Unemployment and Crime

Panel data analysis for Europe

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Abstract

In this paper I investigate the influence of unemployment on crime by using data for Europe over the time period 1995 to 2012. I look at the impact of total unemployment, youth unemployment and long term unemployment on various types of crimes. I conduct a fixed-effect estimation where country and time specific effect and various factors are controlled for. The estimation is done with both ordinary least square (OLS) estimation and two stage least square (2SLS) estimation where employment protection legislation is used to instrument unemployment. Using OLS estimation I find that higher youth unemployment leads to more burglaries and that higher unemployment, regardless which one is used, leads to more drug offences. Using 2SLS estimation I find that higher unemployment rate leads to more property crimes (burglary and motor vehicle theft) but less violent crimes regardless which unemployment rate is used. The results indicate that all three unemployment rates have significant impact on crime but crime responds most to an increase in youth unemployment.

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1 Introduction

Crime is a global phenomenon that results in loss of properties, lives and misery. It is generally acknowledged to have damaging affect on societies psychologically and economically due to substantial cost and social deterioration (Donohue, 2007). Given its negative effect on societies it has become an important subject to policy makers and researches worldwide. Understanding the main determinants behind crime is critical as it provides a tool to reduce crime. Numerous researchers have identified various labor market factors as the main determinants of crime, namely unemployment rate. Theory suggests that unemployed individuals face strong incentive to engage in a criminal activity because return form legitimate work is usually reduced with involuntary unemployment so the substitution effect induces individuals to engage in criminal activity. Thus, criminal activity, as any other activity, is motivated by economic incentives (Becker, 1968; Ehrlich, 1973).

The impact of unemployment on crime has been studied for several countries such as United States, United Kingdom, New Zealand and France to name a few. Although the effect of unemployment on crime has been extensively researched few researches have studied it on an international level. One of few researches is Altindag's (2012) paper where he investigates the impact of unemployment on crime in Europe. Overall, researches from different parts of the world suggest similar results, that higher unemployment rate has positive effect on crime, especially on property crimes.

In this paper, I will extend Altindag's study and investigate how unemployment affects crime in 24 European countries over the time period 1995 to 2012. The countries included are listed in Appendix Table 1. I use three types of unemployment rate: total unemployment, youth unemployment and long term unemployment, and five categories of crime: burglary, motor vehicle theft, violent crime, robbery and drug offence. I conduct a fixed-effect estimation where country and time specific effects are controlled for in addition to average income, income inequality, education and urbanization. I use two methods to estimate the influence of unemployment on crime, I use ordinary least square (OLS) estimation and two stage least square (2SLS) estimation where I instrument unemployment by employment protection legislation to rule out causality.

This research makes two contribution to the existing literature on the effects of unemployment on crime. First, it updates Altindag's (2012) research for Europe. This paper uses more recent data which cover a longer period of time. Altindag's study covers

the time period 1995 to 2003. My results are based on data that covers the time period 1995 to 2012. Everything else being equal, these additional nine years which result in a larger sample size lead to more precise estimation. Second, total unemployment may not be able to identify individuals on the margin of engaging in a criminal activity. Therefore I use two additional unemployment rates that are less broad, youth unemployment and long term unemployment. Although numerous researches have studied the effect of unemployment on crime few studies have focused on youth unemployment and long term unemployment. This paper is the first, to my knowledge, to analyze the effect of youth unemployment and long term unemployment on crime in Europe.

The OLS results suggest that higher youth unemployment, but not total unemployment nor long term unemployment, leads to more burglaries indicating that youth unemployment has a stronger relation with crime than the other two unemployment rates. However, drug offence is significantly affected by all three unemployment rates. The 2SLS results indicate that unemployment has statistically positive effect on property crimes and violent crime, regardless which unemployment rates is used. However, a given increase in youth unemployment rate leads to more increase in crime than an increase in either total unemployment rate or long term unemployment rate. Nonetheless, the results indicate that all three unemployment rates have significant effect on crime so fighting any of these three unemployment rates should have declining effect on property crimes.

The paper is structured as follows. Section 2 introduces the economic theory of crime and discusses the findings of previous empirical studies. In section 3 the crime regression is presented and econometric specification. Section 4 describes the data used in the research. Finally, section 5 presents the results from both OLS and 2SLS estimation and section 6 concludes.

2 Literature Review

2.1 Economic Theory of Crime

Crime is generally perceived as a form of employment in economics as it requires time and effort and generates wealth. This implies that crime and work are substitutes (Witte and Tauchen, 1994). Becker (1968) and Ehrlich (1973) were the first to model the choice between crime and work. The one period decision-making model introduced here is based on their models and illustrates how rational individuals decide whether to engage

in a criminal activity by comparing expected benefit and cost. Individuals decide to engage in a criminal activity if:

$$(1-p)\ U(W_c) - p\ U(S) > U(W_L) \quad (1)$$

where, W_C denotes the return from a successful crime, W_L denotes the return from an alternative legitimate work and *U(.)* denotes the utility. In this model, crime and work are alternative activities and cannot be combined. If individuals decide to engage in a criminal activity they face the probability of being caught denoted as *p* and if caught they ensure punishment denoted as *S*, which can be in form of fine or imprisonment. Thus, the decision between crime and work depends on expected benefits from crime, left hand side of equation (1), and expected cost of crime (expressed as an opportunity cost of foregone legitimate work), right hand side of equation (1).

Individuals decide whether to engage in a criminal activity by comparing the expected benefit and expected cost. If the expected cost of engaging in a criminal activity is outweighed by the expected benefit a rational individual will decide to engage in a criminal activity. The decision may change if either expected benefit or expected cost of engaging in a criminal activity change. Hence, if returns from an alternative legitimate work increase, *ceteris paribus*, fewer individuals will decide to engage in a criminal activity. The same holds for higher probability of being caught or tougher punishments (Becker, 1968; Ehrlich, 1973; Freeman, 1999). So, to understand changes in crime over time factors that change the expected benefit and/or expected cost should be the main focus. One of these potential factors is unemployment (Becker, 1995).

2.1.1 Unemployment and Crime

Crime has been linked to many economic factors. One famous hypothesis is the relation between unemployment and crime. Previous researches generally find a positive correlation between unemployment and crime. The direction of the causality is however uncertain. That is, does unemployment cause crime or vice versa. A third factor might also be driving the relation.

