University of Economics, Prague

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DID LEGALIZED ABORTION CUT CRIME IN THE CZECH REPUBLIC?

Bachelor's thesis

Author: Peter Dubovský

Supervisor: Petr Bartoň, MA

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I declare on my honor, that I wrote this thesis individually with the use of the referenced literature only.

Peter Dubovský

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ABSTRACT

In this thesis, I test with Czech data the hypothesis of Donohue & Levitt (2001) which proposes that the growth of abortion rate lowers the future crime rate. The fixed effects model I use is derived from Donohue & Levitt (2001) and adjusted on the basis of criticism by Foote & Goetz (2005; 2008) and Joyce (2004; 2009a; 2009b). As regards period 1994-2009 the results imply that the rise of abortions by 10 per 100 born children lowers theft by eight percent in an age group after it reaches the criminal age. Considering the periods 1968-1976 and 1978-2009 the estimates are low and weakly significant indicating only little impact of abortion on crime during the socialist period.

KEYWORDS: abortion, crime
JEL-CLASSIFICATION: J11

ABSTRAKT

V záverečnej práci testujem na českých dátach hypotézu, ktorú vytvorili Donohue & Levitt (2001), a ktorá tvrdí, že rast miery potratovosti spôsobuje pokles kriminality v budúcich rokoch. Model fixných efektov, ktorý používam, je odvodený z uvedeného článku a upravený na základe kritiky v článkoch Foote & Goetz (2005,2008) a Joyce (2004,2009a,2009b). V prípade obdobia 1994-2009 výsledky naznačujú, že nárast o 10 potratov na 100 narodených detí spôsobí 8 percentný pokles krádeží pre danú vekovú skupinu v dobe po dosiahnutí kriminálneho veku. Pre obdobia 1968-1976 a 1978-2009 sú odhady nízke so slabou signifikanciou a naznačujú len malý dopad potratov na zločin počas obdobia socializmu.

KĽÚČOVÉ SLOVÁ: potrat, kriminalita
KLASIFIKÁCIA JEL: J11

CONTENTS

I. INTRODUCTION

In 2001, economists John Donohue and Steven Levitt presented interesting hypothesis stating that the legalization of abortion in the USA in 1973 have affected the development of the crime rate in the USA in 1990's. The crime rate in the USA in 1980's was surging and the forecasts were very pessimistic about the further development. From 1991 the crime rate started to fall unexpectedly. It was Donohue and Levitt who proposed that the important reason for the decline could be that some criminals were simply not born. According to them, the abortions were disproportionately demanded by women who were in socio-economic situation that would not assure the optimal environment for raising a child. As the children who are raised in such environments are generally more criminal, the effect of the abortion legalization should be reflected in the decline of crime, ceteris paribus.

The development of legal regulation of abortion in the Czech Republic provides the necessary background for testing this hypothesis using the data from the Czech Republic. The abortion in Czechoslovakia was legalized in 1958 and in 1987 the abortion law was further liberalized, giving pregnant women who did not want to have children at the time easier access to abortion. The easier availability was reflected in the increase of the abortion rate. The higher abortion rate could therefore mean that less unwanted children were born and the cohort's propensity to crime lowered. When these cohorts reach the criminally active age, the criminality should start to fall, ceteris paribus.

In my thesis, I use the model of Donohue & Levitt (2001) and after making the adjustments that were proposed by the critics and that were possible, given the available data, I test the link between the abortion and crime in accordance to the hypothesis. The outcome of the regressions for the period 1994-2009 says that the relation is rather strong, with the most convincing estimate stating the 8 percent fall of age-group's crime as a result of the increase by ten abortions per 100 born children. This is similar to the estimate of 10 percents in Donohue & Levitt (2001) However, the estimates for periods that include years of Communist rule are much smaller and show only very weak connection between abortion and crime.

In the following section I summarize Donohue & Levitt (2001) and several important contributions to the debate that ensued. Based on the literature mentioned, I formulate a model, in the section III, which is used for the estimation of correlation between the abortion and the crime in the Czech Republic. I introduce the issue of fixed effects to the reader as

well. After that, in section IV, the history of abortion in Czech Republic is summarized and the simple time series graphs of abortion and crime are discussed to give reader a picture of their development. Then, in the section V, I present the data on abortion and crime and discuss their pros and cons with regard to testing the hypothesis of Donohue & Levitt (2001). Section VI and VII consists of regressions on three periods and presents the table of results which are discussed. Section VIII concludes.

II. THE DEBATE ABOUT THE ABORTION-CRIME LINK

A. THE INTRODUCTION OF THE IDEA

The idea that the legalized abortion might be one of the causes of crime decline has been introduced by Donohue and Levitt (henceforth D&L) in their paper The Impact of Legalized Abortion on Crime (2001). The research was triggered by the specifics of the crime development in the states of the USA in 1990's. Despite the unfavorable prognosis at the time, the crime rate started to fall in 1991. By the time, when D&L wrote their study, the murder rate had fallen by 40 percent and violent crime by 30 percent as well as property crime. Several explanations of the plummeting crime rates arose, which could not have been responsible for the crime reduction alone. Either these factors had been ongoing for several decades already[1] or they had been present only in some of the states/cities[2] or there was no clear connection between these factors and crime[3] (Donohue & Levitt, 2001).

D&L brought in the idea that the drop of crime could have been caused by the legalization of abortion two decades earlier. The manner in which the abortion lowers crime according to their hypothesis can be explained in two steps. Firstly, abortion and its higher availability allow women to avoid having children if they do not want them. In other words, abortion decreases unwantedness of a cohort because only the wanted children are born. Second step is the relation between unwantedness and crime. As D&L note, several studies'

[1] Higher incarceration, higher numbers of police.
[2] New policing strategies, the declines in the crack cocaine trade.
[3] D&L reference for instance Ruhm (2000) who found out that murder rate might be correlated positively with GDP.

results imply that the unwanted child is more prone to becoming a criminal later in life. [4] When these two steps are added together, the logical outcome that arises is staggering - abortion causes less crime.

D&L offered several arguments that support this hypothesis. First the legalization of abortion set off the upsurge of abortion rate. This phenomenon had several characteristics – it was large, abrupt and continuing - exactly as the decline of the crime about twenty years later. Second, the abortion was legal since 1970 in five states and in 1973 the abortion was legalized in all states by Roe v. Wade (1973). Approximately the time when the cohorts influencing the crime in nineties were born: "For example, the peak ages for violent crime are roughly 18-24, and crime starts turning down around 1992, roughly the time at which the first cohort born following *Roe v.* Wade would hit its criminal prime." (Donohue & Levitt, 2001, p. 382). Thirdly, there appears to be a congruency between the timing of the legalization of abortion in individual states, and the timing of the onset of the drop in the crime rate. In other words, the crime decline occurred sooner in those states that were the first to legalize the abortion, compared to the rest. Lastly, the states with higher abortion rates[5] have bigger declines than those with lower abortion rates.

These are however, as D&L write, just anecdotal arguments and the substantial part of their study is dedicated to the empirical search for the evidence. They undertake several approaches to estimate the relation between crime and abortion about which I write more thoroughly in section III. The results of their models estimated association of increase in abortion rate by 100 per 1000 born children with 13 percent decrease in violent crime, 9 percent decrease in property crime and 12 percent decrease in murders.

B. THE CRITICAL RESPONSE

The controversy of associating abortion with crime in a way that Donohue and Levitt (2001) did, launched a discussion which continues until the present time. Beside the wave of criticism which denounced the morality of associating the crime with abortion[6], the disputes

[4] D&L reference Dagg (1991) who "found out that the children who were born because their mothers were denied an abortion were substantially more likely to be involved in crime and have poorer life prospects, even when controlling for the income, age, education, and health of the mother." (Donohue & Levitt, 2001)

[5] D&L use term "rate" as the number of abortions per 1000 born children. In demographics, however, this measure is called abortion *ratio* while abortion *rate* is defined as number of abortions per 1000 women of age 19-44 (see for instance statistics of Centers for Disease Control and Prevention). In my thesis I follow the D&L's way of using this term to avoid confusion.

[6] D&L state that the intention of their research is clearly positivistic without any policy proposals : "While falling crime rates are no doubt a positive development, our drawing a link between falling crime and legalized

on the empirical front have arisen too. I would like to refer to a paper by Ted Joyce (2009b) who depicts this debate thoroughly. I will present here some of the most important contributions to this debate from which I have taken an inspiration for latter formulation of the model that I use for estimation of correlation between abortion and crime in the Czech Republic.

One of the first significant reactions to D&L's paper came from Ted Joyce[7]. In his study (2004), he criticizes the approach of D&L (2001) in which they compare changes in crime between high abortion states and low abortion states. According to Joyce, they do not control for crime inducing factors like the crack epidemic. He states that the controls for mere state and year fixed effects[8] which they use (see Equation 2) would not filter the impact of crack epidemic because the epidemic reached different states at different time. Joyce therefore tries to obviate these problems by using the difference-in-difference model[9]. He also criticizes D&L's use of abortion data prior to the legalization, for which D&L assume zero abortion rate. By using the difference-in-difference analysis, he is able to avoid using the prelegalization estimates of abortion rate as it utilizes only data from short period of six years between 1985 and 1990.

