Nezaposlenost i kaznena djela u Hrvatskoj

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Tougher Than the Rest? Relationship between Unemployment and Crime in Croatia

Abstract

In this paper, the relationship between unemployment and crime is analysed. A panel of 20 Croatian counties over the years 1998-2013 is used to estimate the effect of unemployment on the rates of various groups of property and violent crimes. According to the theory of economics of crime, increase in unemployment leads to higher crime rates. A fixed-effects model, including time- and county-specific effects and several covariates, is estimated. The results show there is no impact of unemployment on aggregate property crimes. For all violent crimes bar rapes, the results oppose the theory and intuition. The unexpected results are discussed in the context of the Croatian-specific macro-environment.

Keywords: crime, unemployment, fixed-effects model, panel data

JEL classification: K42, J00, J69

Nezaposlenost i kaznena djela u Hrvatskoj

Sažetak

U ovom radu analizira se veza između nezaposlenosti i kriminala. Korišteni su podaci za 20 hrvatskih županija od 1998. do 2013. godine kako bi se procijenio učinak nezaposlenosti na stope različitih imovinskih i nasilnih kaznenih djela. Prema teoriji ekonomike kriminala, veća nezaposlenost vodi do viših stopa kriminala. Procijenjen je model s fiksnim učincima uključujući kontrole za vremenske i županijske specifičnosti te niz kovarijata. Rezultati pokazuju da nema utjecaja nezaposlenosti na agregatnu razinu imovinskih kaznenih djela. Za nasilna kaznena djela, izuzev kaznenog djela silovanja, rezultati su obrnuti od teorije i intuicije. Neočekivani rezultati diskutirani su u specifičnom hrvatskom makrokontekstu.

Ključne riječi: kaznena djela, nezaposlenost, model s fiksnim učincima, panel podaci

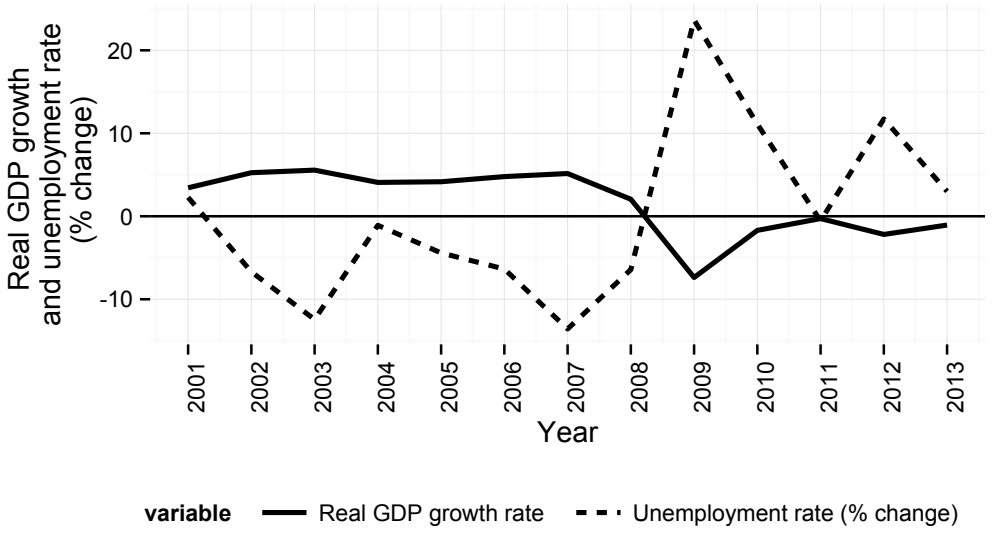
JEL klasifikacija: K42, J00, J69

1 Introduction

The theory of economics of crime observes crime as a type of work - an alternative activity to obtain economic benefits (Becker, 1968). If work and crime are alternative activities, there exists some return on work (i.e., wage) and return on crime (i.e., loot). According to the simple model of economics of crime, individuals choose crime if the expected return from crime minus idiosyncratic psychological cost of committing a crime is higher than the expected return from work (for more details see Ehrlich, 1973; Edmark, 2005). Consequently, if there is no work, people tend to look more for other sources of income. Therefore, in this framework, the expected effect of unemployment on crime is positive: higher unemployment makes more people willing to commit a crime. However, empirical research on this particular relationship is far less conclusive than suggested by this theory. There are several reasons why Croatia makes an interesting case study for testing the theory of economics of crime.