Unemployment rate is traditionally used as an indicator of legitimate employment opportunities in the market. Hence, when unemployment rate rises individuals are left with fewer employment opportunities and legitimate income opportunities decline. In equation (1) higher unemployment rate lowers the expected cost of crime as it reduces the return from an alternative legitimate work which is represented as W_L. Higher

unemployment rate can also affect the expected benefits of crime as unemployed individuals have less to lose if caught and imprisoned because they are not sacrificing any legitimate employment opportunity. So, higher unemployment rate lowers the opportunity cost of being imprisoned which is represented as S in equation (1). Furthermore, unemployed individuals are provided with more time and opportunities to engage in criminal activity than unemployed individuals. So, accordingly higher unemployment rate, *ceteris paribus*, causes more crimes (Becker 1968; Ehrlich 1973).

The relation between unemployment and crime can also be reverse. The explanation behind a reversed causality is twofold. First, individuals with criminal records have lower future employment prospect which may lead to higher unemployment (Freeman 1992; Nagin and Waldfogel 1995). Second, high crime rate within a distinguished area could impend employment growth since high crime rate might make new industries reluctant to move to the area (Raphael and Winter-Ebmer 2001). Thus, higher crime rate causes higher unemployment, *ceteris paribus*.

Finally, the relation between unemployment and crime can also be caused by a third factor. The relation can be driven by various factors such as education, alcohol and/or drug addiction and immigration etc. Listed factors could affect both unemployment and crime and therefore cause an artificial relation between the two variables.

2.2 Empirical Researches

The economic theory of crime was originally proposed by Becker (1968) and extended by Ehrlich (1973). Their work has been the groundwork for empirical researches in the field of crime-economics. A great number of researches have used Becker's and Ehrlich's theory in attempt to establish a link between crimes and various labor market factors. In particular, a relation between unemployment rate and crime. The unemployment-crime relation has been studied for different countries and with different methodologies. Most recent studies have used panel data for analyzing the relation and instrumental methods to control for potential endogeneity problems (Levitt, 2001).

Panel researches for state or county level estimations in the United States show fairly consistent results for the effect of unemployment on crime. Raphael and Winter-Ebmer (2001) analyze the impact of unemployment on crime with state level data for the United States from 1971 to 1997. To isolate the effect they control for age structure, percentage of population in metropolitan areas and poverty. Using OLS estimation the

elasticity of property crimes with respect to unemployment ranges from 1.6 to 2.3 percent. Furthermore, they control for endogeniety by using instrumental variables. To instrument unemployment they use military spending and oil price shock and find that the elasticity of property crime with respect to unemployment ranges from 2.8 to 5.0 percent. The results show little evidence of a connection between unemployment and violent crimes.

Gould, Weinberg and Mustard (2002) find similar results when estimating county level data for the United States from 1979 to 1997. They focus on the effect of unemployment and wage of less educated young male on crime. They control for education, cognitive ability and parental background. In addition they instrument wages and unemployment with three elements: initial industrial composition of the county, the national industrial trend and changes in demographic composition within each industry at the national level. They find that both wage and unemployment have significant effect on property crimes and violent crimes, where crime is better determined by wage then unemployment.

Lin (2008) estimates state level data for the United States from 1974 to 2000. He uses host of control variables such as state education, public health expenditures, number of police officers, prisoners and death penalties, alcohol consumption, age structure and percentage of metropolitan population. In addition, he instruments unemployment with several combinations of exchange rate changes, state employee percentage in the manufacturing sector, percentage of state union membership and oil prices. The elasticity of property crimes relative to unemployment with 2SLS estimation is 4 to 6 percentage but only 1.8 percent when using OLS estimation. Thus, his results suggest that OLS underestimates the effect of unemployment on crime since the elasticity is higher when using instrumental variables.

Researches for other countries have also been a useful contribution to understanding the relation between unemployment and crime. Papps and Winkelmann (2002) study a panel of sixteen regions in New Zealand over the period 1984 to 1986. They control for two variables, clearance rate and income. In addition they consider a possible causal effect by using a lag of the endogenous variable as an instrument. They find that unemployment has significant effect on crime when using control variables and instrumental variable. Sardakis and Spengler (2012) find similar results for Greece over the time period 1991 to 1998. They focus on the effect of unemployment and clear-up rate on various crimes. They use Generalized Methods of Moments (GMM) and use a lag

of the endogenous variable as an instrument. They find that property crimes are significantly affected by both unemployment and clear-up rate in Greece after controlling for income and demographic variables and taking into account possible endogeniety of unemployment and clear-up rate. Like most empirical researches they find no significant impact of unemployment on violent crimes. However, not all empirical researches have been successful in finding a relation between unemployment and crime. Entorf and Spengler (2000) find no significant relation for Germany over the time period 1975 to 1996. Their results imply that unemployment has small and often insignificant effect on crime.

Carmichael and Ward (2001) estimate the effect of male unemployment on crime in England and Wales from 1989 to 1996. They find that both youth male unemployment and adult male unemployment have significant effect on various types of crimes. However, the relation between youth unemployment and crime is stronger than for adult unemployment. Fougére, Karamarz and Pouget (2009) estimate the influence of youth unemployment on youth crime using data for France from 1990 to 2000. In their study they control for fraction of foreigners, age structure, family status, education and urbanization. Furthermore, they use industrial structure type instruments. Their find evidences of a strong effect of youth unemployment, but not overall unemployment, on property crimes. Using Swedish data from 1985 to 2007, Grönqvist (2011) also finds a significant positive effect of youth unemployment on various types of crime. He focuses on males aged 19 to 25 and the duration of unemployment. Grönqvist controls for a lag of crime and socio-demographic factors such as share of foreigners, family status and education. His result indicate a positive influence of youth unemployment on various crimes. Furthermore, his findings suggest that individuals with more time, possibly due to unemployment, are more likely to engage in a criminal activity as most crimes are during weekdays. The results from the latter three researches imply that youth unemployment is an important factor to understand the age distribution of crime.

Duration of unemployment has also been used to understand the relation between crime and unemployment rate. One of few researches that focus solely on long term unemployment rate is Almén and Nordin's (2011) research. They use 288 municipalities in Sweden from 1997 to 2009. They control for long term unemployment by using age structure of Swedish men, share of foreigners, education, urbanization and alcohol consumption. To instrument unemployment they use corporate bankruptcies. Their findings suggest that long term unemployment is better at determining groups at the

margin of committing crimes than total unemployment. They find that the elasticity of property crimes relative to long term unemployment rate ranges from 1.5 and 4 percent and for violent crimes it ranges from 1.3 and 2.3 percent.

The impact of unemployment on crime can also be studied on an international level. The advantage of using international data over national is large variations across countries in unemployment rate where as the drawback is the possibility of low comparability of data across countries (Levitt, 2001). This method has been used to study the link between crime and inequality, income and poverty (Wolpin, 1980; Stack, 1984; Soares, 1999). However, few papers have studied the influence of unemployment on crime on an international level. Altindag (2012) studies the effect of unemployment on crime for Europe. He analyzes the impact with data for 33 European countries from 1995 to 2003. He controls for deterrence, economic incentives, alcohol consumption and demographic variables. Furthermore, to instrument unemployment Altindag uses earthquakes, industrial accidents and exchange rate movements weighted by manufacturing sector's value added to GDP. The elasticity of crime with respect to unemployment is found to be around 2 percent when using OLS and a little higher when using 2SLS.