In their reply, D&L (2004) criticize Joyce's concentrated focus on the short period because, as they write, it is the period in which the crack epidemic caused upsurge of crime among the observed cohorts and the outcome of his analysis is therefore flawed. They denounce the use of short period for creating models and state that "it is important to look at the whole period for which data are available" (Donohue & Levitt, 2004, p. 48)

Joyce (2009a) includes another criticism in reaction to improved measure of abortion of D&L (2008). He writes that the estimation of residence of women that got abortions is flawed. The reason for his skepticism is that D&L (2008) used one source of abortion data for instrumenting another in order to estimate the residence of women that underwent abortion. The problem lies in the fact that these two sources were already preinstrumented using one another by the institutions that compile the data. Therefore Joyce assumes that the estimates "are based on dubious restrictions" (2009a).

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abortion should not be misinterpreted as either an endorsement of abortion or a call for intervention by the state in the fertility decisions of women." (Donohue & Levitt, 2001, p. 415)

[7] A professor of Economics and Finance at Baruch College

[8] I will discuss the fixed effects in separate section.

[9] I did not use the diff-in-diff model because, there would be only groups of 4 states on each "side" of median and that would mean low variability. Also, Joyce (2009a) in his difference-in-difference-in-difference (DDD) approach takes use of the time gap between early and late legalizers which is not applicable for the Czech Republic.

Another intellectual exchange took place between D&L on one side and Foote and Goetz on the other, in which they presented two main points of criticism in their paper Testing Economic Hypothesis with State-Level Data: A Comment on Donohue and Levitt (2001). The first point of criticism was quite embarrassing for D&L, as they admitted, because Foote and Goetz discovered that D&L, contrary to their own belief, failed to estimate one of their models in the way they claimed. Specifically, they did not include the control for the state-year interaction. This control is vital in this type of research as it controls for the type of factors like crack epidemic. The spread of crack cocaine was associated with the upsurge of crime and that could have easily confounded the findings of D&L. The second part of their criticism focused on the functional form of the model estimating the correlation between abortion and crime. In their crucial equation[10], D&L use only the absolute levels of crime, though specific for age groups. In other words, they do not consider the size of the population within an age group. Foote and Goetz write, „to test whether abortion has a selection effect, one needs to know whether a person exposed to a high abortion risk in utero is less likely to commit a crime. By "less likely," we mean a lower probability, but the only way to measure a probability is to divide the number of crimes by the number of people who could commit them. In other words, ARRESTS must be in per capita terms." (Foote & Goetz, 2008, p. 3) According to Foote and Goetz (2008) the absolute measure of crime is not telling us much because, as they write, the abortion rate parameter is in its essence - and independently of D&L's hypothesis validity - negatively related to the crime. They argue that abortion rate consists of abortions divided by population and if there was some exogenous factor causing the growth of the population, keeping the amount of abortions steady, the abortion rate would fall and crime would rise as there would be more people to commit the crime.

Donohue and Levitt (2008) replied to the criticism of Foote and Goetz by admitting the mistake of not including the controls for state-year fixed effects. However, they show that by employing improvements to their method of measurement of abortion rate, the estimates are even stronger than in D&L (2001). The improvements are made in three points. Firstly, they measure the abortion rate according to the estimated data of residence of pregnant women as opposed to the place where it was carried out. Secondly, they adjusted the abortion measure based on the migration. And lastly, they modified the way of determining the time when the cohort was in utero. After executing the regressions incorporating these changes they optimistically conclude: "A more thoughtfully constructed proxy yields results that are in

[10] See Equation (3) in the following section

many cases stronger than those reported in our initial paper even after addressing the issues raised by Foote and Goetz (2005)" (Donohue & Levitt, 2008)

III. FORMULATION OF THE MODEL FOR THE ABORTION-CRIME LINK IN THE CZECH REPUBLIC

In my analysis I will use a model similar to the equation (3) of Donohue and Levitt (2001, p. 411) (see equation 3) and several modifications of it. In the next part I will describe the methods that D&L (2001) use to find a link between abortion and crime so that I can explain why I derived my analysis from this equation.

A. DERIVING MY MODEL FROM DONOHUE AND LEVITT (2001)

Donohue and Levitt (2001) tried to estimate the effect of abortion on crime using two different regressions. The first one applies the data for crime from Uniform Crime Reports[11], which are the statistics that compile the data about crime as reported by victims or witnesses. These data on crime are not age-specific and therefore can not give us any information about the course of criminality within an age-group, what is crucial in this type of research (Joyce, 2009b). D&L therefore use a special variable for abortion data, which is supposed to bypass this disadvantage because it contains the age information. The Effective Abortion Rate (EAR), as they call it, is a sum of the age-specific abortion rates weighted by the proportional representation of this age group among the arrested persons. The abortion rates[12] (AR) are specific for each state but they use only single weights for all the states, based on national arrests of 1985 (Donohue & Levitt, 2001, p. 401). The equation is the following:

$$Effective\_Abortion_t = \sum_a Abortion_{t-a}(Arrests_a / Arrests_{total}), \qquad (1)$$

where *a* stands for age of an arrestee, and *t* for year; $Abortion_{t-a}$ is the abortion rate in year of birth of cohort. The EAR in year 1990, for instance, is the abortion rate from before 15 years (year 1975) multiplied by the proportion of 15-year-olds among US arrestees in 1990, plus the

[11] D&L collect these crime data from Federal Bureau of Investigation yearbook *Crime in the United States.*
[12] Number of abortions per 1000 born children. I calculate abortion rate as AR = number of aborted pregnancies per hundred of born children, which is more common use of this measure in the Czech Republic. As D&L use different rate (per 1000 born children) I will have to adjust the results of my research accordingly when comparing with those of D&L.

abortion rate before 16 years multiplied by the proportion of 16-year-olds among US arrestees in 1990 and so on up to age 29. (Joyce, 2009b). D&L use EAR to implement the cohort information into the model which they further develop. They also use several control variables. Among these are e.g. police numbers, numbers of prisoners, economic strength controls, and generosity of welfare system. The resulting equation is the following:

$$\ln(CRIME_{st}) = \beta_1 ABORT_{st} + X_{st}\Theta + \gamma_s + \lambda_t + \varepsilon_{st}, \quad (2)$$

where $CRIME_{st}$ is the crime per population in state s and year t; $ABORT_{st}$ is the Effective Abortion Rate, X_{st} is a vector of control variables, γ_s are the state fixed effects and λ_t are the year fixed effects. This equation is however not sufficient to properly examine the link between abortion and crime, for example Joyce writes, referencing DiNardo (2006), Foote and Goetz (2008) and Joyce (2009a), that "it is impossible to credibly identify a cohort effect without age-specific crime rates. Thus the value of these regressions as a causal test of abortion and crime is questionable." (Joyce, 2009b, p. 15)

D&L meet these requirements in the third equation of their paper (see Equation 3), where they approximate the crime level with the arrest data that contain the age information. Specifically, D&L obtained data for 15 to 24-year-old arrestees for years 1985 to 1996. This time the explanatory variable is the age specific abortion rate as opposed to the EAR. The relevant abortion rate for each age group is the one in year preceding their birth, or *t-a*-1, where *t* is the current year and *a* is the age of a group. This is the year when the cohort spent most of the time in utero on average. The resulting regression is following:

$$Ln(ARRESTS_{stb}) = \beta_1 ABORT_{sb} + \gamma_s + \lambda_{tb} + \theta_{st} + \varepsilon_{stb}, \quad (3)$$

where $ARRESTS_{stb}$ is a number of arrested persons in state *s*, in cohort *b* and in year *t*. Variable $ABORT_{sb}$ is the abortion rate for cohort *b* (the abortion rate in year preceding the birth-year of cohort *b* in state *s*. The Greek letters γ, λ and θ are variables marking the controls for fixed effects and their interactions (Donohue & Levitt, 2001, p. 411)

I derive my main model from this equation, to which I make several changes: First, on the basis of criticism of this equation (e.g. Foote & Goetz, 2005) I change the functional form of dependent variable from log of level to log of rate. Second I rename the dependent variable on the basis of taking prosecuted persons as approximation of crime. Third I rename the *ABORT* variable to *ABORTRATE* to clarify the form of this measure. Fourth, I change name of

indexes to suit my data. And last, I substitute the control for fixed state effects with state(region)-year interaction control. The resulting equation is following:

$$Ln(PRSCTDRATE_{rat}) = \beta ABORTRATE_{rt-a-1} + \gamma_{ra} + \lambda_{at} + \theta_{rt} + e_{art}, \quad (4)$$

where $PRSCTDRATE_{rat}$ describes the number of prosecuted persons per 10000 persons in region *r*, in age group *a*, in year *t*. Variable $ABORTRATE_{rt-a-1}$ represents the abortion rate in region *r*, in year *t*-*a*-1. Variables γ_{ra}, λ_{at} and θ_{rt} represent the controls for region-age, age-year and region-year fixed effects' interactions.

B. FIXED EFFECTS MODEL: THE FIXED EFFECTS AND THEIR INTERACTIONS

The regression analysis of simple model regressing the rate of prosecuted persons on abortion rate will form the basis upon which I will build its variations by adding the controls for interactions between the three layers of information. As Foote and Goetz write in their response to D&L's paper, "organizing data along the state-year-age level allows the researcher to eliminate any confounding effect that varies along any two of these levels (that is, state-year, age-year, and state-age)." (Foote & Goetz, 2005) As the analysis of the link between abortion and crime utilizes three layers of information – age, region and year, there should be added also controls for interactions between these layers. I will therefore include the controls for interactions between the three sources of fixed effects – age group, year and region.