First, in the Great Recession of 2008/2009, Croatia experienced its longest economic crisis in the last two decades. Gross domestic product shrunk by 13 percent cumulatively between 2009 and 2014, while unemployment reached its war and post-war levels. This economic agony is best depicted in Figure 1. Once the GDP growth dipped into the negative, it has not recovered since. No other country in Europe has had such a persistent crisis, which makes the investigation into potential repercussions on crime rates even more interesting.

Figure 1: Real GDP Growth Rate and Unemployment Rate in Croatia, 2001-2013



Source: Author's calculations based on data from Croatian Bureau of Statistics and Croatian Employment Service.

Second, there was substantial variation in the unemployment across the observed period. In the first three years unemployment rose, followed by constant decline from 2001 to 2008. When the crisis struck, unemployment soared again. These swings are similar to those in Edmark (2005), and as she notes, they greatly facilitate the identification of the supposed effects of unemployment on crime. Another potentially important thing to note is that even in the expansive period of 2001-2008, the unemployment rate never dipped under 11 percent, which is still considered to be high in Western European countries as well as in the United States.

Furthermore, this paper tries to overcome some of the limitations from existing empirical studies in this area of research. Unlike cross-country studies, a panel dataset for 20 counties in one country overcomes problems regarding the differences in definitions of crime, reporting propensities and data collection. Moreover, according to Levitt (2001), it transcends the weaknesses of time-series analysis of country crime data, by using the fixed-effects panel data estimation and thus controlling for the unobserved heterogeneity. The analysis is conducted for both property crimes and violent crimes. Namely, violent crimes could also be economically motivated, although to a lesser extent.

Additionally, I further the approach adopted by Edmark (2005) by including sub-category clear-up rates for all categories of crimes as well as controlling for the number of employed police officers. Namely, when substantial swings in unemployment are present, it is possible that the decrease in unemployment is accompanied by an increase in the number of employed police force and therefore a surge in crime reporting propensities and vice versa. Besides, a larger police force could have a sufficient discouraging psychological impact on criminals even without the effective changes in reporting propensities or clear-up rates and therefore should be included in the analysis.

The results show there is no significant impact of unemployment on aggregate property crimes. However, they suggest that a rise in unemployment has an impact on burglary and grand larceny. It is important to note here that under Croatian criminal law, burglary is actually a sub-category of grand larceny. Consequently, a positive significant effect of unemployment is found for only one type of property crimes. The results for violent crimes are similar to those presented by Raphael and Winter-Ebmer (2001), i.e., counter-intuitive with negative signs for all violent crimes bar rapes.

The obtained results are discussed in the context of the country-specific environment: consistently high unemployment and long-term unemployment rates in Croatia, along with a strong family safety-net, alleviate the impact of unemployment on crime. I posit that because of these specific systemic conditions, the variation in crime rates can predominantly be explained by the psychological cost of committing a crime rather than unemployment or any of the used covariates.

The next section discusses previous findings about the impact of unemployment on crime. The third section presents the gathered data and methodological approach. In the fourth section, the results of estimations are presented and discussed. The final section concludes.

2 Unemployment and Crime

The vast majority of empirical research on the unemployment and crime nexus is conducted on United States data (Britt, 1994; Raphael and Winter-Ebmer, 2001; Gould et al., 2002; Lin, 2008; Phillips and Land, 2012). Britt (1994) investigates the relationship for youth population in the US by using a time-series analysis. He finds support for

the impact of opportunity effect of current unemployment on criminal activity and for the impact of prolonged unemployment on property crime. Raphael and Winter-Ebmer (2001) and Lin (2008) both use the instrumental variables method to estimate the impact of unemployment on property crimes and find significantly positive effects. Gould et al. (2002) examine the degree to which changes in crime rates can be explained by changes in the labour market opportunities for those most likely to commit a crime, i.e., less-educated men. They find that crime rates are significantly determined by wages and unemployment rates of less-educated males. Phillips and Land (2012) also find support for a positive relationship between unemployment and property crimes.

One can conclude that the connection between unemployment and crime is fairly robust in the United States. However, the question remains whether these results can be generalized to other geographic, cultural and economic entities. For Europe there is a shortage of empirical work on this topic, probably due to the lack of suitable datasets. Still, a few exceptions are worth mentioning. Entorf and Spengler (2000) use a rich dataset for Germany, but provide weaker support for the relationship between unemployment and crime than the studies conducted in the US. Their estimates for West Germany are even negative for some theft crimes. Carmichael and Ward (2001), Edmark (2005) and Fougère et al. (2009) all find significant impacts of unemployment on crime in England and Wales, Sweden and France, respectively. Altindag (2012) provides the most comprehensive study of this relationship for Europe to date, and finds a positive influence of unemployment on property crimes. His study covers 33 countries in the period 1996-2003.