Overall, the studies cited above support the existence of the relation between unemployment and crime. Empirical researches for both national and international level support the hypothesis for property crimes but show weaker evidence for violent crimes. This is in line with economic-crime theory which mainly focus on financial benefits from property crimes. Furthermore, studies that focus on youth unemployment indicate that youth unemployment is a better determinant for crime than overall unemployment. Possible reasons for that will be discussed in next section.

3 Empirical Framework

In this paper I estimate the impact of unemployment rate on crime in Europe with special focus on youth unemployment and long term unemployment. The focus on youth unemployment is in line with previous empirical studies which suggest that youth unemployment has more effect on crime than total unemployment (Carmichael and Wald, 2001; Fougere et al, 2009). Theoretically this can be explained by lower opportunity cost of criminal activity for younger individuals than their older counterparts. Young individuals generally have lower opportunity cost of crime since they have lower

earnings and have therefore less to lose if caught and imprisoned. Furthermore, individuals under eighteen face more lenient punishment than their older counterparts which raises the benefit of engaging in a criminal activity (Levitt and Lochner, 2001; Han, Bandyopadhyay and Bhattacharya, 2013). Researchers have also shown that duration of unemployment is an important factor when looking at the relation between unemployment and crime (Grönqvist, 2011; Almén and Nordin's; 2011). Theoretically, duration of unemployment should increase the probability of engaging in criminal activity. The reason is twofold. First, individuals that are long term unemployed have lower expected cost than short term unemployed individuals due to more probability of remaining unemployed for a longer period of time than short term unemployed individuals. Second, unemployed individuals might use their savings before engaging in a criminal activity to earn income and long term unemployed are less likely to have savings left than short term unemployed. These reasons imply that long term unemployment rate is a better indicator for the unemployment-crime relation than total unemployment which is comprised of both long term and short term unemployed individuals (Chamlin and Cochran, 2000; Grönqvist, 2011).

To estimate the effect of unemployment on crime in Europe I use three types of unemployment rate: total unemployment, youth unemployment and long term unemployment. For crime I use five categories of crimes: burglary, theft of motor vehicle, violent crime, robbery and drug offence. The empirical estimation is done with a fixed effect panel structure where I control for both country fixed effects and time fixed effects. By including country fixed effects it is possible to control for factors that are different between countries and constant over time. By including time fixed effects it is possible to control for factors that vary over time but are the same for all countries (Hill, Griffiths and Lim, 2012). Following the empirical researches of Entorf and Spengler (2000) and Papps and Winkelmann (2002) I estimate the impact of unemployment on crime in a log-log specification.[1] The equation estimated is following:

$$Crime_{ijt} = \gamma_i + \lambda_t + \beta\, Unemployment_{ijt} + \varepsilon_{it} \qquad (2)$$

[1] Numerous researchers have also estimate the relation between unemployment and crime by using a log-linear specification (Raphael and Winter-Ebmer, 2001; Lin, 2008; Altindag, 2012). Using this alternative changes my results relatively little.

where, *i* denotes the country, *j* denotes the category of crime and type of unemployment rate and *t* denotes the year. $Crime_{ijt}$ stands for the log of a particular category of crime per 100,000 population, $Unemployment_{ijt}$ denotes the log of a particular type of unemployment, the parameters γ_i stands for country fixed effects, λ_t denotes the year fixed effects and ε_{it} is an error term. The parameter of interest in equation (2) is β as it represents the elasticity between unemployment and crime. I expect a positive sign for the parameter β. Thus, higher unemployment causes more crimes. According to theory the impact of unemployment should be stronger on property crimes, such as burglary and theft of vehicles, than violent crimes since financial benefits are usually not involved for the latter.

There are some drawbacks to the equation presented above. First of all, omitted variable bias may be present in the model even though I control for country and time specific effects. This occurs if variables that are neither constant over countries or time but affect crime are excluded from the equation. Second of all, the explanatory variable unemployment rate may be endogenously determined in the equation which leads to a biased and inconsistent estimation. In the next two subsections I deal with these problems by including control variables in the equation and introducing an instrumental variable.

3.1 Control Variables

To test the effect of unemployment on crime it is necessary to isolate the direct effect of unemployment on crime and reduce the risk of omitted variable bias. That is done by including control variables in the equation. Therefore, I expand equation (2) by including a vector of control variables which are denoted as X_{it} in following equation:

$$Crime_{ijt} = \gamma_i + \lambda_t + \beta\, Unemployment_{ijt} + \delta\, X_{it} + \varepsilon_{it} \qquad (3)$$

The variables I control for are inspired by former researches and have been shown to have a significant effect on crime. The four variables I control for are average income, income inequality, education and urbanization.[2]

[2] Previous researches have shown that alcohol consumption and percentage of foreign population affects the relation between unemployment and crime (Ruhm, 1995; Raphael and Ebmer, 2001; Bianchi, Buonnanno and Pinotti, 2012). However, neither variable had significant effect on the relation of unemployment and crime in the dataset used in this paper and where therefore excluded.

First of all, I control for average income, where GDP per capita is used as a proxy, as it is a potential driving mechanism behind the relation of unemployment and crime. Usually, unemployment reduces average income since involuntary unemployment lowers legitimate employment opportunities. Unemployment may therefore affect crime trough average income. The effect of average income on crime is however ambiguous, it could have positive, negative or zero effect. First, average income may have positive effect on crime as higher average income increase the consumption of expensive goods, such as jewelry and/or consumer durables, which lead to higher expected benefits of engaging in a criminal activity. Thus, higher average income leads to more crimes. Second, average income may have negative effect on crime as higher average income increases the expected cost of engaging in a criminal activity, Thus, higher average income reduces crimes. Finally, both effects may cancel each other out and the effect of average income on crime may therefore be zero (Han et al, 2013).

Second of all, I control for income inequality. Researchers have shown that unemployment is one of the main reasons for income inequality as the unskilled low-income share of the population are worst affected when unemployment is high (Harding and Richardson, 1998; Mocan, 1999). Thus, unemployment might affect crime through income inequality which can affect crime through number of different mechanisms such as social tension and higher return of engaging in a criminal activity. The effect of income inequality is positive as countries, states and counties with higher income inequality generally face higher crime rates due to higher share of low income population. This is supported by Rufrancos, Pickett and Wilkinson (2013) which find a positive relation between income inequality and crime.