The typical pattern of age effect is depicted in Figure 1 (along with the cohort effect). The essence of the age effect is that each cohort (or age group) commits different quantity of crime. In my graph, the older the age group, the more crime it commits. Therefore, the age effect is graphically expressed by the size of the gap between the lines that mark different age groups. The importance of this phenomenon, is that it could be misinterpreted as the effect of some exogenous factor, in this case - the abortion rate. The upsurge of crime within one cohort, might not be caused by lower rate of abortion, but just by "natural" development within the age-crime profile. For example as D&L write, "the property crime is disproportionately done by the young" (Donohue & Levitt, 2001, p. 394) and therefore as the cohort grows older its number of committed property crimes falls independently on exogenous effect of abortion rate.

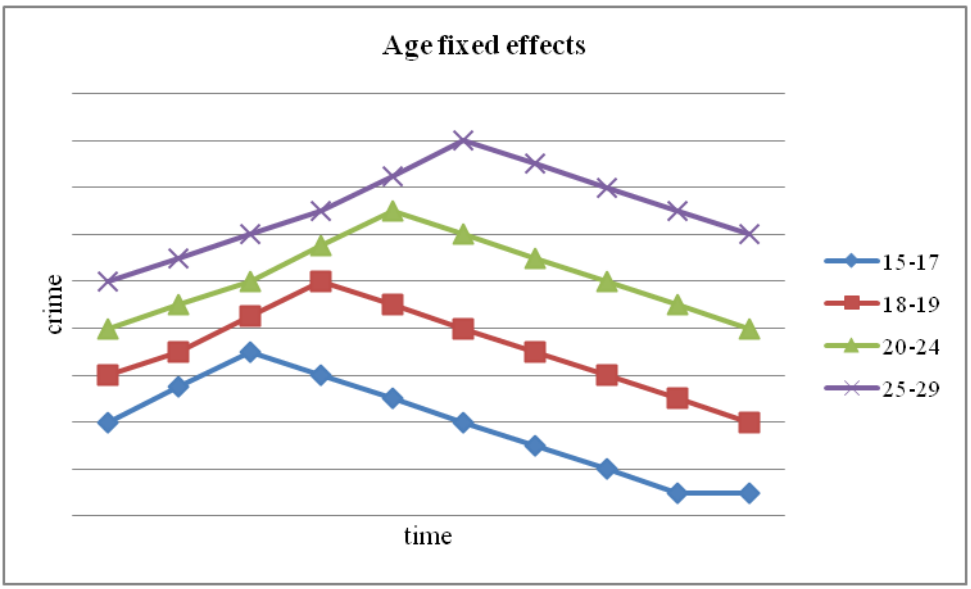

Figure 1: Hypothetical quantities of crime of different age groups within one region with consecutive slumps resulting from less criminality of younger cohorts (Cohort effect)[13] (Joyce, 2009b)

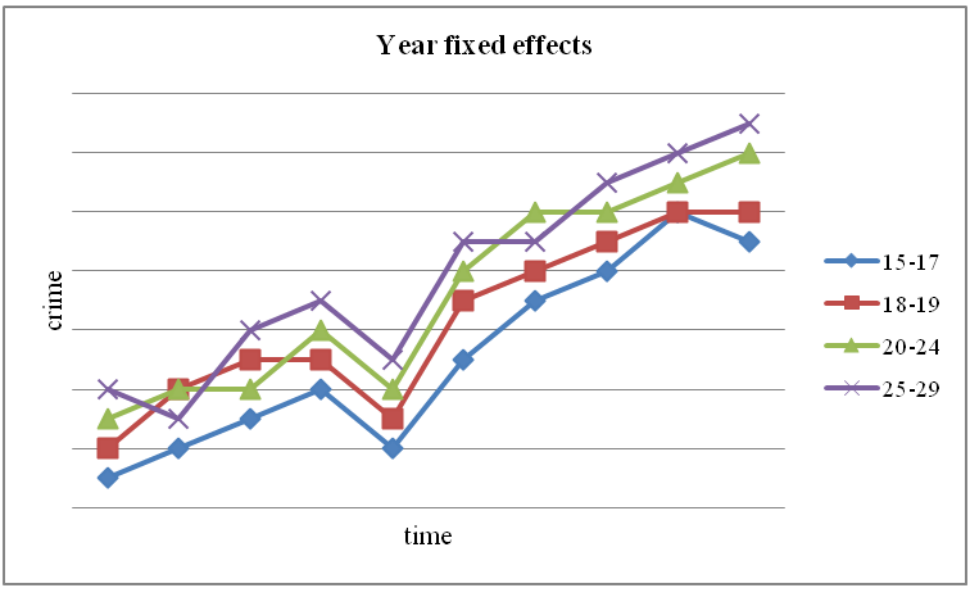

Figure 2: Hypothetical quantities of crime for different age groups within region (Joyce, 2009b)

The second type of fixed effects, that models using panel data should be concerned about are the year effects. These effects are associated with certain years in which the overall crime trend across all the generations diverts in the same direction (see Figure 2). The year effects might be caused by sudden exogenous shocks - for example economic depression or political turmoil. Again these effects too could be misinterpreted as the impact of the factor

[13] Please note the difference between the age fixed effect and the cohort effect. The D&L hypothesis seeks for the cohort effect, while controlling for confounding effect of age fixed effect (and other fixed effects).

that is sought after - in this case the abortion rate. It is important to say that beside the augmentation, these effects can as well weaken the connection in the estimated model, and controlling for them clears the overall obfuscation within the model.

The last source of fixed effects in my model are another cross-sectional units (beside age groups) – the regions[14]. Each region has specific and unique characteristics which influence the crime rate. Therefore it is not surprising that the crime rate between the regions systematically differs. Figure 3 shows these effects in the hypothetical crime rates for one age group in different regions. Due to the region effect, the Prague region (PRH[15]), for instance, has always higher crime level, than all the other regions in the figure.

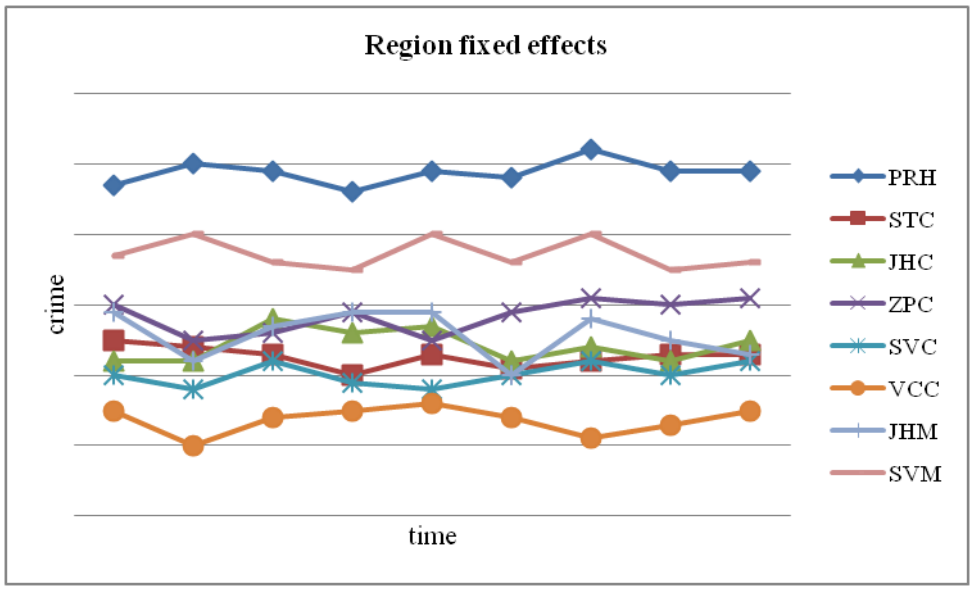

Figure 3: Hypothetical quantity of crime of an age group within different regions

I presented the three basic sources of fixed effects in my model, age, year and region, however, controlling just for these single effects might yet not be the optimum. We have to consider also the interactions between these effects. As they interact one with another, we should control for three different interactions. It is the region-year interaction, which controls for the effects influencing all age groups within a certain region in a certain year. Then there should be controls for region-age group interactions, which de-mean the level of crime committed by a certain age group within a certain region. And the third interaction is the year-

[14] To achieve the required continuality in the data, I consider the regions of administrative division that lasted from 1960 to 1999. The data for the rest of the years within my sample period (that is 2000-2004) were fortunately collected with regard to the now-old administrative division too.