Lee (2009) argues that the relationship between unemployment and crime is generally ambiguous. Moreover, it depends on the apprehension rate, which suggests that the effect of unemployment on crime would vary across different legal systems and cultures. Therefore, it is sensible to assume that the unemployment-crime nexus could differ significantly across different parts of the world.

Research that depicts this connection in a South European, Mediterranean state environment is scarce. Strong family connections in the Mediterranean countries (Kohli et al., 2005) could have non-negligible effect on the unemployment-crime relationship. A family safety-net might serve as a shock absorber after a person loses his/her job or is looking for a job longer than initially anticipated and therefore the spillover from

unemployment to crime as suggested by theory might be delayed or even non-existent. Saridakis and Spengler (2012) provide evidence for deterrence of property crimes due to higher clear-up rates and for positive impact of unemployment on property crimes. They find no support for these relationships when violent crimes are used as dependent variables. Buonanno (2006) fails to provide evidence of the relationship between unemployment and crime when not accounting for the difference between South and North Italy. His findings show that the relationship between unemployment and crime predicted by theory holds only for South Italy. Buonanno and Montolio (2008) provide evidence for larger pertinence of socioeconomic variables in comparison with unemployment for Spain.

This paper examines the effects of unemployment on crime in Croatia using county panel data for the period 1998-2013. While being a Mediterranean state, Croatia is also a post-transition economy. Research into the unemployment-crime nexus in post-transition countries is, to the best of my knowledge, non-existent. Consequently, this paper contributes to the existing literature about the relationship between unemployment and crime in two areas where research is deficient.

3 Data and Methodological Approach

The data are gathered for 20 Croatian counties in the period 1998-2013. Croatia actually has 21 counties, but data are gathered according to county police departments. Consequently, the County of Zagreb and City of Zagreb are aggregated into one county for the purpose of this analysis, since the Zagreb police department has both of them under its jurisdiction. Unemployment data are collected from the Croatian Employment Service. Crime data are not officially published and were obtained from the Ministry of the Interior, which is the official crime statistics provider in Croatia. The data for covariates are gathered from Croatian Bureau of Statistics publications and 2001 and 2011 population censuses. A summary of the gathered data is in Table 1.

Table 1: Summary Statistics for Crime Rates and Covariates

Statistic	N	Mean	St. Dev.	Min	Max
Aggregate property crimes	320	64.522	41.785	11.651	248.178
Burglary	320	34.360	22.656	5.709	142.141
Robbery	320	1.462	1.563	0.000	10.369
Grand larceny	320	37.446	24.506	6.058	147.763
Theft	320	25.613	17.656	3.861	103.468
Aggregate violent crimes	320	3.214	0.925	0.699	6.893
Murder[1]	320	0.503	0.254	0.000	1.863
Rape[2]	318	0.248	0.172	0.000	1.225
Serious injury	320	2.465	0.831	0.350	5.760
Unemployment	320	764.954	229.348	255.942	1,263.343
Unemployment (female)	320	421.523	125.690	166.478	685.994
Aggregate property clear-up	320	0.425	0.109	0.148	0.814
Burglary clear-up	320	0.403	0.107	0.145	0.841
Robbery clear-up	317	0.644	0.254	0.000	3.000
Grand larceny clear-up	320	0.409	0.107	0.148	0.808
Theft clear-up	320	0.442	0.135	0.136	0.848
Aggregate violent clear-up	320	0.953	0.049	0.769	1.048
Murder clear-up	318	0.979	0.110	0.000	1.667
Rape clear-up	295	0.951	0.164	0.000	2.000
Serious injury clear-up	320	0.948	0.059	0.717	1.059
Infant mortality	320	0.606	0.653	0.000	11.145
Divorces	320	10.244	2.976	3.019	22.114
Police officers	320	49.420	17.849	25.916	105.329
Drug abuse	320	16.923	13.107	2.250	78.345
Average income[3]	320	40.349	8.691	22.638	58.948
Tourist overnight	320	125,219.700	206,075.900	584.437	955,390.100

Note: All variables except clear-up rates are expressed as number per 10,000 inhabitants where number of inhabitants is obtained from 2001 and 2011 censuses.
Sources: Croatian Bureau of Statistics, Croatian Employment Service and Ministry of the Interior.

There are a few important remarks about the data presented in Table 1. First, N is not equal for all clear-up rates because in some counties there were cases where there were zero reported and zero solved crimes. Therefore, clear-up rates could not be computed. Second, for some crime categories, the clear-up rate exceeds 1 (100 percent)

[1]Includes executed and attempted murder crimes.
[2]Includes executed and attempted rape crimes.
[3]Net wage deflated by CPI.

which points to two possible scenarios: (i) in the years in which this occurs, some old crimes from previous periods were solved, or (ii) there were errors in data collection. Regardless of the source of this unusual occurrence, there is no reason to believe that the influence of these cases is high enough to change the results of the conducted analysis.