Third of all, I control for education by using the share of population with upper secondary education. Education has been suggested to lower the probability of unemployment because education is believed to increase skills and efficiency. That is, higher education level signals higher performance prospects and therefore reduces probability of being unemployed (Mincer, 1991; Brunello, Garibaldi and Wasmer, 2009). Previous studies also suggest that education is related to crime through income, as higher educated individuals receive on average higher income and have therefore higher expected cost of crime. Thus, educated individuals are less likely to engage in a criminal activity (Lochner and Moretti, 2003).

Finally, I control for an additional variable that may affect crime, urbanization. I do this to lower the risk of omitted variable bias. I control for the share of urban

population as urban areas usually deal with higher crime rate. This high crime rate in urban areas compared to rural areas is usually explained by lower probability of being caught due to lower probability of recognition (Glaeser and Sacerdote, 1999). Although I control for various factors it's fair to say that the list of control variables is incomplete as countless factors affect crime. However, by including listed control variables and exploding the panel structure by using both country fixed effects and year fixed effect this problem is minimized.

3.2 Instrumental Variables

The direction of causality between unemployment and crime can be questioned, does unemployment cause crime or vice versa. If unemployment, the explanatory variable, is endogenously determined in a crime regression it violates one of the key assumptions for OLS and leads to a biased and inconsistent estimation (Hill et al, 2012). To deal with this problem instrumental variables have been used in previous studies. However, researches provide mixed evidence when using instrumental variable. Gould et al. (2002) find little difference between OLS and 2SLS estimations for unemployment and crime. However, Raphael and Winter-Ember (2001), Lin (2008) and Altindag (2012) find larger estimated coefficients when using 2SLS estimations than OLS estimations. Thus, OLS might underestimate the effect of unemployment on crime.

To rule out the possibility of reverse causality and reduce omitted variable bias I estimate the impact of unemployment on crime by instrumenting the unemployment rate. However, finding a good instrument can be challenging as it must require two components. First, the instrument must affect the endogenous explanatory variable. Second, the instrument may not have direct effect on the dependent variable. In other words, the instrument must affect unemployment rate but not crime, except through unemployment rate (Hill et al, 2012).

In this paper I am going to instrument the three unemployment rates by employment protection legislation.[3] This instrument has not been used before to instrument unemployment in a crime regression to my knowledge. Employment

[3] In addition I tried an instrument that both Lin (2008) and Altindag (2012) used in their papers, exchange rate weighted by either number of manufacturing workers or share of manufacturing sector's value added to GDP. However, both instruments where weak and therefore not used to instrument unemployment rates in this paper.

protection legislation, measures the cost and procedure of dismissing workers and hiring workers (OECD, n.d). The effect of employment protection legislation on unemployment is ambiguous as it can have positive, negative or zero effect. The positive effect on unemployment can be explained by lower propensity to hire workers. This is because employment protection legislations makes it more difficult to fire workers in the future and makes employers therefore more selective when choosing workers because of high cost of bad hiring. In contrast, the instrument can also have negative effect on unemployment because employment protection legislation induces workers duration. Finally, the negative and positive affect can weight each other out and the effect of employment propensity legislation on unemployment can be zero. Previous researches have shown different results and often insignificant relation between unemployment and employment protection legislation (Addison and Teixeira, 2001; Stahler, 2007; Avdagic, 2013).

Table 1: First-stage results of the effect of employment protection on unemployment

	Total Unemployment	Youth Unemployment	Long Term Unemployment
Employment Protection Legislation	-1.112***	-1.018***	-1.355***
R^2	0.866	0.752	0.910
F-statistic	23.75	14.97	20.89

*Robust standard errors in parentheses; ***, ** and * indicate significance at the 1, 5 and 10% level. All variables are in logarhtim.*

The first-stage results of the effect of employment protection legislation on the three unemployment rates are presented in Table 1. The estimation includes control variables and country and time fixed effects. The results show that employment protection legislation has a significant negative effect on the three unemployment rates. However, for the instrument to be valid the coefficient must also be significantly different from zero. This can be tested with a Wald-test in which the F-statistics must be at least 10 or higher for the instrument to be a good candidate (Stock and Watson, 2003). The F-statistics which are presented in Table 1 indicate that employment protection legislation is a good instrument for the three unemployment rates as the F-statistic exceeds the rule-of-thumb value. Although the instrument appear to be strong it is not perfect. Previous researches have been unable to establish the relation between employment protection legislation and unemployment. They find mixed and often

insignificant results. If employment protection legislation truly has no significant effect on unemployment rate the instrument might be irrelevant.

4 Data

The empirical research is based on a panel dataset of annual data from 1995 to 2012 at country level for 24 European countries. The countries are listed in Appendix Table 1. Unfortunately not all the European countries could be included in the research due to missing data. Nonetheless, these countries should be a good representative for whole Europe as these 24 countries account for 65 percentage of total population in Europe.