[15] For marking the regions I use shortcuts derived from Czech names of the regions: PRH=Prague,STC=Central Bohemian Region,JHC=Southern Bohemian Region, ZPC=Western Bohemian Region, SVC=North Bohemian Region, VCC=Eastern Bohemian Region, JHM=Southern Moravian Region, SVM=Northern Moravian Region.

age group interaction, which marks the change of crime committed by a certain age group in a certain year in many regions. As Foote and Goetz (2005) write "virtually all confounding effects would be expected to operate in one of these three ways. Therefore, if we still detected a negative relationship between abortion and crime after three rounds of de-meaning, we would be reasonably sure that this relationship was not due to a confounding factor. Importantly, we would not need to know the source of these state-year, age-year, or state-age effects. They could be due to the emergence of crack in the 1980s and 1990s, the proliferation of video games, a general breakdown in social morals, changing unemployment rates, or anything else." (Foote & Goetz, 2005, p. 5)

IV. ABORTION AND CRIME IN THE CZECH REPUBLIC

A. THE HISTORY OF ABORTION IN CZECH LANDS

The abortion in Czechoslovakia was legalized by passing a law in 1957, which came into effect on January 1, 1958. Any type of legalization however usually comes with more or less restricting legal barriers, meaning that various conditions have to be fulfilled, and it is a matter of deeper insight how much freedom to abort her unborn child a woman really gets. The most radical step towards lifting these barriers was taken on 1958 but it was not the first one on this road. In the beginning of the twentieth century, there was still in effect an act of 1852 (Section 144 of Act No.117/1852 Coll., Criminal Code) (Czech Statistical Office, 1986). It stated that any abortion, even that in the sake of woman's health, was forbidden under the penalty of up to five years in prison (Subrtova, 2002). Only in 1912, an amendment was made to legalize those abortions which were carried out to save woman's life or save her from serious injury. During the First Czechoslovak Republic (1918-1938), in spite of the ongoing discussions among the professionals and within the parliament, the status quo remained unchanged (Subrtova, 2002). In 1950, the new Criminal Code was published. According to its Section 218 only those pregnancies could have been terminated that threatened the life or health of the woman (Czech Statistical Office, 1986). As such, this approach was not any more permissive than that of the First Czechoslovak Republic. From 1953, the first statistics on abortion started to be collected, these statistics however do not reflect the real numbers of

abortions as they do not take account of the abortions that were carried out for other reasons than health.[16]

In 1957, the Act No. 68/1957 Coll., was passed by which the abortion was legalized effectively from 1958. The abortion legalization followed other states of the Eastern Block and the USSR where the abortion was temporary prohibited and again permitted after Stalin's death. The legalization was followed by a sudden increase in number of registered abortions. However we can only guess what the real growth was when we take into consideration the unknown number of unregistered abortions before the legalization. In 1986, with the Act No.66/1986 Coll., the committees that were deciding about the requests for abortion were cancelled. After this every woman could have gotten the abortion, unless it was a threat for her health and unless the pregnancy was too advanced[17]. This liberalization was followed by upsurge of abortions. From 1991, as the effective contraception begun to be available the abortion rate rapidly decreased and at this time it is on its lowest from the beginning of its measuring. (Czech Statistical Office, 2004)

B. THE TIME SERIES GRAPHS

Now, I would like to continue with presenting some simple time series graphs showing the development of abortion rate and crime rate.

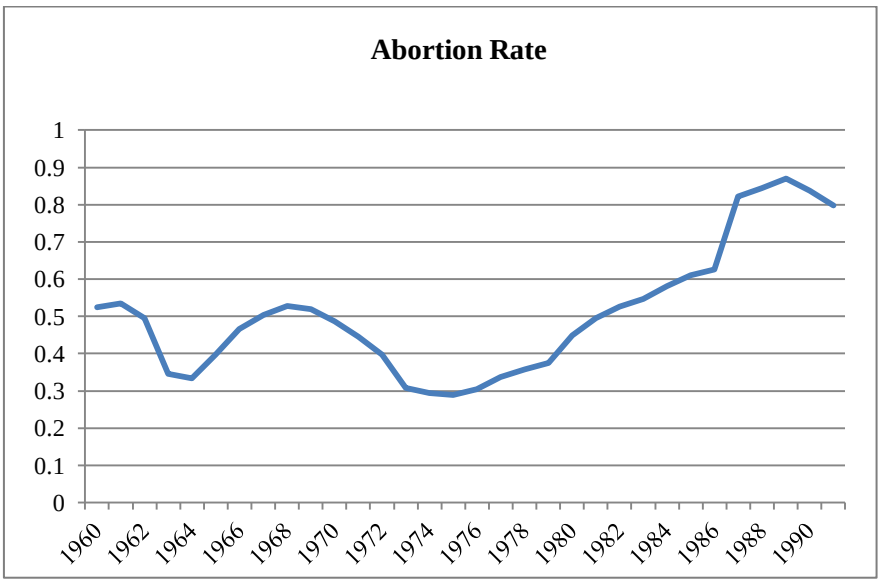

Figure 4: The development of abortions upon request per born child (1960-1991) (source: Medical Yearbooks from Institute for Medical Information and Statistics)

[16] These are not available for regions and therefore unsuitable for panel analysis.
[17] More than 12 weeks

In Figure 4, we can see the sharp increase from 1986 to 1987 which was triggered by dismissing the committees that had had to approve of the abortion before it would have been carried out. This growth of abortion rate was brought about by two means, first one is the substitution when the more readily available abortion simply partially substitutes other means of contraception. Second mean is the increase in wantedness of the cohort, which in my opinion bears more responsibility for the increase in the abortion rate as it is quite sharp. The substitutive effect would be spread in time in form of gradual increase, as the information about the relatively lower cost of abortion would spread among the people, and affect their sexual behavior in direction of more intercourses and less contraception. The steep increase as the reflection of increased wantedness (and therefore possible lower criminal propensity in the future) could be also supported by the decreasing fertility rate, which is on the other hand a part of the trend which started few years sooner.

Now let us look at the graph (Figure 5) showing the crime rate (proxied by the numbers of prosecuted persons). In optimal situation, the effect of steep increase in abortion rate would be seen in each age group at the time when the children born in 1987 would hit the age of this age group. Due to the aggregation of several cohorts in an age group this effect might not be visible as much as it would be, if the crime rate was differentiated by single year of age. Anyway, the effect of steep increase in AR of 1987 should be seen in these periods: for age group 15-17 in 2003 (1987 + 15 years alive + 1 year in utero), 2004 and 2005; for age group 18-19 in 2006 and 2007; for age group 20-24 in years 2008-2012; and for age group 25-29 in years 2013-2017 (which we obviously cannot observe yet).

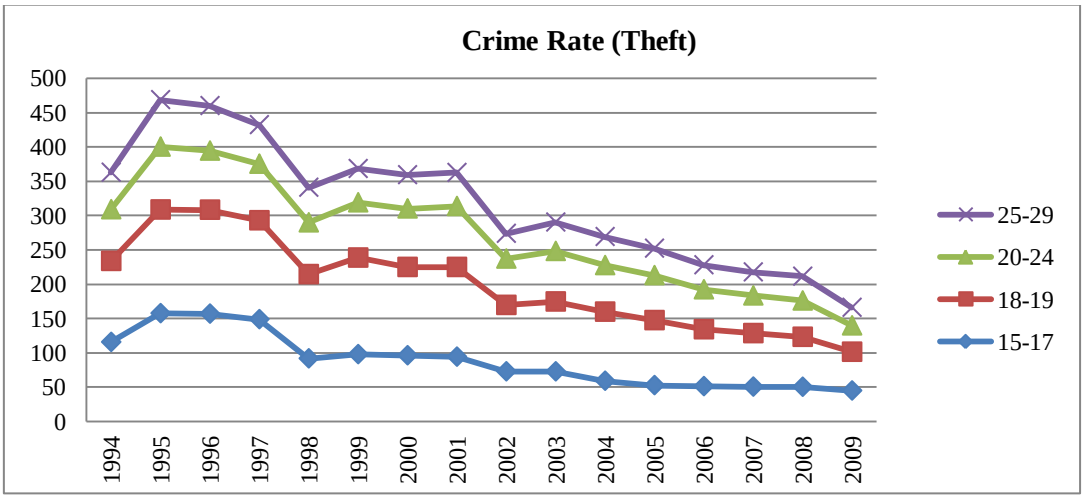

Figure 5: The number of persons prosecuted for theft per 10000 persons by the age groups

(source: Statistical Yearbooks of Criminality from Ministry of Justice)

As we see in the Figure 5, the crime rate in the Czech Republic (proxied by the prosecutions for theft) falls more or less steadily since 1995 and there are no sudden cohort specific slumps in the expected time that would be strong enough to be seen on this graph. The visible slumps in the crime rate are results of the time fixed effects as the slumps are present at one time in all age groups. However, as I noted above, reason for the invisibility of the cohort effects might be caused by the aggregation of age groups, even if the abortion-crime effect (hence, the cohort effect) would be existent and present.

