + \beta_i^C \log P_{ijt-1}^C + \beta_i^F \log F_{ijt-1} + \beta_i^X \log X_{jt} + \lambda_{ij}^Y + \lambda_{it}^Y + \varepsilon_{ijt}^Y, \forall i \tag{2}$$

$$\log P_{ijt-1}^A = \gamma_i^E \log E_{jt-1} + \gamma_i^Y \log Y_{ijt-1} + \gamma_i^Z \log Z_{jt-1}^P + \lambda_{ij}^P + \lambda_{it-1}^P + \varepsilon_{ijt-1}^P, \forall i \tag{3}$$

$$\log E_{jt-1} = \sum \delta_i^Y \log Y_{ijt-2} + \delta^E \log E_{jt-2} + \delta^Z \log Z_{jt-1}^E + \lambda_{ij}^E + \lambda_{it-1}^E + \varepsilon_{ijt-1}^E \tag{4}$$

Equation 2 is the supply-of-offenses equation analogous to equation 1 with lagged deterrence variables. Equation 3 endogenizes P^A and can be interpreted as the production function of police. The output of police is the probability of charge and the inputs are enforcement resources E_j (measured by the number of police officers per 100,000 inhabitants), number of offenses Y_{ij} and socioeconomic variables Z^P. The predicted sign of γ^E is positive and of γ^Y negative.[19] Last, the size of the police force is endogenized in the demand for police equation (4) with the lagged crime rates $Y_{ijt\text{-}2}$, lagged size of the police force $E_{jt\text{-}2}$ and socioeconomic variables Z_{jt-1}^E as the explanatory variables.[20]

19. I do not model the production function of courts since I do not have appropriate measures of the courts' inputs. Therefore, P_{ijt}^C is treated as exogenous. The effective supply of offenders was included as the Z^P variable in the police output equation, with the justification that the police force has to spread its effort over a larger group in order to identify a particular offender as the number of potential offenders increases.

20. The specification for the demand for police equation goes back to Ehrlich (1973). The socioeconomic variable included in the demand for police equation is the average real wage in the public sector – fewer policemen will be demanded if the government has to pay them a higher wage.

Table 5 Test for structural break, SUR specification

	Murder	Robbery	Theft	Failure to support	Rape	Injury
Probability of charge	−0.262	−0.869**	−0.600***	−0.468***	0.375*	−0.337
	(0.344)	(0.387)	(0.089)	(0.182)	(0.211)	(0.319)
Interacted with democracy	0.0188	0.387	−0.077	0.146	−0.616***	0.010
	(0.287)	(0.499)	(0.151)	(0.282)	(0.194)	(0.406)
Probability of conviction	−0.389***	−0.219	−0.245**	−0.135	−0.094	−0.142
	(0.115)	(0.163)	(0.116)	(0.143)	(0.060)	(0.198)
Interacted with democracy	0.061	0.006	−0.053	0.099	−0.040	0.093
	(0.099)	(0.170)	(0.151)	(0.185)	(0.079)	(0.257)
Expected punishment	0.286	0.145	−0.120	0.0379	−0.203	−0.0502
	(0.211)	(0.263)	(0.117)	(0.195)	(0.163)	(0.096)
Interacted with democracy	−0.389	−0.218	0.0532	−0.222	0.208	−0.026
	(0.246)	(0.276)	(0.157)	(0.195)	(0.175)	(0.116)
Effective supply of offenders	9.323**	5.666	3.061	−3.613	−0.766	1.702
	(4.700)	(4.424)	(1.958)	(3.649)	(2.134)	(5.594)
Interacted with democracy	−7.089	−2.014	1.274	2.210	−0.525	−1.893
	(12.020)	(6.007)	(2.520)	(4.691)	(5.696)	(7.911)
Average wage	−0.437	−0.099	2.462	5.247	1.145	−1.380
	(3.496)	(5.779)	(2.072)	(3.310)	(2.963)	(3.046)
Interacted with democracy	−0.552	0.105	−2.448	−5.512*	−1.519	0.986
	(3.360)	(5.097)	(1.891)	(3.159)	(2.466)	(3.079)
Inequality measure	−0.169	−1.930	−2.023*	0.255	−1.191	0.172
	(3.830)	(5.237)	(1.182)	(3.924)	(2.494)	(5.820)
Interacted with democracy	0.274	0.398	0.508	−0.099	0.969	0.105
	(3.929)	(4.955)	(1.037)	(3.744)	(2.290)	(5.691)
Unemployment	−0.036	0.001	0.014	−0.039	−0.028	−0.016
	(0.030)	(0.034)	(0.017)	(0.024)	(0.019)	(0.025)
Region fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	167	167	167	167	167	167
R-squared	0.83	0.98	0.99	0.98	0.89	0.93
Test for structural break						
Deterrence variables						
$Chi^2(3)$	2.65	0.90	0.55	1.31	15.65	0.21
$P > chi^2$	0.4487	0.8249	0.9074	0.7268	0.0013	0.9761
Socio-econ variables						
$Chi^2(4)$	2.59	0.13	5.16	9.12	4.82	0.63
$P > chi^2$	0.6282	0.9979	0.2713	0.0581	0.3065	0.9592