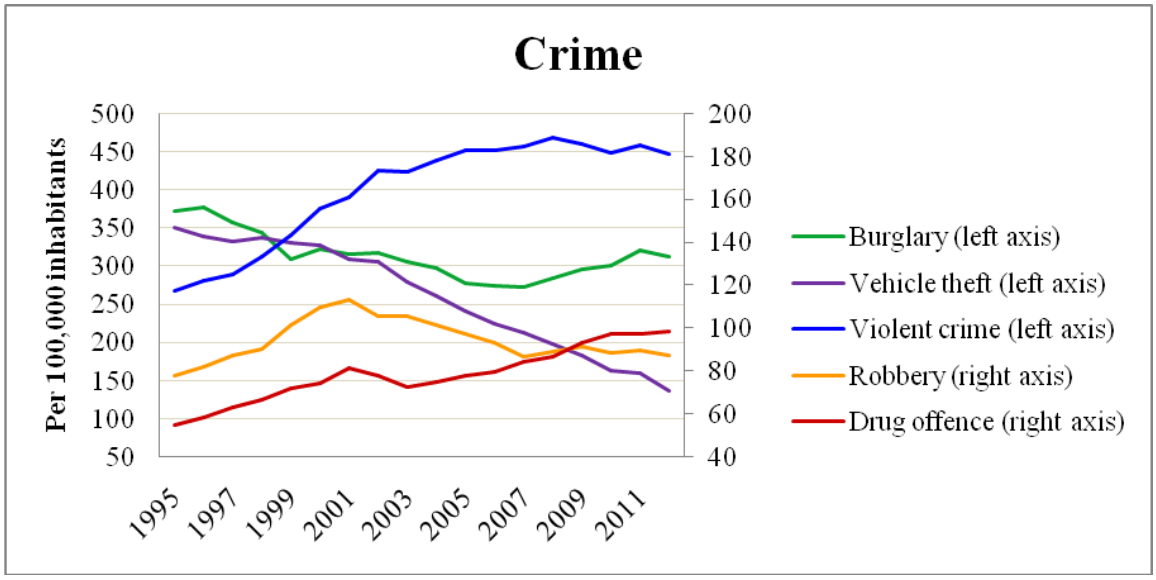

Figure 1: Development of average crime rates per 100,000 inhabitants in Europe

The dependent variable, crime, is categorized to five types of crime: burglary, motor vehicle theft, violent crime, robbery and drug offence. The first two are often referred to as property crimes in previous researches and robbery as violent crime. The crime data is retrieved from Eurostat and consists of number of crimes reported to police in each country. The crime numbers are transformed into crime rates scaled by 100,000 by using population data from World Bank. Figure 1 shows the development of average crime in Europe over the period 1995 to 2012. Property crimes, that is burglary and vehicle theft, follow a decreasing trend and the same holds for robbery after 2000. However, both violent crime and drug offence are slowly increasing over the period. According to newest data violent crime is the most common crime on average in Europe, followed by burglary. Summary statistics for all crime data, as well as other data used in this research, are provided in Table 2 at the end of this section.

Estimating a crime regression can be problematic, the reason is twofold. First, crimes reported to police underestimate the true number of crimes and may bias the estimation. Second, using crime data on an international level can bias the estimation due to possible non comparability of data across countries because legal and criminal justice system are different where as definitions and methods of reporting crime are not necessary the same (Levitt, 2001; Clarke, 2013). These two problems are well known in crime literature and the bias is usually minimized by taking logarithms of crime and using both country and time fixed effects (Ehrlich, 1996; Gould et al, 2002).

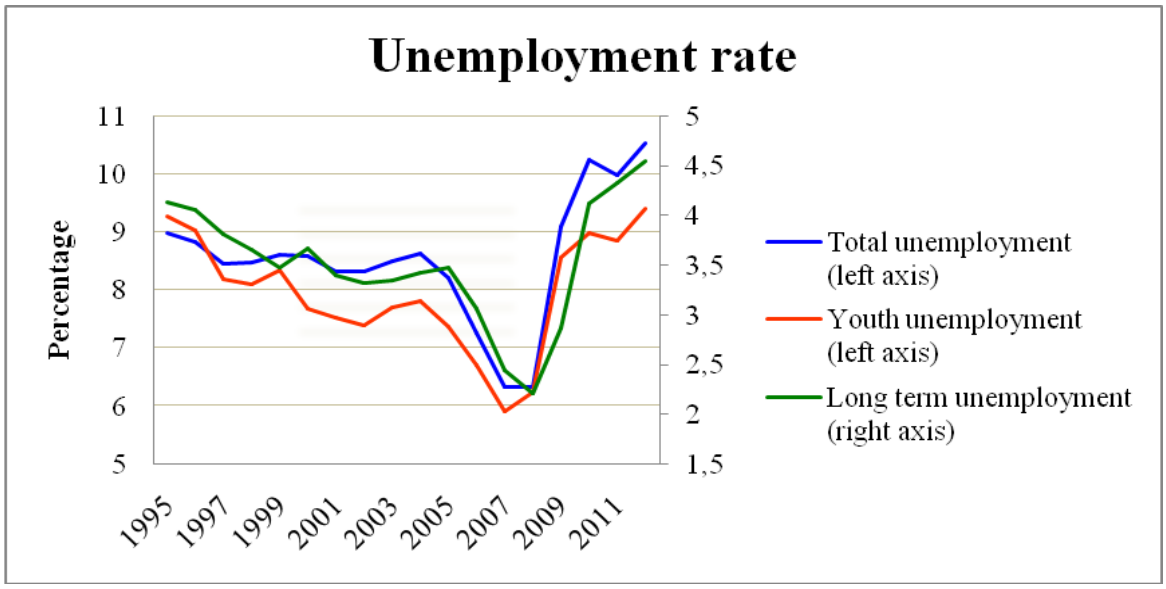

Figure 2: Development of average unemployment rate in Europe

The explanatory variable of main interest is unemployment rate. The variable is categorized to three types of unemployment rates: total unemployment, youth unemployment and long term unemployment. I include youth unemployment and long term unemployment because they are less broad and might therefore better determine individuals on the margin of engaging in a criminal activity than total unemployment. Total unemployment rate accounts for unemployed individuals aged 15 to 74 and youth unemployment rate accounts for individuals aged 15 to 24. Both datasets are retrieved from Eurostat. The long term unemployment rate refers to individuals that have been unemployed for more than a year. The rate is composed by multiplying total unemployment rate by the portion of long term unemployed individuals among all unemployed, obtained by OECD. Figure 2 shows the average development of the three unemployment rates over the time period 1995 to 2012. The three unemployment rates

all have on average similar pattern over time. They show a declining trend until the financial crises and after 2008 they show a sharp rise.

As explained in previous section, I include control variables to isolate the direct effect of unemployment on crime. First of all, I include average income, where real GDP per capita is used as a proxy. The data for real GDP per capita is observed from Eurostat and is given in Euro's per inhabitant. Second of all, I include income inequality. The data is also retrieved from Eurostat and is defined as the ratio of total income received by the richest 20% of the population to that received by the poorest 20% of the population. Unfortunately the data for income inequality is incomplete due to some missing observation in the first years. Third of all, I include education which is defined as a percentage of population with upper secondary education. Like latter two variables the data is observed from Eurostat. Finally, urbanization is included. The variable measures the percentage of population that lives in urban areas. The data is retrieved from World Bank. In addition to control variables I use instrumental variable to control for possible endogeniety. I use employment protection legislation which measures the cost of hiring and firing workers. The data is observed from OECD. Further description of all variables used in the crime regression is provided in Appendix Table 2.