Based on the theory and previous research (Levitt, 2001; Edmark, 2005), but with certain limitations with regards to availableness of the data, several covariates are chosen. As mentioned in the previous section, clear-up rates for each category of crime serve as proxy for the probability of getting caught. This approach is more precise than using the aggregate clear-up rate as control because it approximates the probability of getting caught for a certain crime. The number of police officers is obtained from the Ministry of the Interior (the data are not available to the general public) and is also included as control for the reasons stated in the previous section. Average income is an important control variable ensuring that the estimated unemployment coefficient measures the effect on the supply of crime because income level impacts the demand for crime - in wealthier regions there is more potential loot. Another control variable that is non-existent in the current literature is tourist overnight visits. Croatia is a popular tourist destination, especially in the coastal region which consists of seven counties. Tourist visits could have impact principally on the demand for crime (more loot), but sometimes also on the supply (specifically, when alcohol consumption on vacation exceeds a certain threshold). It is therefore important to control for this factor because seven coastal regions and the Capital (Zagreb) have significantly more tourist visits than the other counties. Drug abuse crimes are included as a covariate for obvious reasons. Infant mortality and divorces are included due to data availability issues of other demographic variables.

As mentioned in the introduction, to control for the unobserved heterogeneity, the fixed-effects panel model is estimated in the form of:

$$Crime_{it} = \alpha_i + \tau_t + \beta_1 Unemployment_{it} + \beta' X_{it} + \epsilon_{it}, \tag{1}$$

where α_i and τ_t represent county and time-specific effects, respectively, ϵ_{it} is the error term, and X_{it} is the matrix of the covariates listed above. The main interest of the paper lies in estimating β_1, i.e., the effect of unemployment on crime. The possibility that this relationship suffers from reverse causality is discussed extensively in the literature. High crime rates in one area could have negative influence on the establishment of new

companies and consequently put restraint on employment. However, all empirical studies that try to tackle this problem by using the instrumental variables approach (Raphael and Winter-Ebmer, 2001; Lin, 2008; Altindag, 2012) find support for a causal direction from unemployment to crime. Moreover, in all studies, 2SLS estimated coefficients are higher than in OLS regressions. Therefore, it is reasonable to assume that the results of fixed-effects estimation reflect a causal direction from unemployment to crime.

4 Empirical Findings and Discussion

This section reports on the results of the analysis. First, property crimes are depicted, followed by an analysis of violent crimes. The exposition of baseline results is followed by sensitivity analysis which serves to test the robustness of the obtained results from the baseline specification. Previous studies use mostly log-linear or log-log specifications of the models. Here, the latter approach is adopted.

4.1 Property Crimes

The baseline specification results are reported in Table 2. No significant effect of unemployment on aggregate property crimes is found. According to this estimation, unemployment has a positive and significant impact on burglary and grand larceny. However, since under Croatian criminal law burglary is a sub-category of grand larceny, unemployment has an expected effect on only one category of property crimes. When unemployment per $10,000$ inhabitants increases by 1 percent, burglary and grand larceny increase by approximately 0.4 percent. This effect is robust across different specifications.

Table 2: Results of Baseline Specification for Property Crimes

	Dependent variable:				
	Total property	Robbery	Burglary	Grand larceny	Theft
Unemployment	0.1444	−0.0931	0.4260***	0.4187***	−0.2015
	(0.1324)	(0.1115)	(0.1468)	(0.1495)	(0.1595)
Clear-up rate	−0.4421	−0.0753	0.0598	−0.0394	−0.9613***
	(0.2851)	(0.0962)	(0.3201)	(0.3222)	(0.3660)
Infant mortality	−0.0626	−0.0161	−0.1402*	−0.1427*	0.0581
	(0.0712)	(0.0610)	(0.0851)	(0.0823)	(0.0654)
Divorces	0.1173*	0.1748**	0.1322	0.1484**	0.0663
	(0.0613)	(0.0730)	(0.0873)	(0.0742)	(0.0593)
Police	−0.3008	0.1357	−0.5495*	−0.5178*	−0.0413
	(0.2123)	(0.2353)	(0.2912)	(0.2870)	(0.2100)
Drug abuse	0.0736	−0.0038	0.1393**	0.1327**	−0.0188
	(0.0543)	(0.0359)	(0.0631)	(0.0651)	(0.0458)
Average income	−1.0750	2.1800***	−1.0740	−0.9609	−1.2470*
	(0.8160)	(0.5754)	(1.0200)	(1.1690)	(0.7454)
Tourist overnight	0.1044	−0.0496	0.1783**	0.1738**	0.0266
	(0.0692)	(0.0381)	(0.0832)	(0.0808)	(0.0703)
Observations	320	317	320	320	320
Adjusted R^2	0.1011	0.0836	0.1825	0.1791	0.0651