Absolute value of standard errors in parentheses.
All variables except unemployment are in logs.
*Significant at 10%; **5%; ***1%.

The system of 13 equations (2–4) is estimated by three-stage least squares and the results are shown in Table 6.[21] Even though the probability of charge is endogenized, the model shows strong deterrence effects. The coefficients on the probability of charge for robbery, theft, failure to support and intentional injury are greater in absolute value than the static SUR estimates with lagged deterrence variables (Table 4). The expected length of a prison sentence has a statistically significant effect on failure to support and intentional injury.[22]

5. CONCLUSIONS

The collapse of communism in the Czech Republic and the very sharp decline in deterrence that immediately followed provided an opportunity to gain new evidence on the old question: whether deterrence cuts crime. I found statistically and economically significant deterrence effects for robbery and theft, somewhat weaker effects for intentional injury and failures to support but insignificant effects for murder and rape. The results are generally robust to alternative specifications. I presented evidence supporting the claim that the results reflect a causal relationship between deterrence and crime rather than unobservable factors through which democracy led to higher crime, even though such factors were empirically important.

With these results at hand, a natural question to ask is: What would the crime rates be if the democratic government somehow managed to keep deterrence at the communist levels? I use the coefficients from Table 4 to predict the crime rates under the assumption that P^A_{ijt}, P^C_{ijt}, and F_{ijt} would stay at the same level as in 1989 for all the following years while the socioeconomic variables and the year fixed effects would evolve as they did. The predicted and actual crime rates aggregated at the national level are plotted in Figure 6. Since the estimates do not show a strong deterrence effect on murders and rapes, it is not surprising that stronger deterrence would not change the number of these offenses. The model predicts, however, that the number of robberies, thefts and intentional injuries would be substantially lower if deterrence did not fall. For example, the robbery rate was 16.6 in 1989 and 48.4 in 2000. Had deterrence stayed the same, the model predicts that the robbery rate would have been only 40.5.

Lin (2007) calibrates the extent in which the differences in crime rates between democracies and non-democracies can be attributed to weaker deterrence. He finds that weaker deterrence is responsible for as much as 40–50% of

21. The right-hand side of the supply of police equation contains a lagged dependent variable and hence the strict exogeneity assumption is violated. The consistent estimation method would first remove the fixed effects by first differencing and then use lagged first differences in lagged right-hand side variables as instruments (Wooldridge, 2002, pp. 299–307). I did try this approach; however, it produced implausible estimates (negative estimate of δ^E, very large standard errors), presumably because of a rather small sample size.
22. The estimated parameters of the police productivity equations are also plausible. A 1% increase in the number of police officers increases the probability of charge by 0.64% for robberies and.38% for thefts. As expected, the number of offenses negatively affects the probability of charge for all crimes except murders. Finally, the demand for police equation shows a strong persistence in the size of police force but no significant adjustment of police to the previous year's crime rates.