Table 2: Summary statistics

Variable	Obs.	Mean	Std. Dev.	Max	Min
Burglary per 100,000 inhabitants	418	313.0	208.9	1203.3	31.75
Theft of vehicle per 100,000 inhabitants	424	259.9	204.2	978.7	25.7
Violent crime per 100,000 inhabitants	412	403.9	337.8	1762.8	46.2
Robbery per 100,000 inhabitants	406	94.8	68.9	356.2	13.9
Drug offences per 100,000 inhabitants	412	79.1	94.4	567.4	0.74
Total unemployment rate	410	8.5%	4.1%	24.8%	1.9%
Youth unemployment rate	415	7.9%	3.5%	20.6%	2.2%
Long term unemployment rate	386	3.2%	2.5%	14.5%	0.1%
Average income	432	22,688	14,292	70,400	2,700
Income inequality	347	4.6	1.1	7.8	2.9
Education	402	46.6%	13.7%	72.2%	12.3%
Urbanization	432	72.3%	11.1%	97.7%	49.9%
Employment protection legislation	358	2.43	0.67	5.58	1.03

5 Results

5.1 Ordinary Least Square Estimation

To investigate the influence of unemployment on crime an OLS estimation is conducted. The estimation is done with fixed effects to minimize omitted variable bias and robust

standard errors to account for serial correlation and heteroscedasticity. The estimation is done for five categories of crime and three types of unemployment rates. The results are based on two estimations. They are based on equation (2) where only unemployment is used as an explanatory variable, this is done to illustrate the raw correlation between unemployment and crime. The results are also based on equation (3) where control variables are include in the equation to isolate the direct effect of unemployment on crime. The results from the OLS estimation are presented in Tables 3 to 5, all tables have the same structure but presents estimation for a different type of unemployment rate. The odd columns in Tables 3 to 5 report the estimation for unemployment and crime controlled for only country and time fixed effects. The even columns report the estimation for unemployment and crime controlled for country and time fixed effects in addition to the control variables; average income, income inequality, education and urbanization. Before proceeding to the main results it is useful to compare the two OLS estimation. After including the control variables the estimated coefficients become substantially smaller. This indicates that the control variables affect the relation between unemployment and crime. It also highlights the importance of using control variables to account for omitted variable bias.

Starting with the results for property crimes, that is burglary and motor vehicle theft, the unemployment-crime elasticity is positive before including control variables. The elasticity ranges from 0.044 to 0.229 percent. After including control variables, where average income and income inequality have most effect, the elasticities are cut by half. Most of the coefficients even become insignificant which is inconsistent with previous papers (Raphael and Winter-Ebmer, 2001; Edmark, 2005; Fougere et al, 2013). A possible explanation for the insignificant effect of unemployment on vehicle theft might be decreasing financial gains from vehicle theft. This might be a consequence of higher probability of being caught due to technical progress in vehicle theft deterrents. Furthermore, the estimation indicates that only youth unemployment has significant positive effect on burglary. Hence, 1 percent increase in youth unemployment increases burglary by 0.15 percent.

The results for violent crime and robbery suggest that violent crime is negatively affected by unemployment but robbery positively affected by unemployment. However, after including control variables, where income inequality and education have most impact, the coefficients for both violent crime and robbery become insignificant. The insignificant effect of unemployment on violent crime is in line with previous researches

Table 2: OLS estimation with fixed effects - Total Unemployment

	Burglary		Vehicle Theft		Violent Crime		Robbery		Drug Offence	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Total unemployment	0.201***	0.085	0.137**	0.053	-0.019	-0.076	0.249***	0.039	-0.106	0.229***
Average income		-0.564**		-0.256		-0.112		-1.25***		2.668***
Income inequality		0.232		0.036		-0.377		0.909***		-0.015
Education		0.012		0.028		-0.366		-0.052		-0.220
Urbanization		2.243***		2.441**		0.833		2.727***		1.762
R^2	0.911	0.918	0.891	0.895	0.919	0.929	0.907	0.925	0.873	0.911

*Robust standard errors in parentheses; ***, ** and * indicate significance at the 1, 5 and 10% level. All variables are in logarhtim.*

Table 3: OLS estimation with fixed effects - Youth Unemployment

	Burglary		Vehicle Theft		Violent Crime		Robbery		Drug Offence	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Youth unemployment	0.229***	0.146***	0.044	-0.019	0.047	-0.015	0.157***	0.002	-0.078	0.199***
Average income		-0.496**		-0.316		-0.018		-1.24***		2.650***
Income inequality		0.191		-0.032		-0.375		0.872***		-0.041
Education		0.021		0.139		-0.399		0.007		-0.147
Urbanization		2.175***		2.488**		0.666		2.761***		2.072
R^2	0.911	0.919	0.882	0.886	0.902	0.930	0.891	0.923	0.849	0.908

*Robust standard errors in parentheses; ***, ** and * indicate significance at the 1, 5 and 10% level. All variables are in logarhtim.*

Table 4: OLS estimation with fixed effects - Long Term Unemployment

	Burglary		Vehicle Theft		Violent Crime		Robbery		Drug Offence	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Long term unemployment	0.075**	-0.03	0.049	-0.012	-0.057	-0.014	0.099***	-0.041	0.049	0.141***
Average income		-0.86***		-0.351		0.522**		-1.77***		1.697***
Income inequality		0.232		0.036		-0.224		0.820***		-0.256
Education		0.067		0.041		-0.348*		-0.134		-0.408**
Urbanization		2.541***		2.93***		0.907		3.121***		1.352
R^2	0.913	0.919	0.892	0.894	0.922	0.932	0.903	0.929	0.906	0.917

*Robust standard errors in parentheses; ***, ** and * indicate significance at the 1, 5 and 10% level. All variables are in logarhtim*

and theory which imply that violent crimes are much less related to economic incentives than property crimes (Raphael and Winter-Ebmer, 2001; Altindag, 2012). Finally, the results suggest a positive significant effect of the three unemployment rates on drug offences after including control variables. The effect of unemployment on drug offences becomes significant after including average income into the regression. The elasticity of drug offence with respect to the three unemployment rates ranges from 0.14 to 0.23 percent. The results are in line with previous researches who also suggest a positive connection between unemployment and drug offence (Fougere et al, 2009; Grönqvist, 2011).

Regarding the control variables, average income has most often negative effect on crime and has significant effect on burglary, robbery and drug offences. The results indicate that average income is an important estimator for crime and also an important driving force behind the relation of unemployment and crime. Income inequality has mixed effects on crime, it has the expected positive effect on property crime and robbery but often insignificant. The results indicate that income inequality is also an important driving force in the unemployment crime relation. Education has little significant effect on crime and the results suggest that the education mechanism might not be important. Finally, the results indicate that urbanization is an important estimator for crime which has significant positive effect on property crimes and robbery.

Overall, the OLS results suggest that burglary is only affected by an increase in youth unemployment indicating that youth unemployment has a stronger relation with crime than both total unemployment and long term unemployment. However, drug offence is significantly affected by all three unemployment rates. Thus, given the results fighting youth unemployment should reduce both burglary and drug offence.

5.2 Two Stage Least Square Estimation

The OLS estimation might, as mentioned before, be biased due to reverse causality. To provide an unbiased estimation of the effect of unemployment on crime I use 2SLS estimation. To instrument the unemployment rates I use employment protection legislation. The estimation is done with fixed effects to minimize omitted variable bias and robust standard errors to account for serial correlation and heteroscedasticity. The 2SLS estimation, like the OLS estimation, is done for five crime categories and three types of unemployment rate. Given the importance of the control variables demonstrated in previous subsection they are included in the estimation. Thus, the estimated results are

based on equation (3). The results from the 2SLS estimation are presented in Tables 6 to 8 where each type of unemployment rate is estimated separately. The OLS estimation is also presented in the tables for comparison. Overall, the 2SLS estimations of the unemployment-crime elasticities are substantially larger than the OLS estimations.