*Notes: Robust standard errors in parentheses; *significant at 10%, **significant at 5%, ***significant at 1%. Fixed effects and year dummies are included in all specifications. The hypotheses that all fixed effects are equal to zero and that all time effects are equal to zero are rejected for all specifications. For robbery, an unbalanced panel is estimated because for three years it was impossible to compute the clear-up rates due to unavailable data.*
Source: Author's calculations based on data from Croatian Bureau of Statistics, Croatian Employment Service and Ministry of the Interior.

The clear-up rate, i.e., probability of getting caught is seemingly important only for theft crimes, and has a large effect of −0.96. This makes sense because under the Croatian Criminal Code[4], Article 216, theft entails *stealing an item in order to unlawfully obtain it, if the value of the stolen item is low.* Since the expected return from crime can be written as[5]:

$$E(W_b) = (1-p)W_b + p(W_b - S), \tag{2}$$

[4]Croatian Criminal Code (Official Gazette No. 125/11).
[5]For more details see Edmark (2005).

where p is probability of getting caught and S is the cost of punishment; when p increases, W_b should also increase in order to compensate for the loss of expected return. When W_b is low with an upper threshold, which is the case with theft, obviously p plays a pivotal role in deciding whether to commit a crime.

The number of police officers has a large negative impact on burglary and grand larceny at the 10 percent significance level which justifies the inclusion of this variable into the analysis of the unemployment and crime nexus. The negative sign provides support for the theory that a larger police force intimidates the criminals and results in lower property crime rates.

Average income has a strong positive effect on robbery and negative on theft. This could stem again from the fact that theft entails low value, so higher wages reduce the need for obtaining small illegitimate benefits. On the other hand, the high positive coefficient on robbery probably points to the demand side of crime. Generally, wages are higher in wealthier counties, so expected return from crime is larger, leading to stronger incentives for committing a robbery. Tourist overnight stays have a positive impact again only on burglary and grand larceny; with the expected sign.

As suggested by Raphael and Winter-Ebmer (2001), county-specific time trends should be included in the regression to test the sensitivity of the results. The same approach is used by Edmark (2005). This is called a random-trend model, as each county is allowed to have its own time trend because an individual-specific trend is an additional source of heterogeneity (Wooldridge, 2010).

In line with this, models from Table 2 are next specified as:

$$Crime_{it} = \alpha_i + \tau_t + \beta_1 Unemployment_{it} + \beta' X_{it} + \psi_i time_t + \omega_i time_t^2 + \epsilon_{it}. \qquad (3)$$

All models are again estimated using the log-log specification. The results of the estimation of the above equation are given in columns 2 and 3 of Table 3. Column 2 includes only the linear trend, while column 3 includes both linear and quadratic trends. The results suggest stability of the results presented in Table 2. The coefficient of unemployment on grand larceny (and burglary) varies between 0.4 and 0.5, while unemployment has no significant effect on any other crime.

Table 3: Effect of Unemployment on Property Crimes, Sensitivity Analysis

	Model:		
Crime	Baseline	Linear	Linear and quadratic
Aggregate property	0.1444	0.0717	0.2213
	(0.1324)	(0.1372)	(0.1372)
Robbery	−0.0931	−0.0717	−0.1245
	(0.1115)	(0.1063)	(0.1128)
Burglary	0.4260***	0.3436***	0.4994***
	(0.1468)	(0.1539)	(0.1539)
Grand larceny	0.4187***	0.3356***	0.4902***
	(0.1495)	(0.1568)	(0.1568)
Theft	−0.2015	−0.2422	−0.1027
	(0.1595)	(0.1702)	(0.1702)

*Notes: Robust standard errors in parentheses; *significant at 10%, **significant at 5%, ***significant at 1%. Fixed effects and year dummies are included in all specifications. The hypotheses that all fixed effects are equal to zero and that all time effects are equal to zero are rejected for all specifications. All estimations include the same set of covariates as the baseline specification.*
Source: Author's calculations based on data from Croatian Bureau of Statistics, Croatian Employment Service and Ministry of the Interior.