Table 6 Dynamic 3SLS specification with lagged deterrence variables

	Murder		Robbery		Theft/burglary		Failure to support		Rape		Intentional injury		Police
Dependent variable:	Crime rate	Lag prob. of charge	Crime rate	Lag prob. of charge	Crime rate	Lag prob. of charge	Crime rate	Lag prob. of charge	Crime rate	Lag prob. of charge	Crime rate	Lag prob. of charge	Lag police per 100,000 inhabitants
Lag probability of charge	0.079		−0.399***		−0.663***		−1.066***		0.316*		−0.537**		
	(0.303)		(0.134)		(0.126)		(0.403)		(0.182)		(0.260)		
Lag probability of conviction	0.027		−0.135*		−0.117		−0.143		0.069		−0.100		
	(0.086)		(0.070)		(0.118)		(0.114)		(0.052)		(0.101)		
Lag length of punishment	−0.056		−0.117		−0.205		−0.307*		0.021		−0.070**		
	(0.159)		(0.249)		(0.132)		(0.158)		(0.0387)		(0.0281)		
Effective supply of offenders	2.398	−0.906	6.759	−3.915	3.064	2.730	−1.885	−0.263	−4.326	1.529	−0.370	−1.967	
	(3.319)	(4.794)	(4.385)	(2.652)	(1.932)	(3.405)	(3.017)	(1.225)	(3.468)	(2.766)	(3.566)	(1.716)	
Average wage	−0.620		−0.254		−0.887		−1.605		0.055		−0.019		
	(1.980)		(1.607)		(1.418)		(2.820)		(0.801)		(2.112)		
Inequality	0.177		−1.502		−1.221*		−0.057		−0.672		0.704		
	(1.719)		(0.974)		(0.686)		(1.638)		(1.059)		(0.932)		
Unemployment men aged 20–29	−0.0578		−0.022		−0.025		−0.055		−0.041**		−0.014		
	(0.039)		(0.033)		(0.0182)		(0.038)		(0.021)		(0.031)		
Lag police		−0.110		0.644*		0.384		0.0445		0.148		0.067	
		(0.652)		(0.384)		(0.452)		(0.486)		(0.315)		(0.426)	
Lag crime rate		0.095		−0.364***		−0.637***		−0.293***		−0.191*		−0.215**	
		(0.104)		(0.104)		(0.136)		(0.050)		(0.112)		(0.089)	
2Lag police													0.874***
													(0.068)
2Lag crime rate murder													−0.005
													(0.010)
2Lag crime rate robbery													0.030
													(0.022)
2Lag crime rate theft													0.009
													(0.023)
Wage in public sector													−0.121***
													(0.042)

Absolute values of block-bootstrapped standard errors in parentheses.
All variables except unemployment are in logs.
*Significant at 10%; **5%; ***1%.