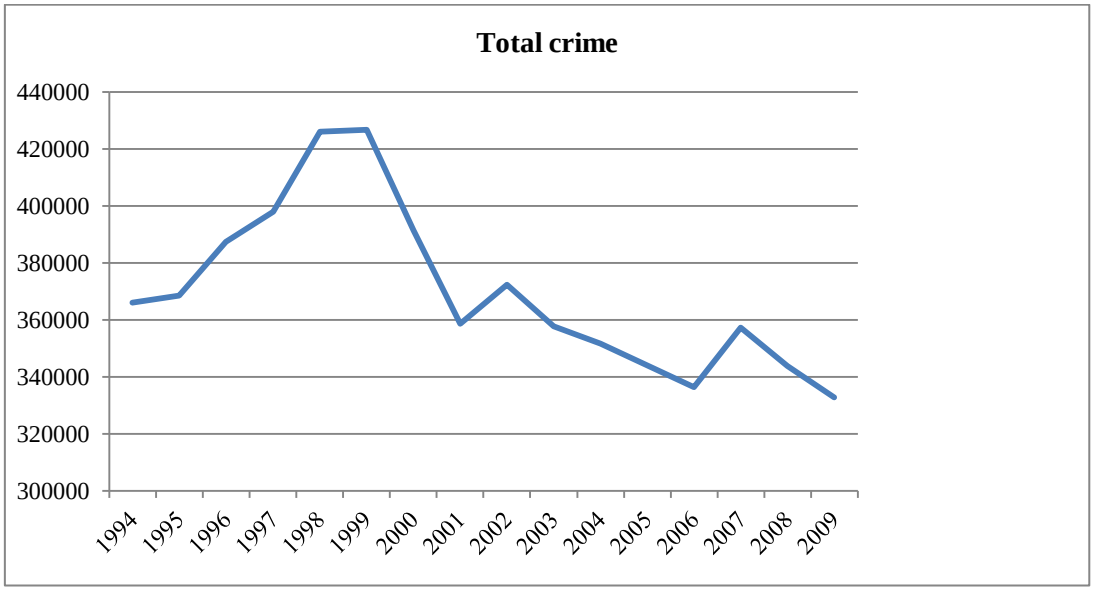

Figure 6: Total crime in the years 1994 to 2009
(source: Police of the Czech Republic)

The data collected by the Police of the Czech Republic in Figure 6 show the similar trend of steadily decreasing crime, even though the peak of criminality seems to be reached sooner than in the age specific data of prosecuted persons. This minor discrepancy might be caused by changing proportionality in commitment of theft crimes that are punitive as opposed to all other crimes (punitive and non-punitive). Another cause could be volatility in the police's success in capturing the criminals and their subsequent prosecution. Yet another source of inconsistency could be possible differing approach of justice towards suspects, and changing rate of trespassers being prosecuted for this crime.

As I want to estimate the effect of abortion on crime, and the only option how to implement the age specific information about criminals is through the number of prosecuted persons, I need to assure that the number of prosecuted persons, esp. the number of prosecuted thieves, is good approximation of the overall crime - simply said, I need to link the

prosecuted persons with crime. Though we will never know the true crime level exactly, the data of police are the best available estimation as they consist also of non-punitive crime and even crime committed by unknown perpetrators. As the model which estimates the relation between the crime data and the data about persons prosecuted for theft[18] says, the numbers of prosecuted persons are a good approximation and therefore the possible effect of abortion can be applied to crime as well. As the relation between prosecuted persons and crime was proven, I can move back to the link between abortion and crime. Taking a glance at the simple time series shown in Figure 4 and Figure 5 we might find a sign of inverse proportionality between crime and abortion rate. The abortion rate starts to rise roughly in 1976 and crime peaks in 1998 when the first cohorts born during rising abortion rate were about 21 years old. As 1976 started the trend of rising abortion rate, the 1998 marked the outset of crime decline which, with minor interruptions, lasted until the end of the sample period. This is the pattern which I would expect, if the abortion-crime link was existent.

On the other hand, looking at the Figure 5, the age differentiation of the criminals shows, that the crime started to fall at the same time in all observed age groups, contradicting the hypothesis about the fall caused by the increased abortion rate. If it was the abortion rate that drove the fall in crime, there would have to be seen distinct age-group-specific drops in crime – the crime reduction would be apparent at first in the youngest age-group and as the generations which were exposed to higher abortion rate would grow older, the crime fall would migrate into the older age groups. Similarly as Joyce (2009b, p. 18) I explain this process graphically in Figure 1. The figure shows the age effects which are embodied in the vertical distances between the lines but it also illustrates the aforementioned movement of the crime reduction across the age groups – the cohort effect. As this effect is unrecognizable, the more thorough analysis needs to be done.

V. THE DATA

In this section I will present the characteristics of the data that I use in the regressions that will follow.

[18] Estimated on the panel data for all 8 regions in years 1994-2009 the numbers of crimes and the numbers of persons prosecuted for theft are well correlated (crime lagged in order to approximate the institutional delay): $\underset{}{total\_\hat{c}rime_{jt-1}} = \underset{(121981)}{37861.6} + \underset{(0.397)}{2.983}\, prsctd\_theft_{jt}$, with R^2=0.97, ρ=0.66, n=128.

The abortion counts I use involve specifically only the abortions upon request, which I was able to collect thanks to the elaborated statistics by the Institute for Medical Information and Statistics[19] that is published annually from 1960. Picking only the abortions upon request clears the confounding impact of spontaneous abortions, and strengthens the association between abortion rate and the wantedness of the cohort. This is one of the improvements to the model of D&L (2001).

Another advantage against D&L's research is that Czech abortion statistics provide the information about the abortions by the residence of the pregnant women, what is very useful because it avoids the potential distortion of abortion data caused by travelling to other regions for getting the abortion and thus considerably lowers deformation in measuring the abortion and crime link. The children are usually raised in the region of their mother's residence and the most of the perpetrations occur in the same region. This data specification is another considerable improvement of D&L (2001) who eventually estimate this specification too in their later paper D&L (2008) though these estimations are dubious (Joyce, 2009a).

The purpose of using the numbers of prosecuted persons, instead of arrestees, is that they are the only available data related to criminals that have reasonable age specification. Therefore number of prosecuted persons serves as an approximation for number of criminals, similarly as the numbers of arrestees do in D&L's equation. The age groups specified in the statistics are following: 15-17; 18-19; 20-24; 25-29; 30-39; 40-49; 50< [20]. Of these, I pick the first four categories. I found these categories to be optimal for my purposes because, first, these groups are the least aggregated ones, and therefore the variability of abortion rate between consecutive years will be reflected in the AR of the group more, as each cohort within the group will have proportionally larger weight. Secondly, the youngest generations are those where the effect of abortion legalization would start to manifest. Third, these groups are the most criminally active ones - generally, about half of the overall crime can be accounted to the persons of age up to thirty years old.[21]

Another important addition to the D&L's model is given by the availability of the population age-specific counts[22] which allow me to approximate also the criminal rate, beside the simple crime levels. The simple crime counts do not consider the size of the population and the models that use it for the purposes of D&L hypothesis produce opaque results. What

[19] Ústav zdravotnických informací a statistiky, 1960-1991.
[20] Beside these age groups, there are several periods in which other groups are observed in the statistics, notably age groups of 15,16 and 17-year-olds, of which I will write in latter parts of this section.
[21] See for example the yearbooks on criminality by Marešová (1994-2010).
[22] Available from Czech Statistical Office

is essential is the crime rate which tells us about the criminal propensity of the population. Thanks to the availability of the data about the size of each single age group in each region and in each year I am able to calculate the measure of number of prosecuted persons per population of that age group in that region and year.

As the crime data are differentiated by the age groups composed of several cohorts[23] I had to adjust the abortion data to assign relevant abortion rate to each age group of prosecuted persons. I estimated the abortion rate for an age group using the arithmetic average of abortion rates of cohorts within the group. For example the abortion rate for age group of 15-17-year-olds for year 1995 in Prague region is equal to average of ARs in 1977,1978 and 1979 in Prague region. The relevant year for AR is always a+1 years before the prosecution as on average the cohort spent most time in utero in this year.

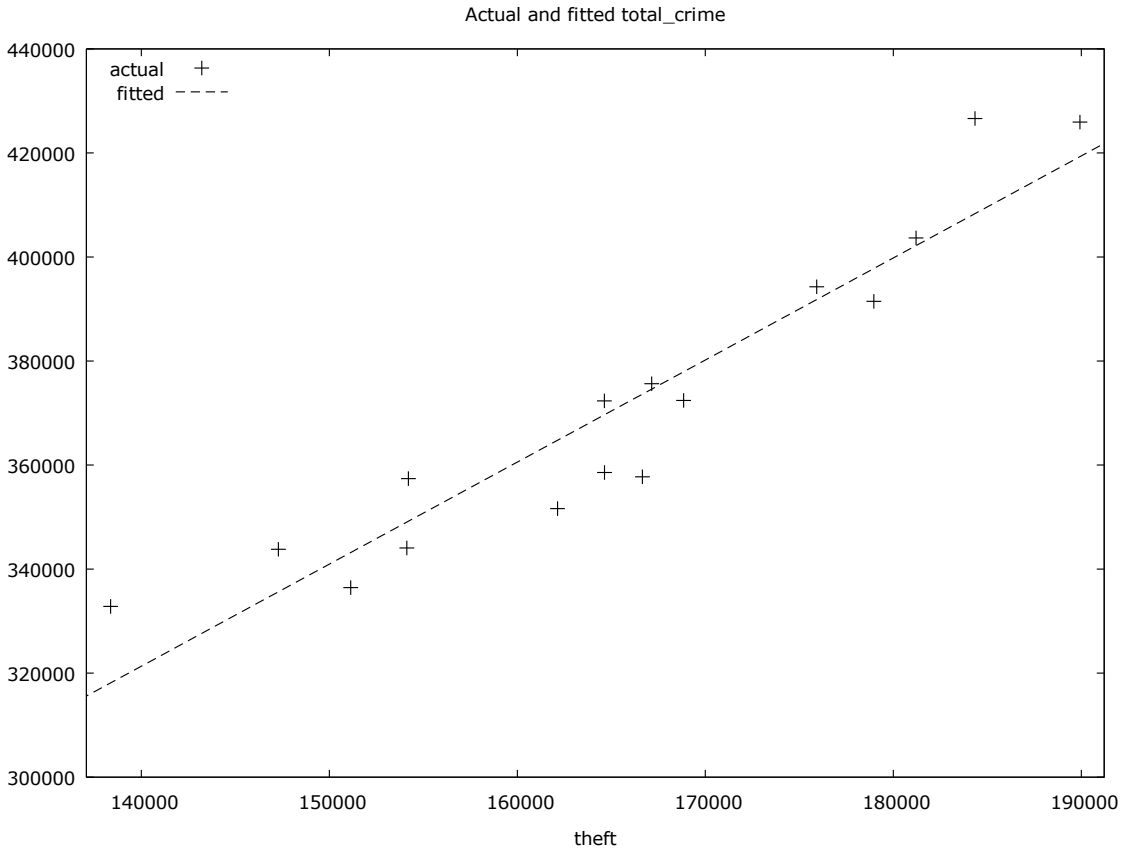

Figure 7: Relation between the theft and total crime
(Source: Statistics by Police of the Czech Republic, years 1994-2009)

[23] The cohort is a dynamic unit, it is a group of same persons, and cohorts do age. The age group is statistic unit which gathers the cohorts which, in the actual period, are of the age that this group embraces.