The results for property crimes show a positive effect of unemployment on crime (as predicted by theory) only for burglary and grand larceny. Again, considering that burglary is a sub-category of grand larceny, the effect was found for only one category of property crimes. The size of the effect depends on the specification, but varies between 0.3 and 0.5. While statistical significance is clear, the main interest lies in determining the economic significance of the estimated effect. If a value from baseline specification of 0.42 is taken, it means that, on average, 1 percent increment in unemployment per 10,000 inhabitants is related to 16 more grand larcenies per 10,000 inhabitants. As shown in Figure 1, swings in unemployment of nearly 10 percent were almost a common occurrence in the observed period. Therefore, the results suggest that common changes in unemployment result in substantial changes in grand larceny rates. The size of this effect roughly corresponds to the one estimated by Saridakis and Spengler (2012) and is significantly larger than effects on other property crime estimated by Edmark (2005). The question which remained unanswered is why are the other property crimes seemingly unaffected by unemployment? The answer is two-fold.

The first argument is based on the distinction between the supply and demand side of crime. Unemployment decreases interaction between people. It therefore decreases *demand* for personal robbery, and could cancel any positive effects of unemployment on the *supply* side of crime. The same explanation is given by Edmark (2005). However, for theft, probably the most plausible argument is the one used to explain the considerable effect of its clear-up rate: low value, i.e., low expected return on crime.

The second is the omitted variable argument. Decision to commit a crime is summarised as (Edmark, 2005):

$$c_n < [(1-p)(W_b) + p(W_b - S)] - [(1-u)W + uA], \tag{4}$$

where c_n is psychological cost of committing a crime, the left parenthesis is expected return from crime and the right parenthesis expected return from honest work. Hence, as long as the right side of the equation is larger, individuals will choose crime. I posit that, in Croatia, c_n is very large *on average* and therefore it is less likely that a change in unemployment (u) will have an impact on the decision whether to commit a crime. There are several arguments behind this reasoning. When looking at R^2 of all the regressions estimated, the largest is in the specification with linear and quadratic trends (0.32). In comparison, Edmark (2005) obtains an R^2 of 0.73-0.95 for property crimes, Fougère et al. (2009) 0.70-0.95, and Lin (2008) 0.92-0.97. These are all markedly different than those in the conducted estimation on Croatian data. All studies use somewhat different sets of covariates but obtain similar results with regards to the goodness of fit measure, i.e., R^2. This suggests that, while unemployment might have an impact on some categories of property crimes, the main determinant of crime rates, c_n, is *unobserved*; and as such cannot be estimated precisely.

There are several possible explanations for the weak explanatory power of unemployment for property crimes and/or potentially considerable impact of unobserved psychological cost of committing a crime. First, Croatia as a Mediterranean country has a developed family safety-net which serves as a shock absorber for the unemployed. The average age of leaving the parental home is 31 years, the highest in the EU-28, the average being 26.2 years. Young unemployed people live with their parents until they get a job and stand properly on their feet. Second, unskilled labour force traditionally migrates to Western Europe, mainly Germany (Bjelajac, 2007) looking for a better life standard.

This historical fact could be another factor mitigating the impact of inability to find a job on committing a crime.

Third, Croatia had relatively high unemployment rates even when economy was growing at a decent pace from 2003 to 2007. For example, based on Eurostat data, the average annual unemployment rate in the period 2003-2007 was 12.5 percent, with an EU-28 average of 8.6. Only Slovakia and Poland had higher average unemployment rates in the pre-crisis period. Looking at the next period, i.e., 2008-2014, the average Croatian unemployment rate is 13.4 in comparison with the EU-28 average of 9.6 percent. In this period, only Greece, Spain and Latvia had higher average levels of unemployment. This simple glance at data suggests that in comparison with its European counterparts, Croatia is standing still, and while it had substantial swings in unemployment in the observed period, it was never even close to the low unemployment levels of developed Western economies. Hence, high unemployment is a characteristic entrenched in the roots of Croatian economy and not a temporary deviation as in Edmark (2005). Perhaps the unemployment and crime relationship should also be observed in this context. People might simply get used to the high unemployment environment and accept that the job search will probably last for some time. Indeed, Croatia has the highest long-term unemployment of all new member states in the EU, with only Spain and Greece having higher rates. Another fact that supports this theory is that in the period 2009-2014 the mean of aggregate property crimes in Croatia was actually lower by almost 11 percent in comparison with the pre-crisis period of 2003-2008. Obviously, the sharp increase in unemployment and deep and persistent recession did not have a detrimental impact on crime rates as one might have expected. Next, I proceed with the estimation of the impact of unemployment on violent crimes.