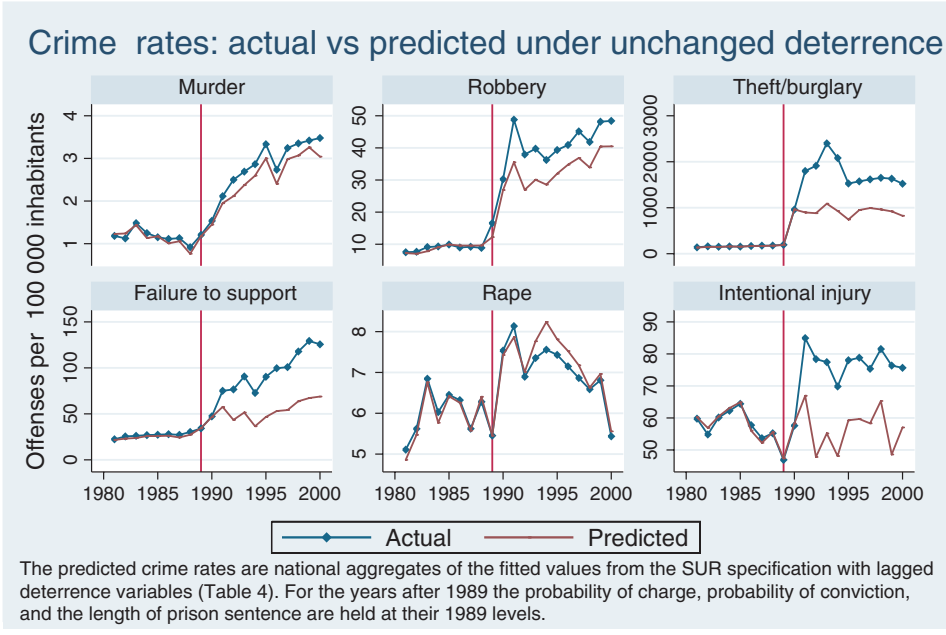

Figure 6 Crime rates: actual versus predicted under unchanged deterrence

Table 7 Contribution of weaker deterrence to the post-1989 growth in crime

		Actual crime rate*	Predicted crime rate**	Fraction of the change accounted for by weaker deterrence (%)
Murder	1989	1.2	3.0	22
	2000	3.5		
Robbery	1989	16.6	40.5	25
	2000	48.4		
Theft	1989	193.9	825.6	52
	2000	1522.7		
Failure to support	1989	34.2	68.8	62
	2000	125.6		
Rape	1989	5.5	5.6	N/A
	2000	5.4		
Intentional injury	1989	46.9	57.0	65
	2000	75.7		

*Nation-wide number of offenses per 100,000 inhabitants.
**The predicted crime rates are national aggregates of the fitted values from the SUR specification with lagged deterrence variables of Table 4. For the years after 1989, the probability of charge, probability of conviction, and the length of prison sentence are held at their 1989 levels.

the democracy's contribution to higher crime. I perform an analogous exercise with the estimated deterrence effects. Table 7 shows how much of the change in crime rates between 1989 and 2000 is accounted for by the change in deterrence.

The estimates imply that deterrence accounts for 25% of the increase in robberies, 52% of the increase in thefts and 65% of the increase in intentional injuries. Overall, these results provide additional evidence that democracies have different patterns of crime, that deterrence explains a large part of the difference for economic crimes such as thefts and robberies, and that deterrence does not explain much of the differences for serious violent crimes such as murders and rapes.

ACKNOWLEDGEMENTS

I appreciate comments and suggestions from Bruce Benson, Randall Filer, Štěpán Jurajda, Jan Kmenta, Daniel Münich, William Trumbull, anonymous referees and participants at the GDN, EEA, and EALE conferences. Tomáš Konečný, Pavel Dvořák and Luboš Dostál provided excellent research assistance. Financial support from GDN grant RRC IV-22/04 is gratefully acknowledged.

Address for correspondence: Libor Dušek, CERGE-EI, Prague (a joint workplace of the Center for Economic Research and Graduate Education, Charles University, and the Economics Institute of the Academy of Sciences of the Czech Republic, Politickych veznu 7, 1121 Praha 1). Tel.: +420224005146; fax: +420224005333; e-mail: libor.dusek@cerge-ei.cz

REFERENCES

Andrienko, Y. and L. Shelley (2005), 'Crime, Violence, and Political Conflict in Russia', in: P. Collier and N. Sambanis (eds.), *Understanding Civil War*, World Bank, Washington, DC, pp. 87–118.

Angrist, J. D. and J.-S. Pischke (2008), *Mostly Harmless Econometrics: An Empiricist's Companion*, 1st ed., Princeton University Press, Princeton.

Cameron, A., J. B. Gelbach and D. L. Miller (2008), 'Bootstrap-Based Improvements for Inference with Clustered Errors', *Review of Economics and Statistics* 91, 414–427.

Cejp, M.. (2003), *Organizovany zlocin v Ceske republice v letech 1993–2002, Kriminalita v roce 2002*, Institut pro kriminologii a socialni prevenci, Praha.

Cornwell, C. and W. N. Trumbull (1994), 'Estimating the Economic Model of Crime with Panel Data', *The Review of Economics and Statistics* 76, 360–366.

Di Tella, R. and E. Schargrodsky (2004), 'Do Police Reduce Crime? Estimates Using the Allocation of Police Forces After a Terrorist Attack', *American Economic Review* 94, 115–133.

Draca, M., S. Machin and R. Witt (2011), 'Panic on the Streets of London: Police, Crime, and the July 2005 Terror Attacks', *American Economic Review* 101, 2157–2181.