The types of crime which I cover in this part are theft[24] and battery[25]. The arguments for picking these crimes, though valid for both types, are especially evident in the case of theft. It is the most prevalent crime so its variability is high. If we look at the statistics of murder for example, there are relatively few homicides every year and the small numbers for each age-region-year observation would not tell us much about the development of crime. The theft is the most widespread crime even among the youngsters so the effect of improvement in criminal behavior could be seen relatively soon within the observed period. The wording of the definition of the crime of theft is also, by the essence of this crime, resistant to changes in formulation by amendments, and ensures the consistency in the measurement of the variable across the years. Most importantly, the crime of theft accounts for roughly one half of total crime and it is a very good approximation of total crime as shown in Figure 7.

I picked the battery for the similar reasons. The numbers of batteries committed are not as high as the numbers of theft but they still have enough variability to provide the reasonable results when used in the model. The crime of battery serves as the representative of the violent crime, of which it is the most prevalent one. The violent criminals' age distribution is shifted to the older age groups and the possible effect of abortion would be shown among other age groups (Donohue & Levitt, 2001). The representation of violent crime in the model is useful because violent crime could be committed by different people with different motivations than the property criminals (represented by theft). The target set is therefore expanded, and the research embraces larger group of criminals.

VI. THE REGRESSIONS

A. VARIANTS OF MODEL

I will estimate series of several slightly different models. The idea is to cover possible variants of interactions within the model. The variance of the models will be determined by: first, two different kinds of crime – the theft and the battery; second, by the inclusion of diverse number of controls and third - and that is the topic that I would like to follow with – by different forms of the dependent variable.

[24] As defined in Section 247 of Act No. 140/1961 Coll., Criminal Code.
[25] As defined in Section 221 and Section 222 of Act No. 140/1961 Coll., Criminal Code.

The functional form of the dependent value will vary in the estimated models as during the debate several have been discussed. The original measure that D&L used was the natural logarithm of raw numbers of arrests (specific for each age group, state and year) – they took this option, though aware of its relatively smaller appropriateness, as the measures of population within age groups were not available to them.

Fortunately there are available data on number of people within each age group and in each year and I am able to evaluate the crime rates as proposed by Foote and Goetz (2005). Therefore I will use also the dependent value in the per capita form, once as a basic ratio of crime to the population (age group specific) and once as a natural logarithm. Altogether, the dependent values will have the following forms: crime rate (crime per 10000 persons), natural logarithm of crime rate and natural logarithm of crime. If the dependent value is crime rate, the found parameter tells us by how much the crime rate will change when the abortion rate changes by a unit. This is quite straightforward and comprehensible interpretation of the possible link between abortion and crime. However, this measure takes into account the prevalence of the crime and thus the more prevalent crime would show stronger correlation. Therefore it might be also useful to estimate the model for the dependent variable in the form of natural logarithm of the crime rate. The found parameter of this model tells us by how many percent the crime rate will change when the abortion rate changes. The third form of the dependent value will be the same as in D&L (2001) for the comparison reasons.

Joyce (2009b) proposes several points which, according to him, should be fulfilled in order to gain the acceptance of the empirical model that explores the relation between abortion and crime. The points are following: "1.The crime measure must be age-specific in order to identify cohorts 2.The outcome should be a rate of crime and not a level. 3.The hypothesis should be consistent with the timing of abortion legalization and should be evident or not contradicted by basic time-series plots. 4. The abortion rate should be measured by state of residence 5. The abortion rate should be inversely related to fertility rates. 6. Regressions of age-state-year crime rates should include state-year fixed effects 7. The number of observations with no measure of abortion should be minimized 8. Statistical tests should take account of the auto-correlation in crime-rate residuals." (Joyce, 2009b, p. 38)

Fortunately my research meets most if not all of these criteria. To remind the reader I will run regressions on the following model, and its variants (with fewer controls).

$$Ln(PRSCTDRATE_{rat}) = \beta ABORTRATE_{rt-a-1} + \gamma_{ra} + \lambda_{at} + \theta_{rt} + e_{art}, \quad (4)$$

B. THE REGRESSION ON PERIOD OF 1994 TO 2009

In the first part of the regression analysis I explore 16 years period from 1994 to 2009. The following are the reasons that lead me to this decision. First, there is a source of abortion variability lying in the liberalization of the abortion law in 1987, when the country's abortion rate sharply rose by one third from 62 to 82 abortions per 100 births. Second, the data about crime possess higher credibility than if they were collected during the rule of the Communist Party. The totalitarian regime was very restrictive regarding the information in general, and an issue of crime being a very sensitive political topic was in all probability within the scope of the information restriction. Third, as the legalization of abortion took place already quite a long time ago, and the statistics are completed since 1960, the information about AR of the cohorts I examine is exact and I do not need to assume the abortion rate as D&L did.

The results of the regression are in the tables 1 to 6. In the tables 1-3, we can see the estimates of different specifications of model that regresses the crime of theft on the abortion rate. Each of these tables differs in the variant of the form of dependent variable. The Beta parameter in Table 1 tells us by how much the number of theft crimes per 10000 people changes when the number of abortions per 100 born children rises by one. We can see, that the model improves as the different controls are added – the beta estimate is higher and with broadly increasing significance as the standard errors shrink. Also the R^2 is rising and the autocorrelation coefficient is falling. When all the controls are added, the estimated model tells us that when the abortion rate rises by one, the theft rate rises by 0.88. It means that ten more abortions per 100 born children result in 8.8 less thefts per 10000 people.

Table 2 sums up the results of different specifications when the dependent variable is the natural log of theft rate. The development of quality is similar like in the case of the Table 1, the more controls are added the higher and more significant the estimate Beta, the higher R^2 and the lower the autocorrelation coefficient. The best estimate (in the first column on the right) says that when the abortion rate increases by ten, the theft rate falls by 8 percent.

Table 1: Regression results of model estimating the impact of abortion rate on the number of persons prosecuted for theft per 10000 people

Dependent variable	PROSECUTIONS FOR THEFT PER 10000 PEOPLE					
specification	simple model[26]	add controls for region, year and age group effects	add UNEMPLOYMENT	add region-year interaction controls	add region-age group interaction controls	add year-age group interaction controls
ABORTION RATE	**-0.197**	**-0.833**	**-0.837**	**-0.847**	**-0.858**	**-0.881**
	(-0.102)	(-0.0754)	(-0.075)	(-0.0724)	(-0.059)	(-0.165)
	[-1.932]	[-11.048]	[-11.164]	[-11.699]	[-14.554]	[-5.327]
adjusted R^2	0.00532	0.84	0.841	0.853	0.904	0.958
ρ	0.918	0.688	0.687	0.725	0.572	0.448
n	512	512	512	512	512	512

Table 2: Regression results of model estimating the impact of abortion rate on the natural logarithm of persons prosecuted for crime per 10000 people

Dependent variable	Ln(PROSECUTIONS FOR THEFT PER 10000 PEOPLE)					
specification	simple model	add controls for region, year and age group effects	add UNEMPLOYMENT	add region-year interaction controls	add region-age group interaction controls	add year-age group interaction controls
ABORTION RATE	-0.00151	**-0.00444**	**-0.00445**	**-0.0046**	**-0.0049**	**-0.0082**
	(-0.00125)	(-0.00082)	(-0.000821)	(-0.00075)	(-0.000607)	(-0.00156)
	[-1.206]	[-5.414]	[-5.416]	[-6.141]	[-7.996]	[-5.264]
adjusted R^2	0.000888	0.874	0.874	0.897	0.932	0.975
ρ	0.978	0.767	0.768	0.805	0.654	0.319
n	512	512	512	512	512	512

Table 3: Regression results of model estimating the impact of abortion rate on the natural logarithm of persons prosecuted for theft

Dependent variable	Ln(PROSECUTIONS FOR THEFT)					
specification	simple model	add controls for region, year and age group effects	add UNEMPLOYMENT	add region-year interaction controls	add region-age group interaction controls	add year-age group interaction controls
ABORTION RATE	**-0.0149**	**-0.0105**	**-0.0105**	**-0.0108**	**-0.0112**	**-0.0112**
	(-0.00127)	(-0.000837)	(-0.000838)	(-0.00078)	(-0.00054)	(-0.0017)
	[-11.757]	[-12.581]	[-12.585]	[-13.801]	[-20.657]	[-6.556]
adjusted R2	0.212	0.898	0.898	0.913	0.958	0.977
ρ	0.963	0.805	0.806	0.639	0.639	0.592
n	512	512	512	512	512	512

[26] Simple model is simple regression of dependent variable on the abortion rate without any control variable.