4.2 Violent Crimes

The empirical strategy for this section is identical as described above, except violent crime rates are used as dependent variables. The results are depicted in Table 4. Unemployment has a significant negative effect on aggregate violent crimes, murders and serious body injuries, and a significant positive effect on rapes. These somewhat counter-intuitive results are similar to those presented by Raphael and Winter-Ebmer (2001), the difference being that they obtain a negative coefficient even for rape crimes. As they note, this might have something to do with the greater frequency of interactions between potential victims and criminals when larger proportion of the population is employed.

To tackle this peculiarity, I employ the approach used by Raphael and Winter-Ebmer (2001) and Kapuscinski et al. (1998). Namely, Kapuscinski et al. (1998) find that when female employment is added to the model, homicide rates assume positive significant effects, unlike in the baseline model. When female unemployment is included along with the aggregate, no significant effect of unemployment on any category of violent crime is found. However, when using female unemployment instead of the aggregate, the results from Table 4 stay roughly the same. Interestingly, for rape and murder crimes, the number of policemen has also the opposite effect of those found for property crimes. This is probably due to the higher reporting propensity when the number of police officers is higher, especially in the murder attempt and rape attempt categories. Significant and strong negative effect on rape is found for average income: when deflated real wage is increased by 1 percent, number of rapes and rape attempts per 10,000 inhabitants is decreased by 0.81 percent.

Table 4: Results of Baseline Specification for Violent Crimes

	Dependent variable:			
	Total violent	Murder	Rape	Serious injury
Unemployment	-0.3044^{***}	-0.2764^{***}	0.0896^{*}	-0.2407^{**}
	(0.1098)	(0.0637)	(0.0516)	(0.1099)
Clear-up rate	0.2404	0.0593	0.0042	−0.7396
	(0.4258)	(0.1257)	(0.0561)	(0.5497)
Infant mortality	-0.0483^{*}	−0.0442	0.0102	−0.0423
	(0.0292)	(0.0602)	(0.0414)	(0.0369)
Divorces	0.0525	−0.0162	0.0943^{**}	0.0552
	(0.0554)	(0.0480)	(0.0404)	(0.0665)
Police	−0.0236	0.2238^{***}	0.1341^{*}	−0.1835
	(0.0983)	(0.0816)	(0.0690)	(0.1284)
Drug abuse	0.0539	0.0248	0.0205	0.0348
	(0.0339)	(0.0226)	(0.0197)	(0.0432)
Average income	0.0979	−0.2592	-0.8146^{**}	0.7106
	(0.6833)	(0.5205)	(0.3304)	(0.7074)
Tourist overnight	0.0423	−0.0006	0.0427	0.0233
	(0.0380)	(0.0406)	(0.0262)	(0.0339)
Observations	320	318	295	320
Adjusted R^2	0.0451	0.0520	0.0581	0.0465

Notes: Robust standard errors in parentheses; *significant at 10%, **significant at 5%, ***significant at 1%. Fixed effects and year dummies are included in all specifications. The hypotheses that all fixed effects are equal to zero and that all time effects are equal to zero are rejected for all specifications. For murder and rape unbalanced panels were estimated because for certain years it was impossible to compute the clear-up rates due to unavailable data. Source: Author's calculations based on data from Croatian Bureau of Statistics, Croatian Employment Service and Ministry of the Interior.

Again, I proceed with the estimation of these effects including the linear and quadratic trend to test the sensitivity of obtained results. The results are presented in Table 5.

Table 5: Effect of Unemployment on Violent Crimes, Sensitivity Analysis

	Model:		
Crime	Baseline	Linear	Linear and quadratic
Aggregate violent	-0.3044^{***}	-0.3129^{***}	-0.3502^{***}
	(0.1098)	(0.1151)	(0.1055)
Murder	-0.2764^{***}	-0.2887^{***}	-0.2956^{***}
	(0.0637)	(0.0621)	(0.0692)
Rape	0.0896^{*}	0.0911^{*}	0.0790^{*}
	(0.0516)	(0.0524)	(0.0475)
Serious injury	-0.2407^{*}	-0.2529^{**}	-0.2927^{***}
	(0.1099)	(0.1175)	(0.1066)

Notes: Robust standard errors in parentheses; *significant at 10%, **significant at 5%, ***significant at 1%. Fixed effects and year dummies are included in all specifications. The hypotheses that all fixed effects are equal to zero and that all time effects are equal to zero are rejected for all specifications. All estimations include the same set of covariates as the baseline specification.
Source: Author's calculations based on data from Croatian Bureau of Statistics, Croatian Employment Service and Ministry of the Interior.