Ehrlich, I. (1973), 'Participation in Illegitimate Activities: A Theoretical and Empirical Investigation', *The Journal of Political Economy* 81, 521–565.

Eide, E. (2000), 'Economics of Criminal Behavior', in: B. Bouckaert and G. de Geest (eds.), *Encyclopedia of Law and Economics*, Volume V, Edward Elgar, Chetenham, UK, pp. 345–389.

Evans, W. N. and E. G. Owens (2007), 'COPS and crime', *Journal of Public Economics* 91, 181–201.

Fisher, F. and D. Nagin (1978), 'On the Feasibility of Identifying the Crime Function in a Simultaneous Equations Model of Crime and Sanctions', in: A. Blumstein, D. Nagin and J. Cohen (eds.), *Deterrence and Incapacitation: Estimating the Effects of Criminal Sanctions on Crime Rates*, National Academy of Sciences, Washington, DC, pp. 361–399.

Katz, L., S. D. Levitt and E. Shustorovich (2003), 'Prison Conditions, Capital Punishment, and Deterrence', *American Law and Economics Review* 5, 318–343.
Klick, J. and A. Tabarrok (2005), 'Using Terror Alerts Levels to Estimate the Effect of Police on Crime', *Journal of Law and Economics* 48, 267–279.
Levitt, S. D. (1997), 'Using Electoral Cycles in Police Hiring to Estimate the Effect of Police on Crime', *American Economic Review* 87, 270–290.
Lin, M.-J. (2007), 'Does Democracy Increase Crime? The Evidence from International Data', *Journal of Comparative Economics* 35, 467–483.
Lochner, L. (2007), 'Individual Perceptions of the Criminal Justice System', *American Economic Review* 97, 444–460.
Ministry of Justice of the Czech Republic (1981–2001). *Rocenka kriminality v Ceske republice (Criminal Statistics Yearbook)*, Ministry of Justice of the Czech Republic, Prague.
Mustard, D. B. (2003), 'Reexamining Criminal Behavior: The Importance of Omitted Variable Bias', *The Review of Economics and Statistics* 85, 205–221.
Police Directorate of the Czech Republic (1992–2001). *Statistika kriminality na uzemi CR (Statistics of Crime in the Czech Republic)*, Ministry of Interior of the Czech Republic, Prague.
Pridemore, W. A. (2001), 'Using Newly Available Homicide Data to Debunk Two Myths About Violence in an International Context', *Homicide Studies* 5, 267–275.
Rincke, J. and C. Traxler (2011), 'Enforcement Spillovers', *Review of Economics and Statistics* 93, 1224–1234.
Sah, R. (1991), 'Social Osmosis and Patterns of Crime', *Journal of Political Economy* 99, 1272–1295.
Shepherd, J. M. (2002), 'Police, Prosecutors, Criminals, and Determinate Sentencing: The Truth about Truth-in-Sentencing Laws', *Journal of Law and Economics* 45, 509–534.
Tomin, M. (1991), *K nekterym pricinam vzestupu krmininality v roce 1990*. Institut pro kriminologii a socialni prevenci, Prague.
Tucek, M., E. Rendlova, M. Rezkova, A. Glasova and J. Cerny (1999), 'The Fluctuation of Public Opinion between Years 1990 and 1998', Sociological Papers No. 1.
Vujtech, J., S. Diblikova, V. Hanak, Z. Karabec, P. Kotulan, S. Krejcova *et al.* (2001), *Ucinky transformace trestniho zakonodarstvi na stav kriminality a zvysovani efektivnosti justice ve vztahu k bezpecnosti obcanu CR v horizontu roku 2000*. Institut pro kriminologii a socialni prevenci, Prague.
Williams, J. L. and A. S. Serrins (1995), 'Comparing Violent Crime in the Soviet Union and the United States: 1985–1990', *Studies on Crime and Crime Prevention* 4, 252–266.
Wolpin, K. I. (1980), 'A Time Series-Cross Section Analysis of International Variation in Crime and Punishment', *The Review of Economics and Statistics* 62, 417–423.
Wooldridge, J. M. 2002, *Econometric Analysis of Cross Section and Panel Data*. MIT Press, Cambridge, MA.