For property crimes, the effect of unemployment is now positive and significant at 5 percent level, unlike the OLS estimation. This is consistent with previous findings (Raphael and Winter-Ebmer, 2001; Lin, 2008; Fougere et al, 2009; Altindag, 2012). The results suggest that the elasticity of burglary relative to the three unemployment rates ranges from 0.91 to 1.24 percent. The elasticity of vehicle theft relative to the three unemployment rates is considerably larger and ranges from 1.5 to 2.03 percent. For both burglary and vehicle theft the youth unemployment coefficient is the largest and long term unemployment coefficient the smallest.

During the period studied the annual average of burglaries in Europe was approximately 1.47 million and the annual average of motor vehicle theft was approximately 1.43 million. Thus, the estimated unemployment coefficients suggest that a 1 percent increase in unemployment rate, *ceteris paribus*, is associated with approximately 13 to 18 thousand more burglaries on average in Europe and approximately 21 to 29 thousand more vehicle thefts. The results depend on which unemployment rate is examined where the highest number of burglary and vehicle theft is resulted from an increase in youth unemployment and lowest number is resulted from an increase in long term unemployment. A one percent increase is a realistic change in unemployment rate for Europe. Total unemployment and long term unemployment changed on average by 1.5 percent each year during the period studied and youth unemployment by 0.5 percent. Thus, the results imply that common changes in unemployment rate can have considerable effect in terms of number of property crimes.

The results suggest a that violent crime is negatively affected by unemployment but robbery positively affected. The effect of unemployment on robbery becomes considerably larger when using 2SLS but remains insignificant. It might be insignificant due to lower financial gains from robbery than other crimes such as burglary or motor vehicle theft. When using 2SLS the effect of unemployment on violent crime becomes significant at 5 percent level. The negative elasticity of violent crime relative to the three unemployment rates ranges from 0.79 to 1.14 percent. Where youth unemployment has the highest coefficient and long term unemployment has the lowest coefficient. These results are

Table 6: 2SLS estimation for Total Unemployment

	Burglary		Vehicle Theft		Violent Crime		Robbery		Drug Offence	
	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS
Total unemployment	0.085	1.134***	0.053	1.824***	-0.076	-0.89***	0.039	0.475	0.229***	-0.205
Average income	-0.564**	1.737**	-0.256	3.475***	-0.112	-2.07***	-1.25***	-0.298	2.668***	0.220
Income inequality	0.232*	-0.271	0.036	-0.514	-0.377	0.553**	0.909***	0.273	-0.015	-0.027
Education	0.012	-0.334	0.028	-0.391	-0.366	0.391	-0.052	-0.600**	-0.220	-0.486**
Urbanization	2.243***	-1.241	2.441**	-2.787	0.833	5.078***	2.727***	0.301	1.762	3.282*
R^2	0.918	0.884	0.895	0.765	0.929	0.943	0.925	0.939	0.911	0.916

*Robust standard errors in parentheses; ***, ** and * indicate significance at the 1, 5 and 10% level. All variables are in logarhtim.*

Table 7: 2SLS estimation for Youth Unemployment

	Burglary		Vehicle Theft		Violent Crime		Robbery		Drug Offence	
	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS
Youth unemployment	0.146***	1.243***	-0.019	2.03**	-0.015	-1.139**	0.002	0.655	0.199**	-0.138
Average income	-0.496**	1.312*	-0.316	2.893**	-0.018	-1.92***	-1.24***	-0.087	2.650***	0.697
Income inequality	0.191	-0.456	-0.032	-0.870*	-0.375	0.780**	0.872***	0.082	-0.041	-0.054
Education	0.021	-0.599	0.139	-0.769	-0.399	0.778	0.007	-0.747*	-0.147	-0.314
Urbanization	2.175***	-0.520	2.488**	-1.784	0.666	5.214***	2.761***	0.136	2.072	3.041*
R^2	0.919	0.841	0.886	0.597	0.930	0.884	0.923	0.925	0.908	0.911

*Robust standard errors in parentheses; ***, ** and * indicate significance at the 1, 5 and 10% level. All variables are in logarhtim.*

Table 8: 2SLS estimation for Long Term Unemployment

	Burglary		Vehicle Theft		Violent Crime		Robbery		Drug Offence	
	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS
Long term unemployment	-0.03	0.914**	-0.012	1.502***	-0.014	-0.79***	-0.041	0.351	0.141***	-0.182
Average income	-0.86***	2.267**	-0.351	4.356***	0.522***	-2.63***	-1.77***	-0.203	1.697***	0.077
Income inequality	0.232	-0.205	0.036	-0.477	-0.224	0.554**	0.820***	0.296	-0.256	-0.002
Education	0.067	-0.058	0.041	-0.036	-0.348*	0.242	-0.134	-0.512**	-0.408**	-0.481**
Urbanization	2.541***	-1.278	2.93***	-2.653	0.907	5.479***	3.121**	0.602	1.352	3.043*
R^2	0.919	0.815	0.894	0.656	0.932	0.908	0.929	0.932	0.917	0.918

*Robust standard errors in parentheses; ***, ** and * indicate significance at the 1, 5 and 10% level. All variables are in logarhtim*

however somewhat strange, they suggests that when unemployment rate increases it reduces violent crime. This is hard to justify by theory. Previous researchers have suggested a negative sign but most often insignificant since violent crimes are less motivated by economic incentives (Raphael and Winter-Ebmer, 2001; Altindag, 2012). This statistically negative sign might be a consequence of using aggregated unemployment rates in a crime regression instead of gender-specific unemployment rates. Females in Europe have faced higher unemployment rate than male so the aggregated unemployment rate consist of more females than males (Eurostat, 2015). Violent crime, which is composed of violence, robbery and sexual offence might therefore be better explained by using a gender-specific unemployment rates than aggregated where as sexual abusers are mainly male (Winter-Ember, 2001; Lin, 2008). Finally, the results suggest that unemployment has insignificant and negative effect on drug offences when using 2SLS. The sign of the elasticity is in contrast to previous researches and hard to explain by theory. Both Grönqvist (2011) and Fougere et al. (2009) suggest a significant positive impact of unemployment on drug offences. However, King and Mauer (2002) find that most drug offenders are employed full-time when arrested implying that drug offences are little related to employment status.