While the results obtained for property crimes suggest at least partial support of the theory of economics of crime, the results for all violent crimes bar rapes are counter-intuitive, but at the same time similar to those obtained by Raphael and Winter-Ebmer (2001). Interpreting these results without caution might lead to the false conclusion that unemployment makes people more placid. Still, the explanation offered by Raphael and Winter-Ebmer (2001) makes more sense: there is some violence-creating factor that varies systematically with unemployment rates which is not accounted for by the model specification. One such factor, the same authors note, could be the greater frequency of interactions between potential victims and offenders when more people are working.

Following the logic of Raphael and Winter-Ebmer (2001), if women are scarcely among the offenders, the negative relationship between violent crimes must be attributable to factors other than a criminal behavioural response by women. On the state level, female offenders account for 10 percent of aggregated violent crimes while the data on the county level are not available. Hence, if the results using female unemployment reflect the same relationship as aggregate unemployment levels, the estimation suffers from

omitted-variable bias. As mentioned in the third section, the results of the same models from Table 4 with female unemployment indeed parallel those obtained with aggregate levels of unemployment which points to the omitted-variable problem. The difference in comparison with the results of Raphael and Winter-Ebmer (2001) is that even in the original specification the estimated coefficient for rape crimes is positive. Moreover, it is robust across specifications. This might suggest that the impact of unemployment on rape crimes is more obvious than the one obtained by Raphael and Winter-Ebmer (2001).

Crutchfield (1989) suggests an alternative explanation. The nature of different crimes might influence the variation in the effects pattern. Murder and assault which results in serious body injuries often occur when the victim and the assailant know each other, while the same cannot be said about rape crimes. As Crutchfield (1989) notes, rape crimes might be less the result of passionate acute anger than murders or assaults, and more of the chronic anger and desperation associated with unemployment. This argument is in line with the one about greater frequency of interaction. More interaction means more people will get to know each other, which could also lead to more arguments between people and result in more murder attempts, murders and serious body injuries.

However, it is again important to acknowledge the poor goodness of fit measure, i.e., R^2 in all specifications is below 6 percent. This goes in line with the earlier observation that the *unobserved* explanatory variable, c_n, might explain the largest portion of variation in both violent and property crimes.

5 Conclusion

This paper analyses the relationship between unemployment and crime in Croatia at the county level. The expected positive and significant relationship that is robust across specifications is found only for grand larceny in the property crimes category, and for rape and rape attempts in the violent crimes category. Several explanations for the unusual results are given.

First, the family safety-net and opportunities to work in Western Europe, especially for low-skilled labour, serve as shock absorbers if a person is laid-off or is job-searching for a long time. Second, high unemployment and long-term unemployment inherent to the Croatian economy have inured people to these otherwise difficult conditions. This could

be the reason why the deepest and longest economic crisis since sovereignty did not result in increased crime rates. Third, with regards to violent crimes, the negative effect of unemployment on all violent crimes bar rape could be attributed to (i) omitted variable bias and (ii) greater frequency of interactions when more people are working. Fourth, as the title of the paper suggests, the explanatory power of unemployment of variations in crime rates is modest. Hence, there is some other, more important underlying factor that has an effect on crime rates, and I argue that this could be the *unobserved* psychological cost of committing a crime.

Another interesting result is that the size of the police force negatively impacts grand larceny and positively impacts murders and rapes, and attempts. This makes sense because a larger police force discourages property crimes owing to a greater probability of getting caught. On the other hand, the size of the police force hardly discourages murders and rapes since they are rarely economically motivated and therefore the probability of getting caught has smaller impact in the *whether-to-commit-a-crime-calculus*. The positive sign can be interpreted through larger reporting propensities when more police officers are employed.

The research presented here also has some limitations. First, the data for number of inhabitants are taken for census years only (2001 and 2011). Hence, the computed ratios per 10,000 inhabitants were computed with inherent standard errors. The data of census 2001 are applied for years 1998-2006, and of 2011 for years 2007-2013. Since the number of inhabitants is a variable that changes significantly only in the long term, the results should not be influenced too much by this. Second, an extensive list of demographic structure covariates on the county level is missing. Again it is difficult to expect that by including these controls the results would change substantially. Nevertheless, it is important to recognize these data limitations. To confirm or disregard the results of the conducted analysis, it would be useful to create population projections and estimate the models with projections instead of approximation by censuses.

Future research should shed more light onto the relationship between unemployment and crime in countries with common historical, cultural, geographical and economic features. For example, a suggested line of research could be to conduct mirrored analyses in similar countries with consistently high unemployment rates. Neighbouring Serbia would be an appropriate case study. Further, it would be useful to conduct qualitative research by

interviewing the offenders in Croatia. It is the only way to demystify the psychological cost of committing a crime which is posited in the paper as the main explanatory variable of crime in Croatia.

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