Table 4: Regression results of model estimating the impact of abortion rate on the natural logarithm of persons prosecuted for crime per 10000 people (period 1994-2009)

Dependent variable	PROSECUTIONS FOR BATTERY PER 10000 PEOPLE					
specification	simple model	add controls for region, year and age group effects	add UNEMPLOYMENT	add region-year interaction controls	add region-age group interaction controls	add year-age group interaction controls
ABORTION RATE	**-0.0279**	**-0.0394**	**-0.0387**	**-0.0384**	**-0.0402**	0.0468
	(-0.0122)	(-0.01)	(-0.00992)	(-0.00897)	(-0.00873)	(-0.0333)
	[-2.280]	[-3.933]	[-3.896]	[-4.286]	[-4.599]	[1.403]
adjusted R^2	0.00815	0.804	0.807	0.844	0.854	0.88
ρ	0.8	0.306	0.286	0.242	0.14	-0.006
n	512	512	512	512	512	512

Table 5: Regression results of model estimating the impact of abortion rate on the natural logarithm of persons prosecuted for theft (period 1994-2009)

Dependent variable	Ln(PROSECUTIONS FOR BATTERY PER 10000 PEOPLE)					
specification	simple model	add controls for region, year and age group effects	add UNEMPLOYMENT	add region-year interaction controls	add region-age group interaction controls	add year-age group interaction controls
ABORTION RATE	**-0.00294**	**-0.00378**	**-0.00374**	**-0.00371**	**-0.00381**	0.00294
	(-0.00108)	(-0.0009)	(-0.000897)	(-0.00084)	(-0.00082)	(-0.0031)
	[-2.720]	[-4.201]	[-4.168]	[-4.419]	[-4.647]	[0.935]
adjusted R^2	0.0124	0.798	0.799	0.826	0.836	0.864
ρ	0.773	0.274	0.267	0.227	0.125	0.002
n	512	512	512	512	512	512

Table 6: Regression results of model estimating the impact of abortion rate on the number of persons prosecuted for battery per 10000 people (period 1994-2009)

Dependent variable	Ln(PROSECUTIONS FOR BATTERY)					
specification	simple model	add controls for region, year and age group effects	add UNEMPLOYMENT	add region-year interaction controls	add region-age group interaction controls	add year-age group interaction controls
ABORTION RATE	**-0.0163**	**-0.0099**	**-0.0098**	**-0.0099**	**-0.0102**	$-5.8*10^{-6}$
	(-0.00144)	(-0.000918)	(-0.000917)	(-0.00087)	(-0.00081)	(-0.0032)
	[-11.295]	[-10.757]	[-10.735]	[-11.457]	[-12.545]	[-0.002]
adjusted R^2	0.199	0.904	0.905	0.916	0.927	0.937
ρ	0.865	0.316	0.311	0.285	0.124	0.013
n	512	512	512	512	512	512

The last table concerning the theft - Table 3 - uses the same form of dependent variable as D&L used. The estimate with full number of interactions controls gives us roughly similar result as that of D&L (2001) who write that their "results suggest that an increase of 100 abortions per 1000 live births reduces a cohort's crime by roughly 10 percent." (Donohue & Levitt, 2001, p. 414) In my case the results say that the same increase in the abortion rate (10 per 100 in my case is equivalent to 100 per 1000 in D&L's case) would be responsible for decrease of 11.2 percent of theft crime.

To sum up the verification of the "theft" models, all of the 18 estimates have the expected negative sign that indicates inverse correlation between abortion and theft. The vast majority of estimates are statistically significant with only one exception which is associated with model without any controls and therefore with the least relevancy. As Joyce (2009b) suggests we should take into consideration the autocorrelation which is present in these models too. It is caused by relative similarity of the abortion rates in time progression which is even strengthened by the necessity to average abortion rates for several cohorts within an age group. It causes that the standard errors are underestimated and the statistical tests are weakened, however the t-ratio is usually high enough to give us the confidence of the results' correctness.

When we look at the models that estimate the effect of abortion rate on the crime of battery we can see that the parameters are slightly less convincing about the link with the abortion. The regressions on the rate of battery in table 1 are much smaller than the estimates associated with theft. However, this is probably caused by smaller incidence of battery than theft. In this table, neither one of the parameters with all controls included in the model is significant and the first one is even positive.

It seems that the controls which are the most "damaging" to the estimates are the controls for the age-year effects. It is true that these controls, being controls for changes of one age group in all regions in one year, might cause underestimation of the true effect of abortion, but as we have seen in the case of theft, this is not detrimental to manifestation of the link if it was strong. If the controls for year-age interactions were not included, than the results of logarithmic dependent variables (Table 5,Table 6) would be broadly similar to those of the theft models.

To check whether abortion rate is not an endogenous variable of theft rate I estimated a model that takes into account the period of twenty six years (1968-1993) in which the actual abortion rate as well as the crime rate (crime data and population data) are available. The estimated coefficient is 0.02 with t-ratio of 5.771. As we can see, there is weak relation

between the abortion rate and the crime rate of same year, however it is nowhere near to the relation of lagged abortion rate, therefore the endogeneity is insubstantial.

VII. EXTENSION: REGRESSIONS ON OTHER PERIODS

In the next part of my thesis I would like to apply the model on different time periods specifically 1968-1976 and 1978-2009. The regressions are done only for the crime of theft as those for battery yield similar results only with high sensitivity to addition of control for age-year effect interaction. Also I omit the unemployment variable as the unemployment rate in the socialist period was very low and its addition to previous models did not change the results significantly.

A. THE REGRESSION ON PERIOD OF 1968 TO 1976

. There are two reasons why I would like to broaden the focus of my research on this period. First, as the legalization of abortion took part in 1958, this is the period when the criminally active cohorts could be affected by this phenomenon for the first time. If dissolving of the committees in 1987 caused the rise of abortion rate by about a quarter, then the legalization itself must have caused even stronger reaction and the rate of abortion probably rose much more. It is a question which will remain unanswered, how prevalent the abortion was during its illegality, but we know for sure it was not zero as D&L assumed for the prelegalization period in the USA[27]. I decided to assign the rate of 30 abortions per 100 born children for the pre-legalization period. This is reflecting the contemporary estimates[28] and though it is probably overestimated rate, it still leaves space for legalization, which started with the rate of about 50-60 abortions per 100 born children, to make an effect in the level of committed crime.

The second reason is that there is available crime data in this period for single years of age for cohorts 15,16 and 17. As the crime data are disaggregated, the possible effect of abortion could appear more distinctly, because there would be clear distinction between the cohorts affected by the legalized abortion as opposed to the older, unexposed, cohorts. In the previous model, the change in abortion rate for single cohort had relatively weaker influence

[27] Criticized by Joyce (2004), see section II.
[28] See for example Srb, Kučera & Vysušilová (1961).

on the overall average abortion rate of the criminal age group. Therefore I would like to make use of this cohort distinction in the crime data and run the regressions with the model for these four relatively narrow age groups (15;16;17;18-19) as, which I already mentioned, these are the cohorts in which the potential effect of abortion on crime could appear.

Therefore when comparing to the models in the period 1994-2009 that I estimated before, the advantages lie, first, in the proximity of the observed period to the legalization of abortion and second, in the disaggregated data on cohorts in which the effect might appear. On the other hand, this second approach has also disadvantages – one being the short period, of only 8 years, which is caused by the limited availability of the single-year-of-age crime data and second, being the distortion in the data about crime which is expected due to the totalitarian rule in the country. In spite of this drawbacks it might be interesting to run the regressions for this period.

Beside the data on abortion and crime which are available, I need also cohort-specific data on population as it is necessary for the calculation of the crime rate. This type of data is however available only since 1974. This is not optimal but to get most of these , I decided to take into consideration always the size of the population of the same cohort in the period when data are available. Therefore for example the data for population of 15, 16, 17, 18 and 19-year-olds in 1968 will be estimated as the populations of these cohorts in 1974, which are 21, 22, 23, 24 and 25-year-olds. I understand that these data might no be exact as each generation population shrinks as it grows older, however, for my needs, the importance lies in the relative size in regards to the other observed generation. I assume that the relative sizes of the cohorts‘ populations are stable throughout the time. To make an example, if there are 20 percent more 15 year olds than 16-year-olds in 1968, then I assume that there will be 20 percent more 18-year-olds than 19-year-olds in 1971.

For the years 1974-1976 in which the concrete data for each generation are available, I will not use these, but again I will take the numbers from six years older statistics when these generations are 21-25-year-old to assure that the numbers of populations are congruent. If I used for example actual data for 15-year-olds in the 1974 from the statistics of 1974, the congruency would be disrupted because these 15-year-olds would not take into account the shrinking of the population as it grows older.