Regarding the control variables, their sign and magnitude vary considerably. My findings suggest that an increase in average income would increase property crimes but reduce violent crimes, however it has no impact on robbery nor drug offence. Further, income inequality and urbanization have positive effect on violent crime. Urbanization has also significant positive effect on drug offence. Finally, education reduces both violent crime and drug offence but has no impact on property crimes. The signs of income inequality, education and urbanization are often unexpected when insignificant. Nonetheless, this is not our main focus as unemployment is the variable of interest and the control variables are mainly used to isolate the direct effect of unemployment on crime and reduce omitted variable bias.

Overall, the results from the 2SLS estimation indicate that OLS estimation underestimates the effect of unemployment on crimes, with the exception of drug offences. Both property and violent crimes showed substantially larger coefficient and considerably stronger relation with more significant coefficients at 1 percentage level. This is consistent with the findings of Raphael and Winter-Ember (2001), Lin (2008) and Altindag (2012) who also find larger coefficients when using 2SLS estimation. Furthermore, the 2SLS estimation appears to be more credible since the three

unemployment rates suggest the same effect on crimes and not mixed as the OLS estimation does.

To summarize the results, the 2SLS estimation indicates that all three unemployment rates affect both property and violent crimes significantly. However, a given increase in youth unemployment rate leads to a higher increase in both property and violent crimes than an increase in either total unemployment rate or long term unemployment rate. Furthermore, only youth unemployment is found to have an consistent effect on burglary since it is significant when using both OLS and 2SLS estimation. Nonetheless, the results indicate that all three unemployment rates have significant effect on crime so fighting any of these three unemployment rates should have declining effect on property crimes.

6 Conclusion

In this paper I investigate the influence of unemployment on crime using panel data for 24 European countries over the time period 1995 to 2012. I use three types of unemployment rate because total unemployment may not be able to identify individuals on the margin of engaging in a criminal activity and therefore I also use two additional unemployment rates: youth unemployment and long term unemployment.

Using OLS estimation I find that higher youth unemployment, but not total unemployment nor long term unemployment, leads to more burglaries indicating that youth unemployment has a stronger relation with crime than the other two unemployment rates. However, drug offence is significantly affected by all three unemployment rates. The elasticity of burglary relative to youth unemployment rate is 0.15 percent and that the elasticity of drug offences relative to the three unemployment rates ranges from 0.14 to 0.23 percent. Furthermore, the findings suggest that motor vehicle theft, violent crime and robbery are unrelated to unemployment rate.

By using 2SLS estimation I find substantially higher coefficients, indicating that OLS underestimates the effect of unemployment on crime. By instrumenting the three unemployment rates by employment protection legislation I find significant effect of all three unemployment rates on property crimes. The elasticity of burglary relative to the three unemployment rates ranges from 0.91 to 1.24 percent and the elasticity of vehicle theft ranges from 1.5 to 2.03 percent. The elasticities suggest that a 1 percent increase in unemployment rate, *ceteris paribus*, is associated with 13 to 18 thousand more

burglaries on average in Europe and 21 to 29 thousand more motor vehicle thefts. This implies that a common changes in unemployment rate can have considerable effect in terms of number of property crimes. Furthermore, the 2SLS estimation suggest a significant negative effect of the three unemployment rates on violent crimes. Hence, the negative elasticity of violent crime relative to the three unemployment rates ranges from 0.79 to 1.14 percent. This negative sign is inconsistent with theory and might be a consequence of using aggregated unemployment rate. It might be advisable to use gender-specific unemployment rate especially when estimating the effect of unemployment on violent crimes since most offenders are male. Further, the 2SLS results show insignificant effect of unemployment on both robbery and drug offence. Overall, the results suggest that all three unemployment rates affect both property and violent crimes significantly where crime responds most to an increase in youth unemployment. Nonetheless, the results indicate that all three unemployment rates have significant effect on crime so fighting any of these three unemployment rates should have declining effect on property crimes.

Researches on the unemployment-crime relation put the cost of unemployment in a broader perspective. According to my results and other researches unemployment does not only keep a part of labour force out of production but comes with an additional cost: more crimes. This indicates that policies amid at reducing unemployment can also be effective in reducing crime. Although most papers agree that unemployment has positive effect on various crimes it is important to continue exploding newer and better data and econometric techniques to identify the relation between unemployment and crime because understanding the relation provides an important tool to reduce crime.

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Appendix Table 1

Country	Year
Belgium	2000-2012
Czech Republic	1995-2012
Denmark	1995-2012
Germany	1995-2012
Estonia	1995-2012
Ireland	1995-2012
Greece	1995-2012
Spain	1995-2012
France	1995-2012
Italy	1995-2012
Luxembourg	1995-2012
Hungary	1995-2012
Netherlands	1995-2012
Austria	1995-2012
Poland	1995-2012
Portugal	1995-2012
Slovenia	1995-2012
Slovakia	1995-2012
Finland	1995-2012
Sweden	1995-2012
Norway	1995-2012
United Kingdom	1995-2012
Latvia	1999-2010
Lithuania	1995-2012

Appendix Table 2

Variable	Description	Source
Burglary	Gaining access to a dwelling by force in order to steal goods.	Eurostat
Theft of a motor vehicle	Covers thefts of cars, motorcycles, buses and lorries, as well as construction and agricultural vehicles.	Eurostat
Violent crime	Composes violence against the person (such as physical assault), robbery (stealing by force or threat of force) and sexual offences (including rape and sexual assault).	Eurostat
Robbery	Particular type of violent crime, defined as stealing by force or by threat of force. It includes mugging (bag-snatching) and theft with violence.	Eurostat
Drug offences	Includes the illegal possession, cultivation, production, supplying, transportation, importing, exporting and financing of drug operations.	Eurostat
Total unemployment rate	Represents unemployed persons as a percentage of the labour force. Unemployed persons comprise persons aged 15 to 74 who were: a. without work during the reference week, b. currently available for work, c. actively seeking work.	Eurostat
Youth unemployment rate	Represents the unemployment rate of people aged 15 to 24 as a percentage of the labour force of the same age.	Eurostat
Long term unemployment	Refers to people who have been unemployed for 12 months or more.	OECD

Appendix Table 2 - Continued

Variable	Description	Source
Average income	Real GDP per capita given in Euro's per inhabitant.	Eurostat
Income inequality	The ratio of total income retrieved by the 20% of the population with highest income to that received by the 20% of the population with lowest income.	Eurostat
Education	Percentage of population with upper secondary education which generally begins at the end of compulsory education. The entrance age is typically 15 or 16 years.	Eurostat
Urbanization	Percentage of population living in urban areas.	World Bank
Employment protection legislation	Measures the procedure and cost involved in dismissing individuals or groups of workers and the procedure involved in hiring workers on fixed-term or temporary work agency contracts.	OECD