Table 7: Regression results of model estimating the impact of abortion rate on the number of persons prosecuted for theft per 10000 people (period 1968-1976)

Dependent variable	PROSECUTIONS FOR THEFT PER 10000 PEOPLE				
specification	simple model	add controls for region, year and age group effects	add region-year interaction controls	add region-age group interaction controls	add year-age group interaction controls
ABORTION RATE	-0.888 (-0.639) [1.39]	-0.997 (-0.86) [1.16]	-0.839 (-0.962) [0.8723]	-0.559 (-1.021) [0.5425]	1.947 (-2.176) [-0.8947]
adjusted R^2	0.00324	0.0885	0.104	0.0525	0.0179
ρ	0.0289	-0.112	-0.0886	-0.134	-0.141
n	288	288	288	288	288

Table 8: Regression results of model estimating the impact of abortion rate on the natural logarithm of persons prosecuted for crime per 10000 people (period 1968-1976)

Dependent variable	Ln(PROSECUTIONS FOR THEFT PER 10000 PEOPLE)				
specification	simple model	add controls for region, year and age group effects	add region-year interaction controls	add region-age group interaction controls	add year-age group interaction controls
ABORTION RATE	**-0.0131** (-0.00353) [3.703]	**-0.00796** (-0.00355) [2.242]	**-0.00846** (-0.00398) [2.126]	**-0.00782** (-0.00417) [1.875]	0.00372 (-0.00879) [-0.423]
adjusted R^2	0.0424	0.511	0.518	0.503	0.707
ρ	0.44	-0.0159	-0.00643	-0.074	-0.0889
n	288	288	288	288	288

Table 9: Regression results of model estimating the impact of abortion rate on the natural logarithm of persons prosecuted for theft (period 1968-1976)

Dependent variable	Ln(PROSECUTIONS FOR THEFT)				
specification	simple model	add controls for region, year and age group effects	add region-year interaction controls	add region-age group interaction controls	add year-age group interaction controls
ABORTION RATE	**-0.017** (-0.00284) [5.991]	**-0.007** (-0.0015) [4.658]	**-0.00765** (-0.00163) [4.69]	**-0.00612** (-0.00146) [4.195]	-0.00316 (-0.00297) [1.064]
adjusted R^2	0.108	0.874	0.884	0.912	0.917
ρ	0.662	0.101	0.205	0.0317	0.0391
n	288	288	288	288	288

The results of the models that observe the relation between abortion and theft show weak results. None of the results are significant when the dependent variable is in the simple rate form. Only when logged, the results improve, but still the significance is on the border with low t-ratios. We can observe better t-ratios in the last table, which resumes the model that is most similar to D&L's one. As I already noted, this model is prone to overestimating the results. The reason is that when the dependent value is in the absolute form, as opposed to rate form, the negative relation is implemented in the nature of the model (Foote & Goetz, 2008).

Overall the outcome is not consistent with the strongly significant results given only by the least credible of three models estimated. This can be caused by small variability in the abortion ratio, for which D&L were criticized too. The reason is that majority of observed cohorts in the observed period were born prior the legalization and are therefore assigned the constant abortion rate of 30. Another drawback of models for this period is that it is very short and therefore any trend is harder to be discovered.

B. THE REGRESSION ON PERIOD OF 1978 TO 2009

In the second part of my extension I will estimate the model for abortion and crime in the longest possible period, given the available data and their continuity.

The age groups for which the crime data has been collected in the statistics yearbooks change throughout the time and the most optimal option for my needs, is to observe the same age groups as in the 1994-2009 regression, that is 15-17,18-19, 20-24,25-29 since year 1978 when the observation of these groups started and which continued undisrupted until present time. The final model will cover 32 years from 1978 to 2009 and it will use over one thousand of observations. This is definitely an advantage comparing to the previous models I estimated.

We can see that the results are somewhat more significant than in the period of section A, however still not as convincing as the regression on theft for the period from 1994 to 2009 as done in section VI. The most straightforward regression with the dependent variable in the form of crime rate tells us that when the abortions per 100 children increase by one, the crime will fall by about 0.25 per 10000 people. Even though this is statistically significant result (in contrast with result from section A), it is more than three times smaller than regression in section VI. As for the other regressions that estimate the link using other forms of the dependent variable the results are nonsignificant when all controls are applied.

Table 10: Regression results of model estimating the impact of abortion rate on the number of persons prosecuted for theft per 10000 people (period 1978-2009)

Dependent variable	PROSECUTIONS FOR THEFT PER 10000 PEOPLE				
specification	simple model	add controls for region, year and age group effects	add region-year interaction controls	add region-age group interaction controls	add year-age group interaction controls
ABORTION RATE	**0.259** (-0.079) [-3.258]	**-0.391** (-0.0609) [6.419]	**-0.372** (-0.057) [6.531]	**-0.381** (-0.0548) [6.941]	**-0.249** (-0.0945) [2.637]
adjusted R^2	0.00931	0.8	0.832	0.845	0.959
ρ	0.827	0.525	0.377	0.351	0.329
n	1024	1024	1024	1024	1024

Table 11: Regression results of model estimating the impact of abortion rate on the natural logarithm of persons prosecuted for crime per 10000 people (period 1978-2009)

Dependent variable	Ln(PROSECUTIONS FOR THEFT PER 10000 PEOPLE)				
specification	simple model	add controls for region, year and age group effects	add region-year interaction controls	add region-age group interaction controls	add year-age group interaction controls
ABORTION RATE	**0.0107** (-0.0015) [-7.059]	-0.000534 (-0.0007) [0.746]	**-0.00194** (-0.0006) [3.250]	**-0.00197** (-0.0006) [3.428]	-0.00016 (-0.0014) [0.115]
adjusted R^2	0.0456	0.927	0.951	0.955	0.977
ρ	0.883	0.562	0.338	0.296	0.306
n	1024	1024	1024	1024	1024

Table 12: Regression results of model estimating the impact of abortion rate on the natural logarithm of persons prosecuted for theft (period 1978-2009)

Dependent variable	Ln(PROSECUTIONS FOR THEFT)				
specification	simple model	add controls for region, year and age group effects	add region-year interaction controls	add region-age group interaction controls	add year-age group interaction controls
ABORTION RATE	-0.00106 (-0.002) [-0.620]	**-0.00825** (-0.0007) [-11.490]	**-0.00985** (-0.0006) [-16.260]	**-0.00986** (-0.001) [-17.430]	-0.00251 (-0.001) [-1.740]
adjusted R2	-0.001	0.94	0.959	0.964	0.979
ρ	0.905	0.603	0.415	0.358	0.336
n	1024	1024	1024	1024	1024

All in all, with 11 significant results out of 15 it is somewhat stronger estimation than that on the period of 9 years between 1968 and 1976. Therefore, it seems that including the years from the communist era within the model weakens the results. Indeed, this idea is supported by estimating the model using only the socialism years from section B, that is period of 1978-1989 where the result in regression using theft rate is very insignificant being 0.002 with t-ratio 0.045[29]. This outcome implies that the abortion-crime link is less distinguished in the socialism period. The most probable cause for weak link would be the generous socialist welfare system. The economically disadvantaged mothers, even if they did not resort to abortion and had children, were provided more necessary means by the state institutions than it was later. The state generally interfered in the family affairs in greater extent and the degree of wantedness did thus play smaller role in the raising of the children.

VIII. CONCLUSION

In my study I tested with Czech data whether there is a relation between abortion rate to which the cohort was exposed when in utero and the crime rate which this cohort commits after it reaches the age of criminal responsibility – the hypothesis that was proposed by Donohue and Levitt (2001).

My approach was based on the equation (3) of their 2001 paper, the paper's equation that has gained most approval by the critics. I tried to improve it on the basis of the evolving debate and criticism of other authors, specifically Foote & Goetz and Joyce. Based on their contribution and available data I was able to form model with better abortion data which were exact, based on women's residence, counted only those upon request and with small number of estimated (therefore incorrect) observations. Also I applied the data on crime per population, which reflect the propensity to criminality rather than mere levels of crime. I also added the missing controls for fixed effects and their interactions which were supposed to clear any confounding effects.

On the other hand, the drawbacks of my model lie in the fact that the crime data is more aggregated and the resulting necessary aggregation of abortion data which accounts for positive autocorrelation present in some of the models I regress. The autocorrelation could overestimate the significance of the estimates. Another drawback lies in fewer cross-sectional units, being number of regions and number of age-groups, which I try to partially compensate

[29] Full range of results available from author on request.

by longer period of observations. Also, the source of errors might lie in the approximation of theft rate by the measure of persons prosecuted for theft. Beside real level of crime of theft, this measure is influenced by the activity of the police and by the judicial process preceding the prosecution of the suspects.

The outcomes of the fixed effect models that I regress imply that the D&L's hypothesis might be valid and that the correlation is accentuated in the post-socialist period when the rise of AR upon request per 100 born children by 10 is associated with about 8 percent decrease in theft . On the other hand the estimates for periods consisting of years under the socialist government are several times smaller and less significant. Though the connection could still be valid, the small estimates might be caused by several factors – the crime data (whether they are realistic or reduced by the totalitarian authorities) show small variability and therefore the effect of abortion would be hidden. Also the connection between the unwantedness and the crime propensity might be weakened by paternalistic character of socialist state.

The reasons and the differences between the outcomes of different periods' models could be a topic for another treatise. Also in several years, the similar study could inquire into potential effect of fall of abortion and expansion of contraception – the ongoing trend which started in early 1990s. The question to solve could be, for example, whether the wantedness of cohorts increased and average conditions for children improved with spreading of contraception. This could be tested on crime or some other social phenomenon that could be affected by the wantedness of a cohort.

It has to be said, that I do not consider the outcomes of the tested hypothesis to be applicable as the proposal for the demographic policy. The view presented is strictly positivistic and does not regard the morality of abortion which is another side of the abortion problem and in my opinion should be taken into consideration by anybody who deals with the abortion policy. The better understanding of relation between wantedness of a cohort and its criminality could however be taken into consideration by authorities when creating the social programs that aim to curb the crime.

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